MARSDEN PARK PRECINCT

Biodiversity and Riparian Assessment

Prepared for
Winten Property Group

July 2012

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Abbreviations

ABBREVIATION	DESCRIPTION
AHCVV	Additional High Conservation Value Vegetation
CEEC	Critically Endangered Ecological Community
CPW	Cumberland Plain Woodland
CLS	Cumberland Land Snail
DoPI	Department of Planning and Infrastructure
DSEWPC	Department of Sustainability, Environment, Water, Population and Communities
EEC	Endangered Ecological Community
ELA	Eco Logical Australia
ENV	Existing Native Vegetation
EPBC	Environment Protection and Biodiversity Conservation Act
ILP	Indicative Layout Plan
NES	Matters of National Environmental Significance
OEH	Office of Environment and Heritage
RC	Riparian Corridor
SEPP	State Environmental Planning Policy
TSC	Threatened Species Conservation Act
VRZ	Vegetated Riparian Zone

Executive Summary

Eco Logical Australia Pty Ltd (ELA) was engaged by Winten Property Group to undertake an Ecological and Riparian Assessment of approximately 1800 ha that forms the Marsden Park Precinct. The aim of the ecological constraints assessment is to inform the preparation of the Indicative Layout Plan on terrestrial, aquatic, groundwater ecosystems, and riparian values.

Seven vegetation communities were identified within the study area, however four communities were only present in Shane's Park, an area of the precinct excluded from the field investigations due to the lack of development planned within that area. The three vegetation communities in the remainder of the site include Shale Plains Woodland (SPW) which is part of the Cumberland Plain Woodland Endangered Ecological Community, listed under the TSC and EPBC Acts, Alluvial Woodland and Shale/Gravel Transition Forest which are both endangered ecological communities listed on Schedule 1 of the TSC Act.

During the field survey, only one threatened flora species listed under the TSC or EPBC Acts was recorded, the juniper-leaved grevillea (*Grevillea juniperina subsp. juniperina*), however threatened flora searches were not conducted in the Shanes Park AirServices site. Four species of endangered micro-bats were recorded on the site.

Good aquatic habitat was found to occur along parts of South Creek, Little Creek and Bells Creek and within a number of small dams, particularly the large dam on an eastern tributary to Little Creek. The remainder of the watercourses were found to be in a significantly degraded and modified state and provide little riparian habitat value.

From a rezoning perspective, the riparian corridors and Exiting Native Vegetation on non-certified lands are recommended to be zoned for environmental protection. Open space areas, road easements, power easements and stormwater controls should be located in a manner that facilitates retention of vegetation across the site, as outlined in the Growth Centres Development Code.

1 Introduction

1.1 DESCRIPTION OF PROJECT

Eco Logical Australia Pty Ltd (ELA) was engaged by Winten Property Group (Winten) to undertake biodiversity and riparian corridors assessment of approximately 1 800ha that forms the Marsden Park Precinct (the precinct). The aim of this assessment is to identify key ecological and riparian constraints, precinct and provide recommendations with respect to terrestrial and aquatic ecosystem management.

Specific objectives of this project are to:

- Undertake a strategic biodiversity assessment including a flora and fauna study and analysis of ecological values.
- Achieve innovative management frameworks for ecological and biodiversity issues which enable long term conservation and management, while facilitating the development outcomes for the precincts (as identified in the structure plan).
- Ensure the statutory requirements for the protection, restoration and enhancement of threatened species, populations, ecological communities and their habitats are met.
- Ensure protection of biodiversity values within areas identified by Growth Centres Biodiversity Certification.
- Ensure that precinct planning is consistent with the terms of any biodiversity certification granted to the Growth Centres SEPP.
- Confirm the presence of Existing native vegetation (ENV) and Additional High Conservation Value Vegetation (AHCVV).

This report demonstrates the objectives are achieved through;

- Methodology that includes a literature review of previous work, terrestrial aquatic and geomorphic field assessment.
- Consideration of statutory requirements, including; Growth Centres Commission Development Code, Threatened Species Conservation Act (TSC Act), Environment Protection and Biodiversity Conservation Act (EPBC Act), TSC Act Growth Centres SEPP Biodiversity Certification, Water Management Act, Fisheries Management Act.

1.2 STUDY AREA

The Marsden Park Precinct lies in the western portion of the North West Growth Centre (See Figure 1). It has been identified as an area suitable for around 10,000 dwellings and is expected to feature a town centre with 30, 000 square metres of retail space and 50 hectares of public recreation space. Planning for the precinct is underway and involves the preparation of numerous planning documents, including an Indicative Layout Plan (ILP), Development Control Plan and an amendment of the Growth Centres SEPP to facilitate the formal rezoning of the site.

The Marsden Park Precinct sits to the north and west of the Marsden Park Industrial Precinct. The Marsden Park Precinct's north-west boundary forms part of the north-west boundary of the entire NWGC. The Marsden Park Precinct contains a very large area of bushland in the south known as the Shane's Park Bushland. The north-eastern edge of the Precinct is formed by Richmond Road and the north-western edge of the precinct is formed by South Creek, a major waterway extending north from its headwaters in the South West Growth Centre. Marsden Park Precinct is located within Blacktown Council Local Government Area.

South Creek forms part of the western boundary of the precinct, with Little Creek and its tributaries running through the precinct from south to north.

The precinct contains rural grassland with numerous scattered remnant trees, with some isolated pockets of intact vegetation within the riparian areas and two smaller areas closer to the eastern side of the precinct. Cattle are currently grazed on the property and the surrounding parcels are used for similar low and high intensity agricultural uses. A substantial area of relatively intact native vegetation exists in the south of the precinct (Shanes Park). The site is very flat, with only slight grades into the numerous watercourses.

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 NSW *Environmental Planning and Assessment Act, 1979* thus turning off the requirements for seven part tests or species impact statements on all certified land. The Marsden Park Precinct contains large areas of both *certified* and *non-certified* lands, with the non-certified lands predominantly along the floodplains of South Creek and its tributaries (see Figure 1).

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

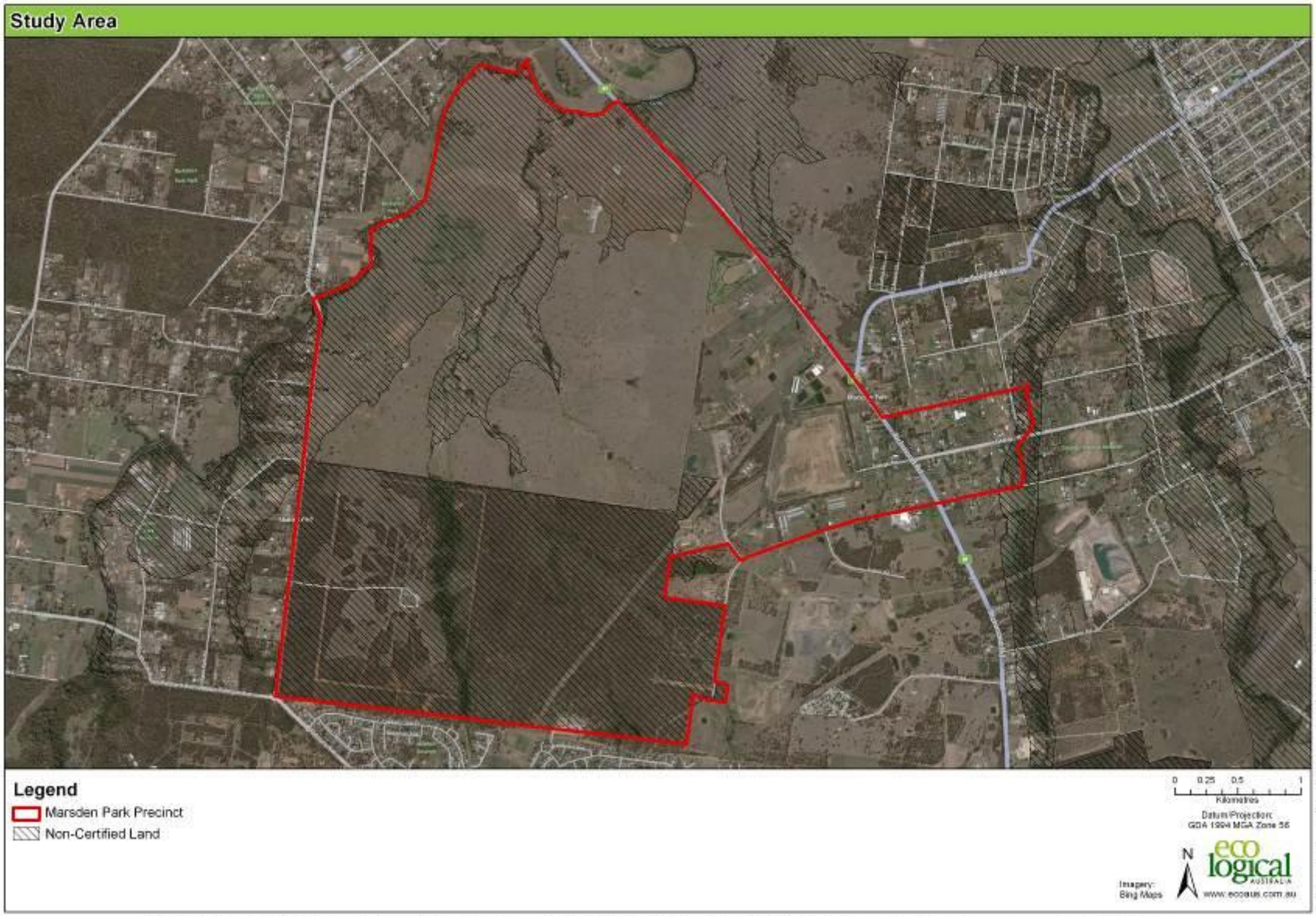

Figure 1: Study Area

1.3 METHODOLOGY OVERVIEW

An overview of the methodology is provided below, full details can be found in Appendix B;

- Review of existing information and historical aerial photography
- 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, threatened species and aquatic/riverine habitat condition mapping and assessments
- Analysis and identification of ecological constraints
- 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 Marsden Park Precinct. 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)

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)
- Noxious Weeds Act 1993
- Protection of the Environment Operations Act 1997
- State Environmental Planning Policy (Sydney Region Growth Centres) 2006
- State Environmental Planning Policy No.19 – Bushland In Urban Areas
- Growth Centres Development Code 2006
- Draft Growth Centres Conservation Plan 2007
- Water Management Act 2000

2.4 LOCAL

- Blacktown Local Environment Plan 1988

2.5 LITERATURE REVIEW

A desktop literature review was undertaken by ELA to determine the location and extent of previous surveys, identify the constraints within the study area and evaluate 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, digital elevation models and aerial photography of the study area
- A search of the NSW OEH Wildlife Atlas database
- EPBC online Protected Matters Database Search

- '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)
- Preliminary results from Draft Part 3A project: Water related Services for the North West and South West Growth Centres - Cumberland Ecology (2010)

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 Relevant Biodiversity Measures (RBM) for biodiversity-certification are documented in the Ministers order for consent[2]. The effect of the biodiversity-certification is that development or activities proposed to be undertaken within the certified areas do not need to undertake assessment of impacts to threatened species, populations or endangered ecological communities, or their habitats, that would normally be required by Part 4 or 5 of the Environmental Planning and Assessment Act.

The *Draft Growth Centres Conservation Plan* assessed native vegetation across the entire Growth Centres area and identified areas of Existing Native Vegetation (ENV) as shown in Figure 2 and Figure 3. By definition (under Schedule 1 of the Biodiversity Certification Order) ENV means areas of indigenous trees (including mature and sapling) 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 RBM 13.

A primary function of this report is to validate the Existing Native Vegetation in Marsden park so that the Indicative Layout Plan and subsequent zoning of the precinct can be assessed against the Relevant Biodiversity Measures of the Certification Order. Validation processes are described in the methods section, however it is important to note that validation of Existing Native Vegetation in the Shanes Park AirServices site was undertaken by desktop methods only as no development is planned within this area. The field validation of vegetation across the site updated the extent of ENV within the precinct. During the field validation, areas of vegetation meeting only a) and b) of the definition of ENV were also recorded as Additional High Conservation Value (A HCV) vegetation.

Under the Draft Conservation Plan (January 2007), the vegetation within Marsden Park precinct has been identified as both 'Higher Long Term Management Viability' and 'Lower Long Term Management Viability (LMV)'. The HMV is contained within the Air Services site (Figure 3) in the southern part of the precinct. The GC Conservation Plan specifically states that the conservation value of the Air Services site, which contains large areas of HMV and smaller areas of LMV is understated in the conservation plan. The conservation plan also notes that the value of the Air Services site is not confined to the HMV vegetation but relates to the size of the property, its resilience and regeneration capacity, its current

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

integrity and overall condition and its proximity to other key areas such as the former ADI site. Protection of this site in its entirety is an essential component of delivering an Improve or Maintain outcome.

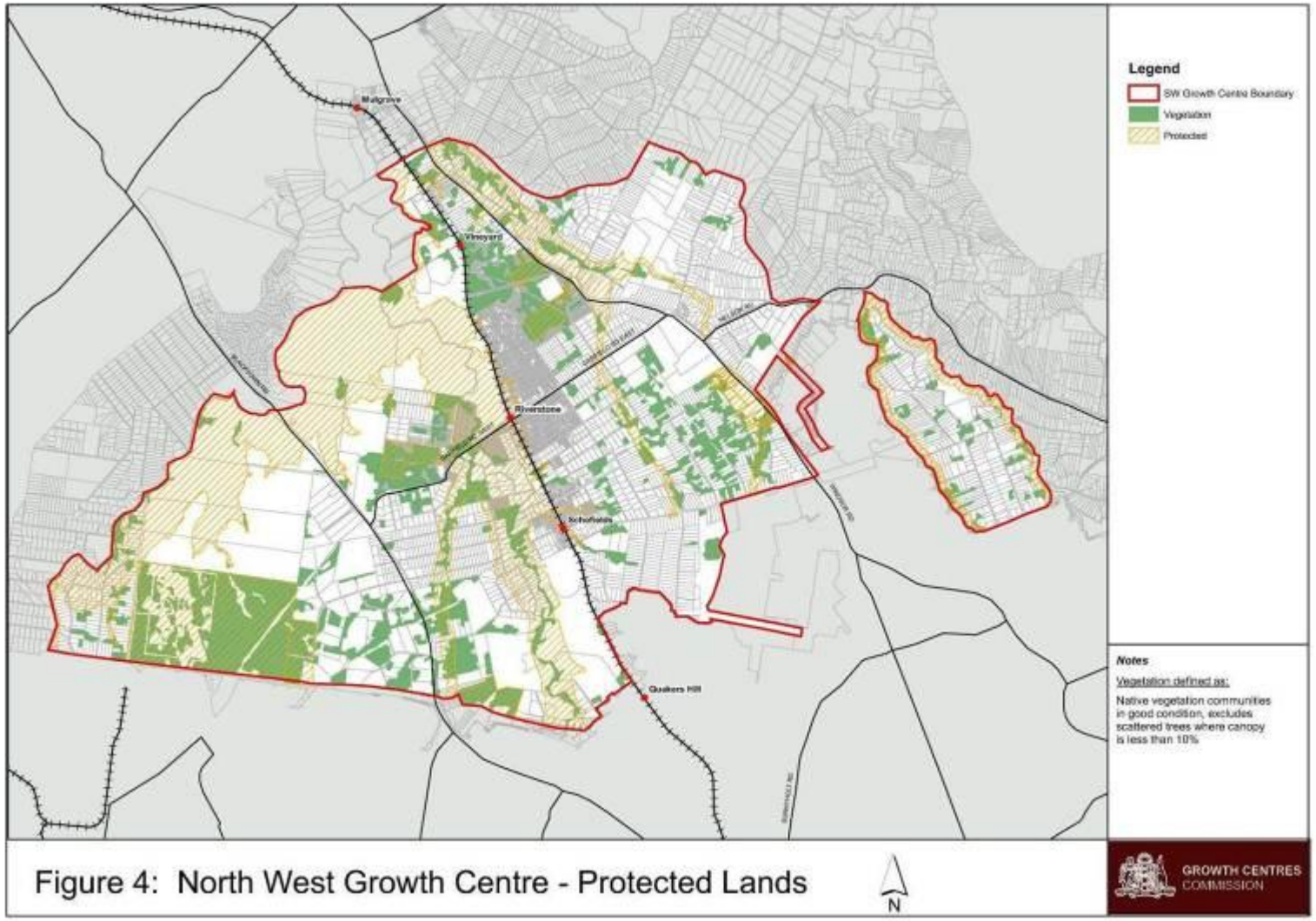

Figure 2: Figure 4 from the Draft Growth Centres Conservation Plan

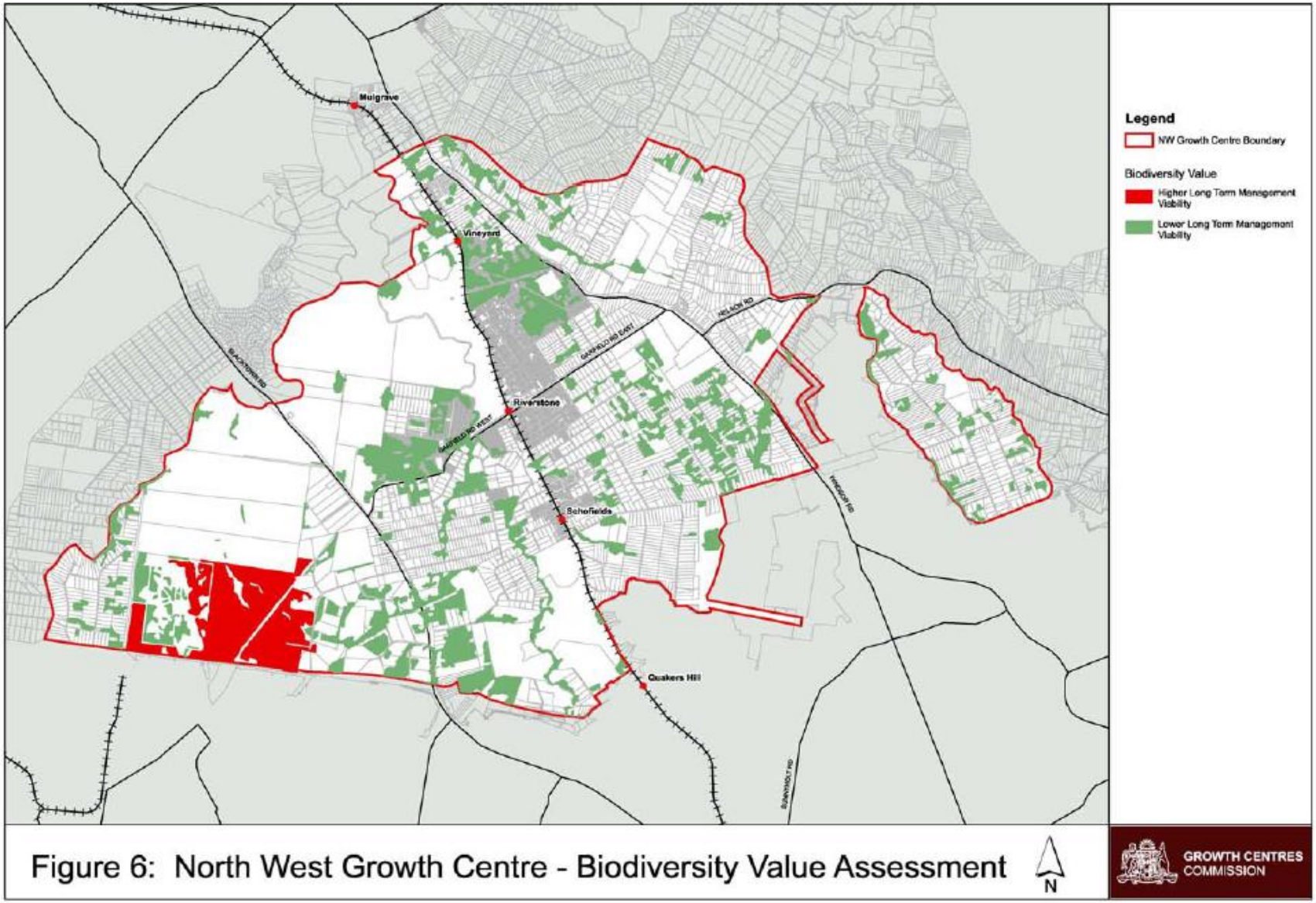

Figure 6: North West Growth Centre - Biodiversity Value Assessment

Figure 3 HMV as per Figure 6 of the Growth Centres Conservation Plan

3.2 METHODS

A floristic survey of the precinct was undertaken to confirm the vegetation communities present. This survey included classification of native vegetation communities in accordance with the OEH profiles. Some properties within the precinct were unable to be accessed due to landowner restrictions. Where access was not available, a combination of aerial photograph interpretation and NPWS 2002 Western Sydney Vegetation Mapping was used to map the extent of remnants and determine the community present. ENV and A HCV vegetation were recorded across the study area.

Threatened species likely or potentially on site were identified prior to field work (Appendix E). Searches for threatened flora were undertaken using random meanders in areas of potential habitat. Habitat associations for threatened fauna were recorded and incidental flora and fauna records were recorded across the site. The desktop and field searches for threatened species did not however include the AirServices site (Shanes Park) as this part of the precinct is not developable.

Detailed methodology can be found in Appendix B.

3.3 EXISTING NATIVE VEGETATION

The original area of ENV (480.46 ha) mapped in the Draft Conservation Plan consisted of seven vegetation communities including Shale Gravel Transition Forest, Shale Plains Woodland, Castlereagh Scribbly Gum Woodland, Castlereagh Swamp Woodland, Cooks River Castlereagh Ironbark Forest, Freshwater Wetlands and Alluvial Woodland, as mapped by NSW National Parks and Wildlife Service (NPWS) Cumberland Plain Vegetation Mapping Project (2002).

Field validation of the ENV has identified that there is 458.96 ha of ENV present in the precinct. The discrepancy between the Draft Conservation Plan ENV and the field validated ENV is likely to have occurred due to:

1. Clearing for approved development and agriculture since the mapping was undertaken;
2. Changes in vegetation condition due to regrowth, clearing or disturbance since the mapping was undertaken; and
3. Changes in vegetation community boundaries due to increased accuracy of aerial photo interpretation.

In terms of areas no longer meeting the definition of ENV, it is difficult to be absolutely certain which reason is behind each change in extent. However, it is estimated that 1.11 hectares of ENV have been cleared, with the remainder of the difference (20.39 ha) being due to the improved scale of mapping.

Validating the ENV also reveals that an additional 119.224ha of native vegetation meets the definition of ENV but was not mapped within the Growth Centres Conservation Plan. This was recorded and mapped as Additional Native Vegetation (A HCV), with the majority occurring in the AirServices site.

Table 1 shows the amount of ENV and HCV within the precinct. This is then mapped in Figure 4.

Table 1: Amount of ENV and A HCV in Marsden Park Precinct (includes Shanes Park AirServices site)

Marsden Park Precinct	ENV as mapped in the Growth Centres Conservation Plan (ha)	Field Validated Conservation Plan ENV (ha)	Additional High Conservation Value (A HCV) native vegetation
Certified	24.52	18.16	27.56
Non-Certified	455.94	440.8	91.66
Total in the precinct	480.46	458.96	119.22

3.4 VEGETATION COMMUNITIES & CONDITION

Seven vegetation communities were identified within the study area, however four communities were only present in Shane's Park, an area of the precinct excluded from the field investigations due to the lack of development planned within that area. All native vegetation communities met the definition of endangered ecological communities under the TSC Act. The characteristics of each vegetation community, their conservation significance and ecological condition are summarised below in Table 2 and presented in Figure 5 Community profiles have been modified from NPWS (2002). A summary of area occupied by vegetation communities and their condition is provided below. Note that for vegetation within the Shanes Park AirServices site, the condition classes are from NPWS (2002).

Table 2 Area and condition of native vegetation

	Condition		
Native Vegetation Community (all EEC)	**Good (A,B,C)**	**Poor (Cmi, TX, TXR)**	**Total**
Alluvial Woodland	34.71	13.69	48.40
Castlereagh Scribbly Gum Woodland	11.90	0.67	12.57
Castlereagh Swamp Woodland	21.83	3.19	25.02
Cooks River Castlereagh Ironbark Forest	105.83	7.39	113.22
Derived Grassland - SPW	0	7.68	7.68
Freshwater Wetlands	5.60	0	5.60
Shale Plains Woodland	50.34	14.80	65.14
Shale/Gravel Transition Forest	294.58	92.98	387.56
Total	**524.79**	**140.40**	**665.19**

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

3.4.1 Shale Plains Woodland

Shale Plains Woodland (SPW) is part of the *Cumberland Plain Woodland in the Sydney Basin Bioregion* which is listed as Critically Endangered Ecological Community, listed under both the TSC and EPBC Acts. SPW was dominated by *Eucalyptus moluccana* (Grey Box) and *E. tereticornis* (Forest Red Gum), while *E. crebra* (Narrow-leaved Ironbark) and *E. eugenioides* (Thin-leaved Stringybark) were also present. A shrub stratum is usually present and dominated by *Bursaria spinosa*. A range of native herbs

and grasses were recorded in the ground stratum including *Dichondra repens* (Kidney Weed), *Microlaena stipoides var stipoides* and *Themeda australis* (*Kangaroo Grass*). Small patches of SPW were scattered across the study area, and were infested with a range of environmental weeds, including *Olea europaea ssp. cuspidata* (African Olive), *Pennisetum clandestinum* (Kikuyu) and *Rubus fruticosus* (Blackberry). Sections of this community where the canopy and shrub layer were absent or regenerating were noted and mapped as derived native grassland.

3.4.2 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. *Eucalyptus amplifolia* (Cabbage Gum), Forest Red Gum and *Casuarina glauca* (Swamp Oak) were the dominate canopy species, while *Bursaria spinosa* was the dominate shrub. A range of native herbs and grasses were recorded in the ground stratum including *Commelina cyanea* (Native Wandering Jew), *M. stipoides* and *Pratia purpurascens* (Whiteroot). This community was recorded in drainage lines and creeks across the study area, and was infested with range of environmental weeds, including *Cirsium vulgare* (Spear Thistle) and *Nothoscordum borbonicum* (Onion Weed).

3.4.3 Shale/Gravel Transition Forest

Shale Gravel Transition Forest (SGTF) in the Sydney Basin Bioregion is a listed endangered ecological community under the TSC Act. SGTF on the site was dominated by *Eucalyptus fibrosa* (Red Ironbark) and Grey Box, and *Melaleuca decora* was commonly present in a small tree stratum. A sparse shrub stratum is usually present and typically includes species such as *Bursaria spinosa* and *Daviesia genistifolia*. Common forbs included *Cheilanthes sieberi subsp. sieberi M. stipoides* and Kangaroo Grass. SGTF was scattered across the study area, and was infested with a range of environmental weeds, including *Conyza bonariensis* (Flaxleaf Fleabane), Kikuyu and *Plantago lanceolata* (Lamb's Tongues).

3.4.4 Castlereagh Scribbly Gum Woodland

Castlereagh Scribbly Gum Woodland in the Sydney basin Bioregion is listed as an endangered ecological community under the TSC Act. The community is dominated by *Eucalyptus parramattensis subsp. parramattensis, Angophora bakeri* (Narrow-leaved Apple) and *E. sclerophylla* (Hard-leaved Scribbly Gum). A small tree stratum of *M. decora* is sometimes present, generally in areas with poorer drainage. It has a well developed shrub stratum consisting of sclerophyllous species such as *Banksia spinulosa subsp spinulosa, M. nodosa* (Ball Honeymyrtle), *Hakea sericea* (Needlebush) and *H. dactyloides* (Broad-leaved Hakea). The ground stratum contains a diverse range of forbs including Kangaroo Grass, *Entolasia stricta* (Wiry Panic), *Cyathochaeta diandra, Dianella revoluta var. revoluta, Stylidium graminifolium* (Grass Triggerplant), *Platysace ericoides, Laxmannia gracilis* (Slender Wire Lily) and *Aristida warburgii*. Castlereagh Scribbly Gum Woodland was originally mapped within Shane's Park and was not observed during field surveys of the remainder of the precinct.

3.4.5 Castlereagh Swamp Woodland

Castlereagh Swamp Woodland Community is listed as an endangered ecological community under the TSC Act. The community is dominated by *M. decora.* Red Ironbark, *Angophora subvelutina* Broad-leaved Apple and *M. linariifolia* (Flax-leaved Paperbark) are present less frequently. A poorly developed shrub layer is dominated of M. *decora, M. linariifolia* and *B. spinosa*. The ground stratum is often dense and diverse, and includes species tolerant of water-logged conditions such as *Goodenia paniculata, Schoenus* apogon (Fluke Bogrush), *Centella asiatica* (Pennywort) and *Juncus usitatus*.

Castlereagh Swamp Woodland was originally mapped within Shane's Park and was not observed during field surveys of the remainder of the precinct.

3.4.6 Cooks River Castlereagh Ironbark Forest

Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion is listed as an endangered ecological community under the TSC Act. The community is dominated by Red Ironbark and *M. decora*, with *E. longifolia* (Woollybutt) occurring at lower frequency. The shrub stratum is dominated by *M. decora, M. nodosa* and *Lissanthe strigosa* (Peach Heath. The sparse ground stratum contains Wiry Panic, *Lepidosperma laterale, Opercularia diphylla, D. revoluta,* Kangaroo Grass*, M. stipoides* and Whiteroot*.* Cooks River/Castlereagh Ironbark Forest was originally mapped within Shane's Park and was not observed during field surveys of the remainder of the precinct.

3.4.7 Freshwater Wetlands (from Benson 1992, cited in Tozer 2003)

Typical species include *Eleocharis sphacelata* (Tall Spike Rush)*,Ludwigia peploides* subsp. *montevidensis*, *Triglochin procera* and *Philydrum lanuginosum* (Frogsmouth). Intermittently inundated wetlands may support scattered shrub species such as *M. linariifolia*, *M. styphelioides* and Swamp Oak. Ground species include *J. usitatus* and *Persicaria* spp. Freshwater Wetlands were originally mapped within Shane's Park and were not observed during field surveys of the remainder of the precinct. *Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney basin and South east Corner bioregions* are listed as an endangered ecological community under the TSC Act.

3.5 FLORA

The field survey undertaken within the study area identified 167 flora species. These species included 101 native species and 66 exotic species. A flora list for the study area is presented in Appendix C. This is not a comprehensive list of flora species likely to be present within the study area. During the 10 days of field survey (5 days x two ecologists), only one threatened flora species was detected on the site – *Grevillea juniperina subsp. Juniperina*. The survey did not however include the Airservices Australia site (Shanes Park) as no development is planned within this area.

Ten flora species identified within the study area are listed as noxious weeds within the Blacktown Local Government Area. *Asparagus asparagoides, Rubus fruticosus sp. agg.* and *Salix sp.* are also listed as Weeds of National Significance (WoNS). These noxious weeds are listed in Table 3

Table 3 Weeds

Family	Botanical Name	Common Name	Noxious Weed Class
Asteraceae	*Gymnocoronis spilanthoides**	Senegal Tea	C1
Pontederiaceae	*Eichhornia crassipes**	Water Hyacinth	C3
Solanaceae	*Cestrum parqui**	Green Cestrum	C3
Asparagaceae	*Asparagus asparagoides**	Bridal Creeper, Florist's Smilax	C4
Oleaceae	*Ligustrum lucidum**	Large-leaved Privet	C4
Oleaceae	*Ligustrum sinense**	Small-leaved Privet	C4
Oleaceae	*Olea europaea ssp. cuspidata**	African Olive	C4
Rosaceae	*Rubus fruticosus sp. agg.**	Blackberry complex	C4
Solanaceae	*Lycium ferocissimum**	African Boxthorn	C4
Salicaceae	*Salix sp.**	Willow	C5

3.6 FAUNA

Based on literature review, a likelihood table was prepared to guide field survey in the precinct (excluding Shanes Park Air Services site). The full table is provided as Appendix E, with a summary in Table 4 Threatened species likely to occur on the site. Note that the table was prepared to guide survey outside of the Air Services site. The field survey identified 36 fauna species. A fauna list for the study area is presented in Appendix C. Field survey identified four endangered bat species utilising the vegetated riparian zone of Little Creek. No species listed under the EPBC Act were recorded.

Table 4 Threatened species likely to occur on the site

Scientific name	Common name	TSC	EPBC	Likelihood of occurrence
BIRDS				
Anthochaera phrygia	Regent Honeyeater	E	E	Potential
Daphoenositta chrysoptera	Varied Sittella	V	—	Potential
Hieraaetus morphnoides	Little Eagle	V	—	Potential
Lathamus discolor	Swift Parrot	E	E	Potential
Petroica boodang	Scarlet Robin	V	—	Potential
MAMMALS (BATS)				
Miniopterus schreibersii oceanensis	Eastern Bent-wing Bat	V	—	Recorded on site
Mormopterus norfolkensis	East Coast Freetail Bat	V	—	Recorded on site
Myotis macropus	Large-footed Myotis	V	—	Recorded on site
Pteropus poliocephalus	Grey-headed Flying-Fox	V	V	Likely
Scoteanax rueppellii	Greater Broad-nosed Bat	V	-	Recorded on site
INVERTEBRATES				
Meridolum corneovirens	Cumberland Plain Large Land Snail	E		Previously recorded on site (Wildlife Atlas)

3.7 ECOLOGICAL CONSTRAINT ASSESSMENT

An ecological constraint ranking was derived applying an amended methodology that has been used in other Precinct planning processes. A full description of the method is provided in Appendix B of this report. In summary the method involves assessing the vegetation community and its condition **(Figure**

5), threatened species habitat **(Figure 6),** recovery potential **(Figure 7)** and local conservation significance **(Figure 8).** This information is synthesised into a single ecological constraint map **(Figure 9**) that categorises vegetation on the site into:

- 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.

The purpose of the ecological constraint analysis is to guide preparation of the Precinct Plan. It does not however affect the Biodiversity Certification. For example, some areas of high ecological constraint are on certified land. Whilst this may be taken into account when developing the Precinct Plan, it does not alter the fact that that land can be cleared without further assessment of threatened species.

Table 5 shows the hectares of each category. Note that whilst the boundaries of extant vegetation in the AirServices Australian site have been updated with smaller scale Aerial photo interpretation, the condition and community classes are based on mapping for the draft Growth Centres Conservation Pan.

Table 5: Constraints summary within the study area

Ecological constraints	Area (HA)	% of Precinct
High	590.21	32.76
Moderate	73.73	4.09
Low	1.26	0.07
TOTAL	665.20	36.92

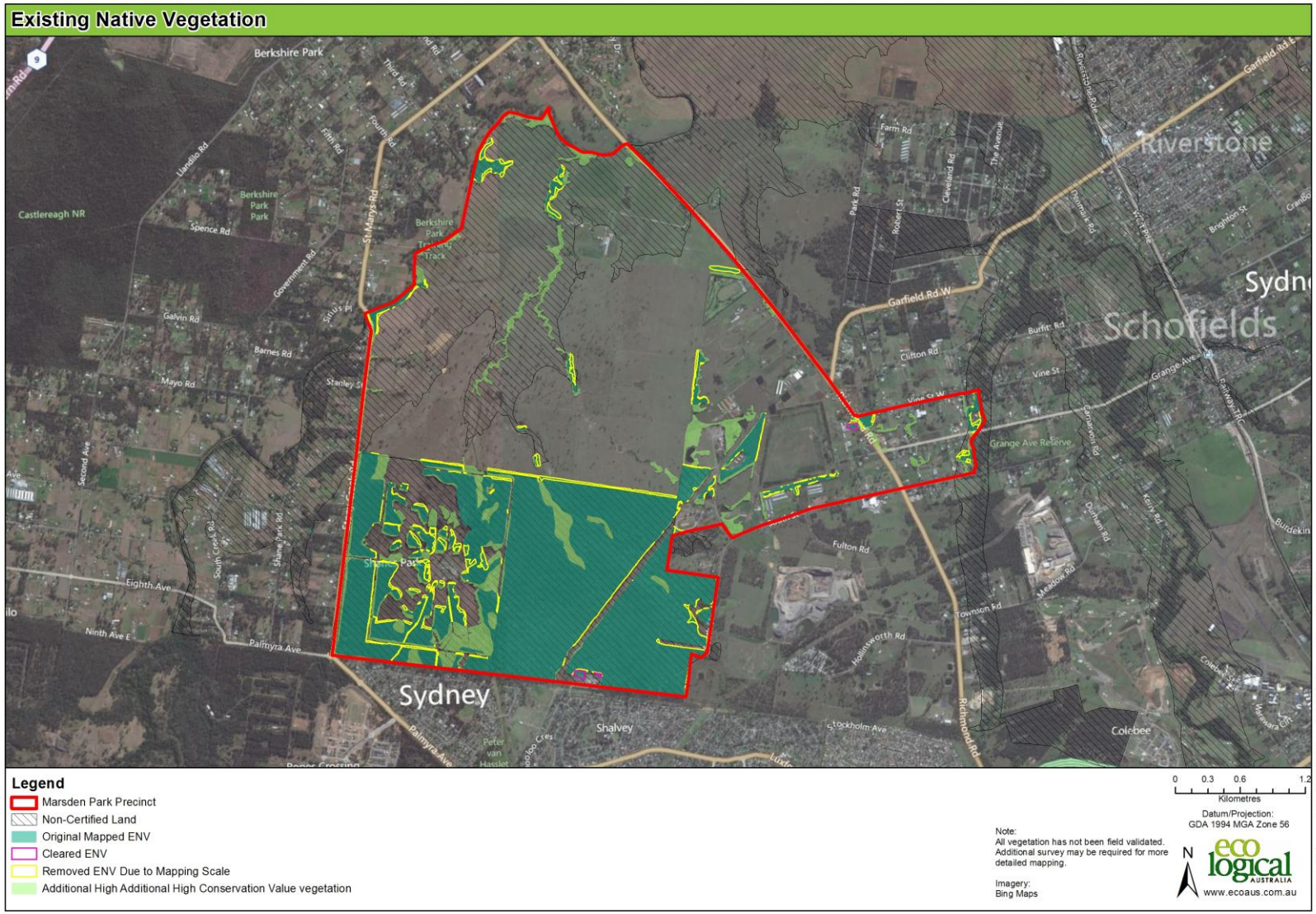

Figure 4 Existing Native Vegetation and Additional HCV Vegetation

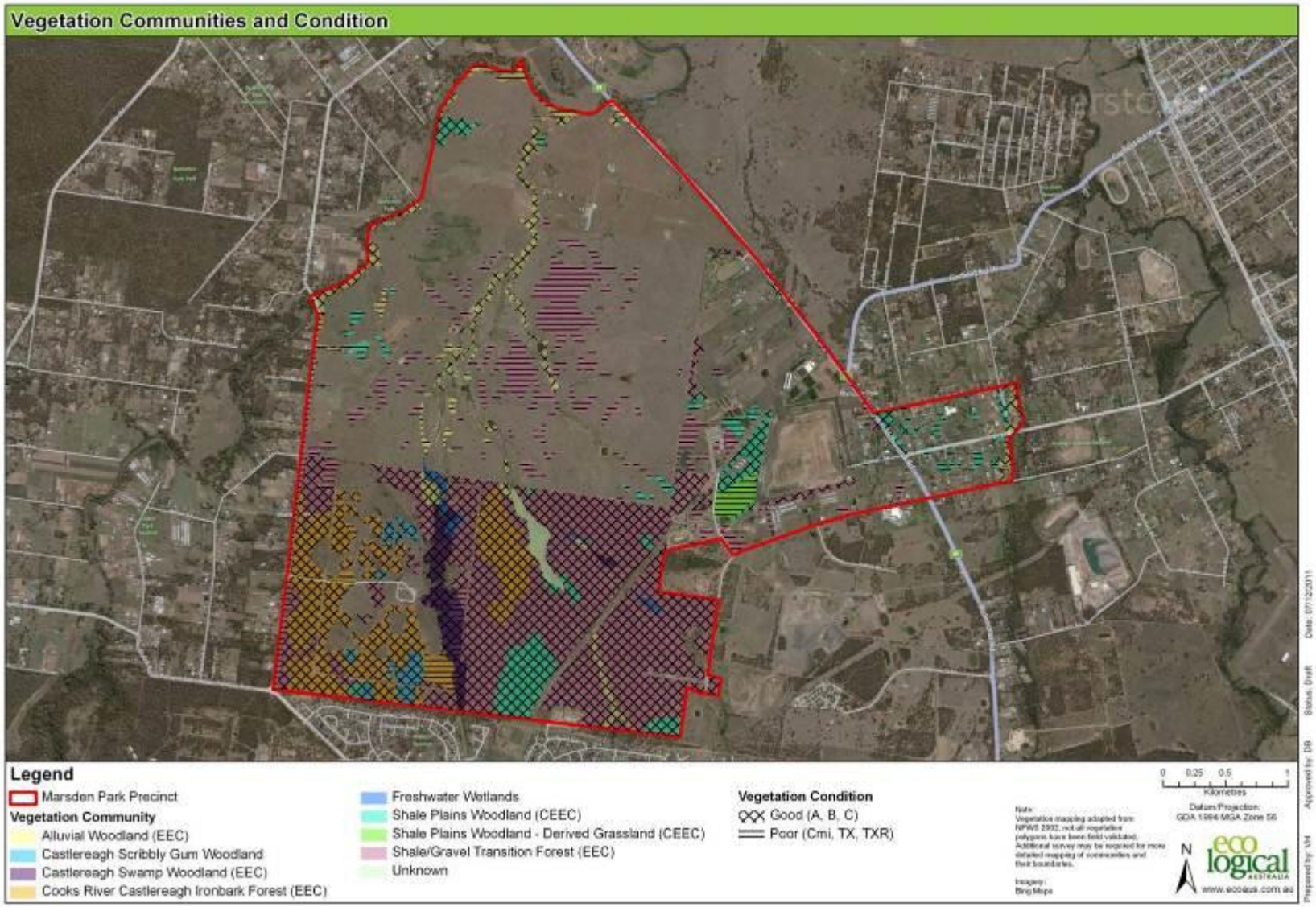

Figure 5 Vegetation communities and condition

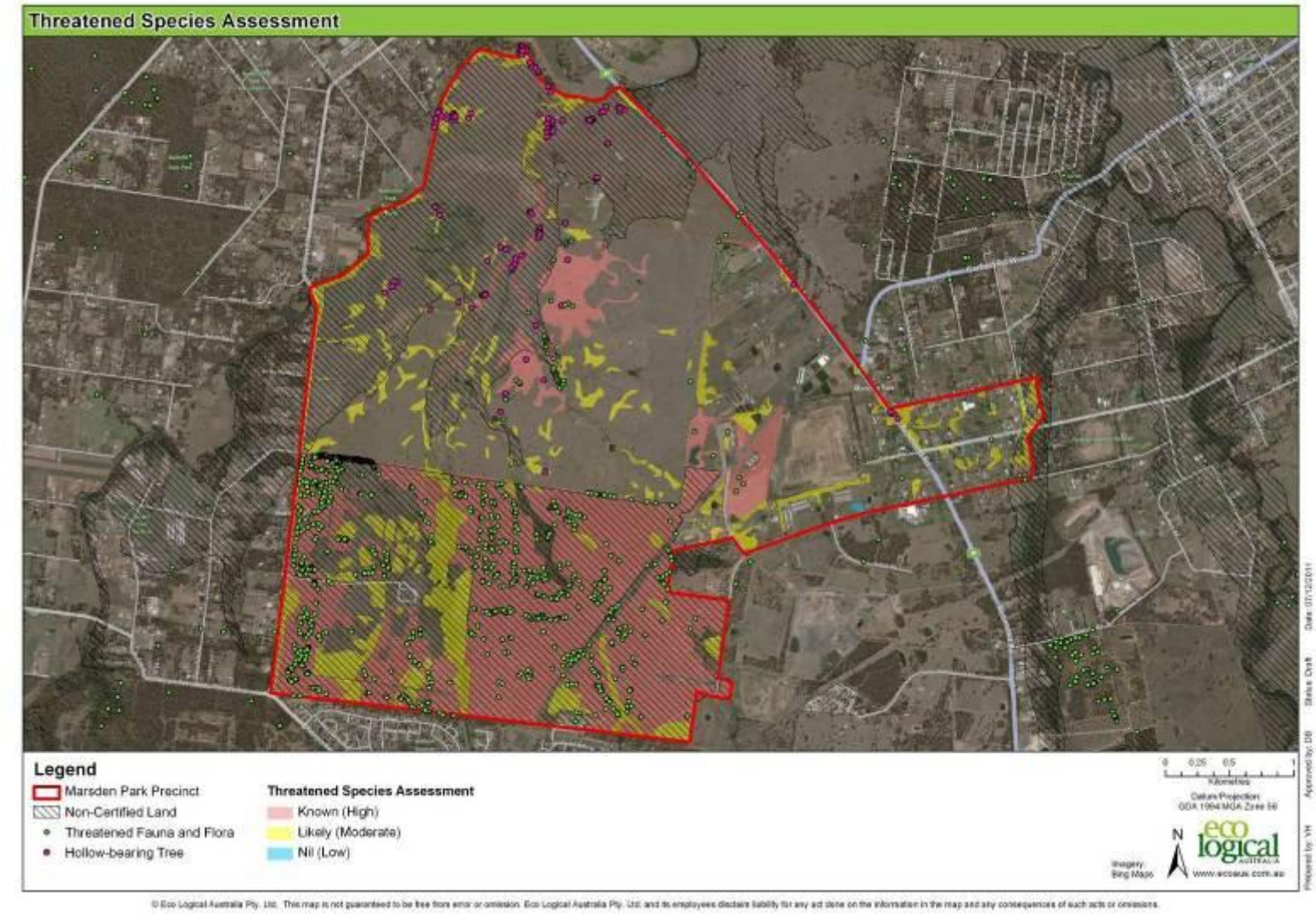

Figure 6 Threatened Species Records

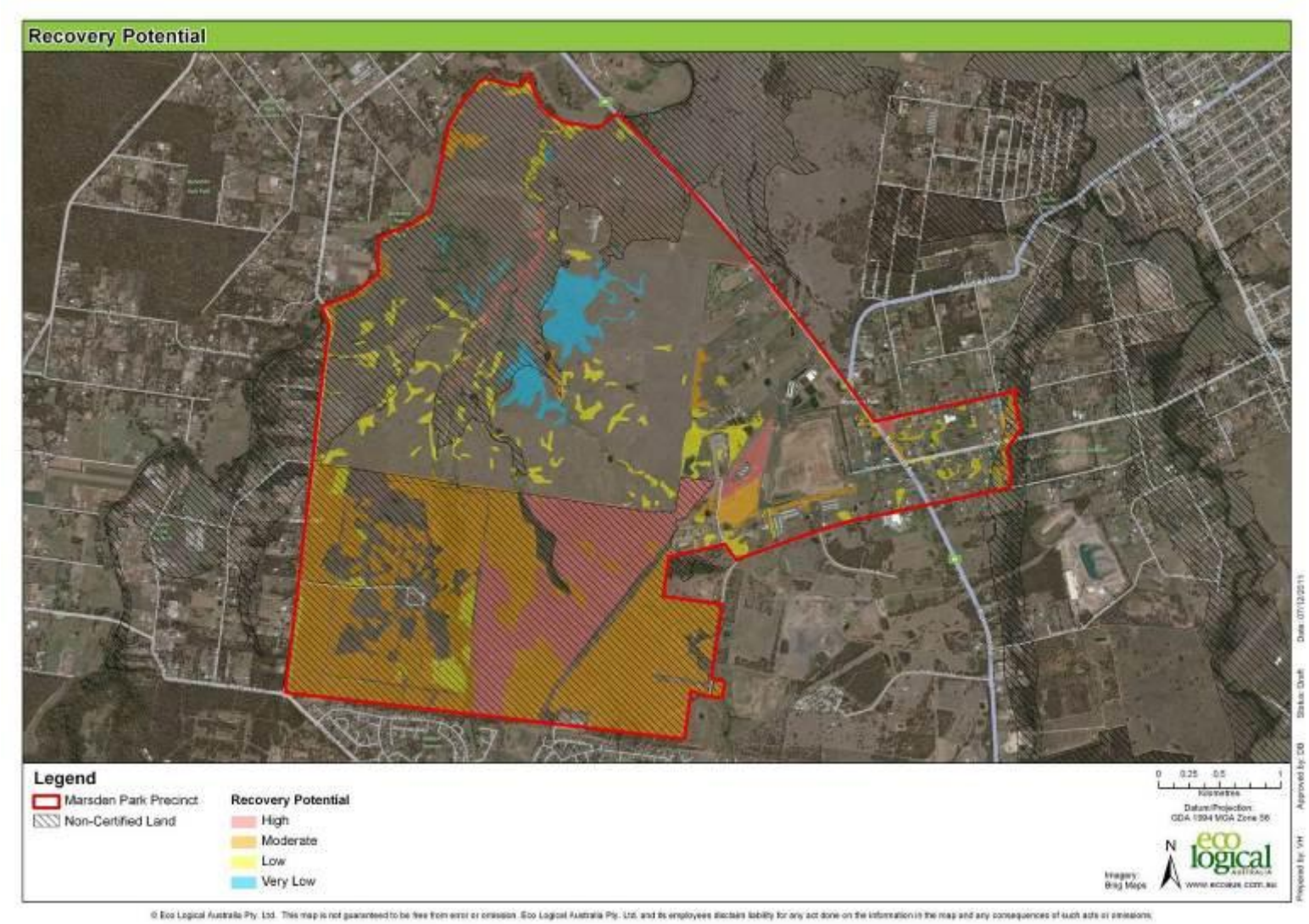

Figure 7 Recovery Potential

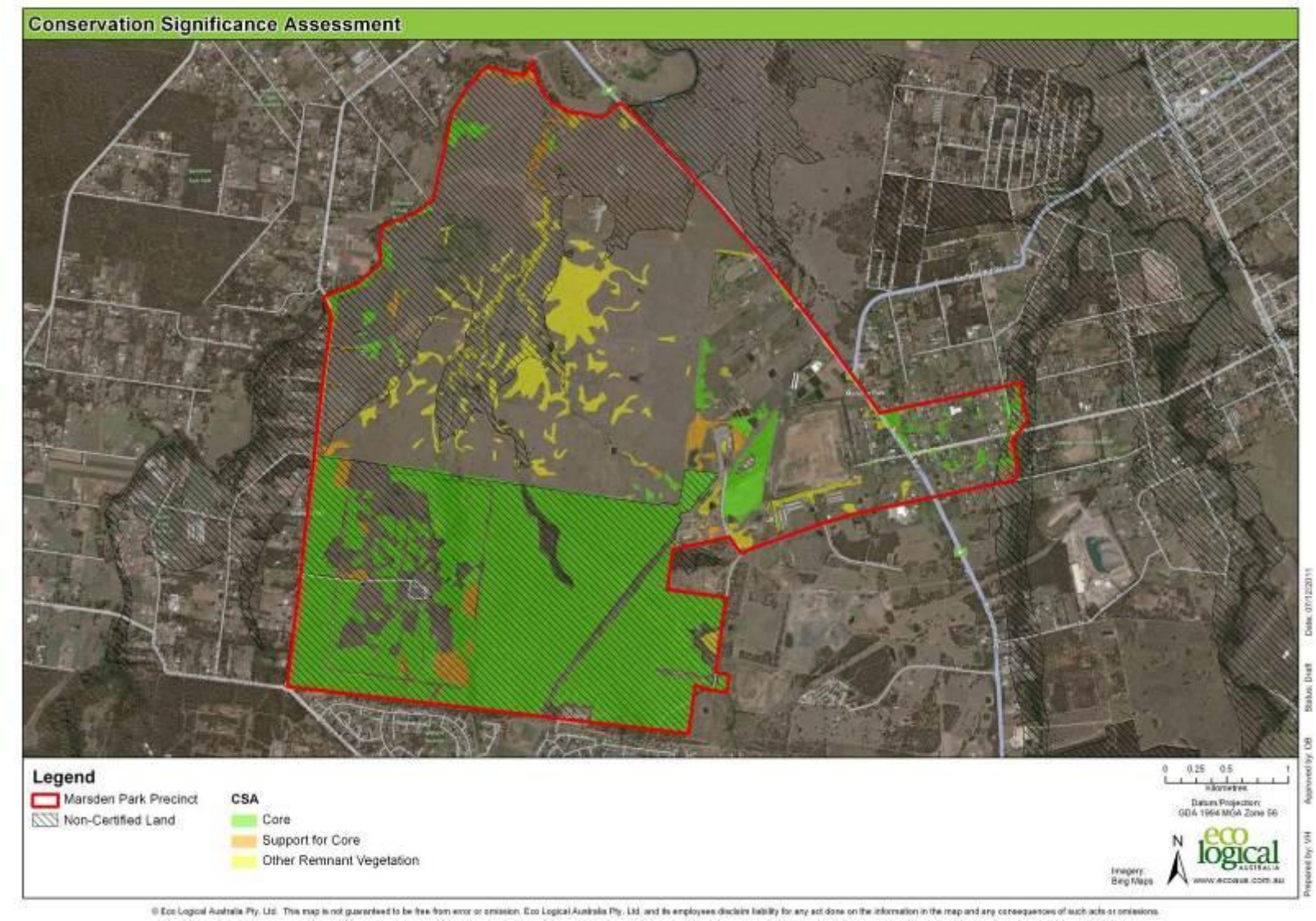

Figure 8 Local conservation significance

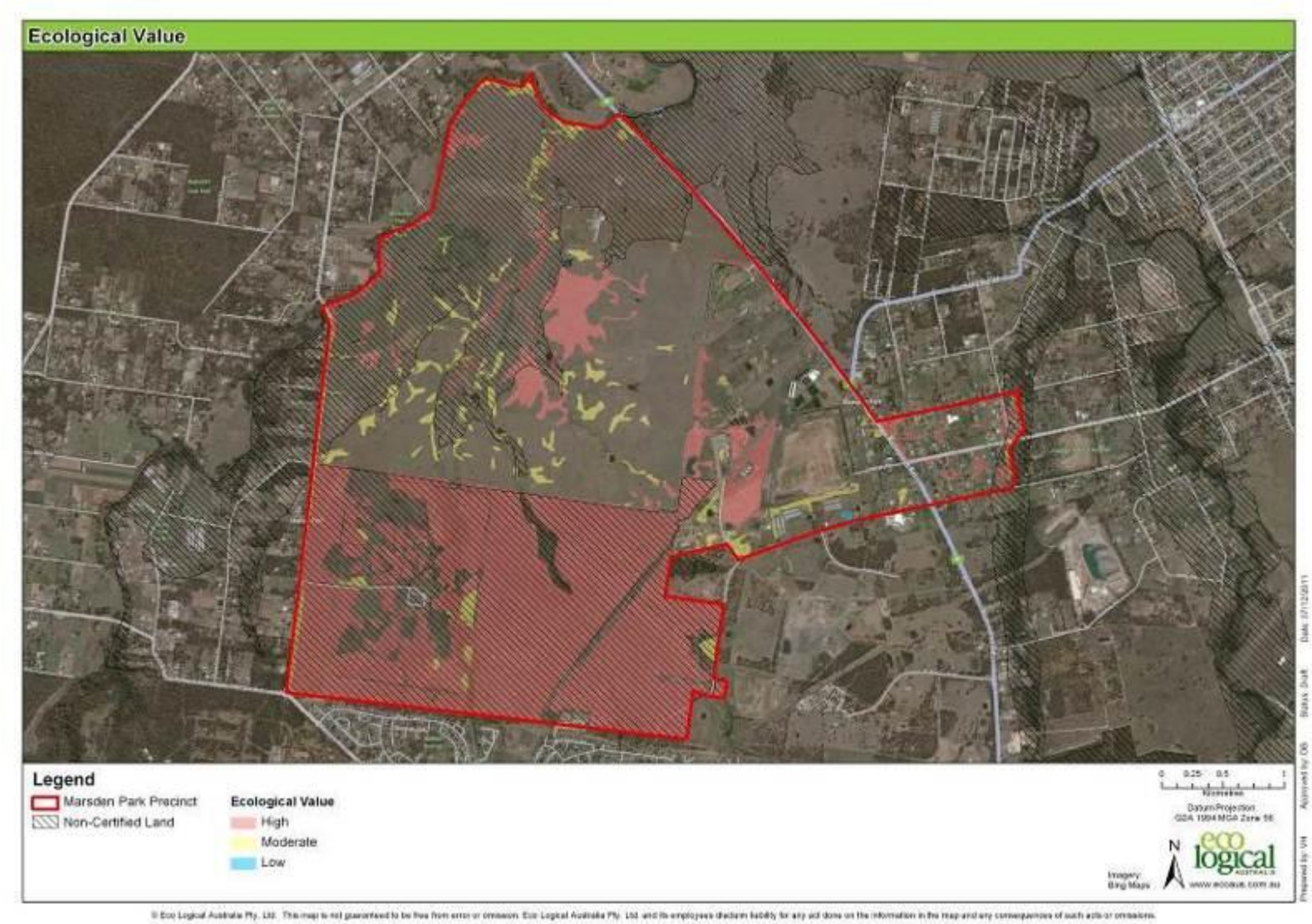

Figure 9 Ecological Constraint

4 Riparian and Aquatic Habitat

4.1 CONTEXT

The Marsden Park Precinct lies within the Hawkesbury-Nepean Catchment which 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 through rural and semi-rural areas of western Sydney. These middle and lower reaches of the system are highly impacted, both directly through waterway modifications and indirectly through land use practises. The Marsden Park Precinct lies within this floodplain of the middle reaches.

4.2 METHODS

Riparian and aquatic assessment was undertaken by an aquatic ecologist over a three day period. Assessment involved the following steps and is detailed in Appendix B. In summary, the method involved:

- Assessment of riparian and aquatic habitat condition by field survey, including searches for threatened species
- Categorisation of watercourse in accordance with the Strahler method.
- Mapping the top of bank of major watercourses
- Identification of groundwater dependent ecosystems

4.3 RESULTS

4.3.1 Riparian and aquatic habitat condition

Figure 10 and **Table 7**: categorise the watercourse reaches into 7 types based on their hydrology, physical form, riparian vegetation and water quality/habitat. The figure shows that the larger creeks (South Creek, Little Creek and Bells Creek) are in moderate-good condition when compared to the smaller watercourses on site, mainly due to the presence of the riparian vegetation and the amount of flow. The larger watercourses also have impacts from grazing, land clearing and poor water quality from adjoining urban areas, however they are still important for the movement of local flora and fauna. The creeks also provide instream habitat for local fish species, aquatic macrophytes and aquatic macroinvertebrates all of which contribute to local ecosystem health. Programs that encourage improvements in these ecosystem values by restoring condition of environments such as South Creek and Little Creek will assist in improving the condition of downstream environments such as the Hawkesbury River that contribute to valuable fisheries resources.

Of particular note however is severe erosion occurring on Little Creek just north of Shanes Park. This section is being actively eroded and should be a focus for short-term stabilisation work in accordance with an overall Vegetation Management Plan.

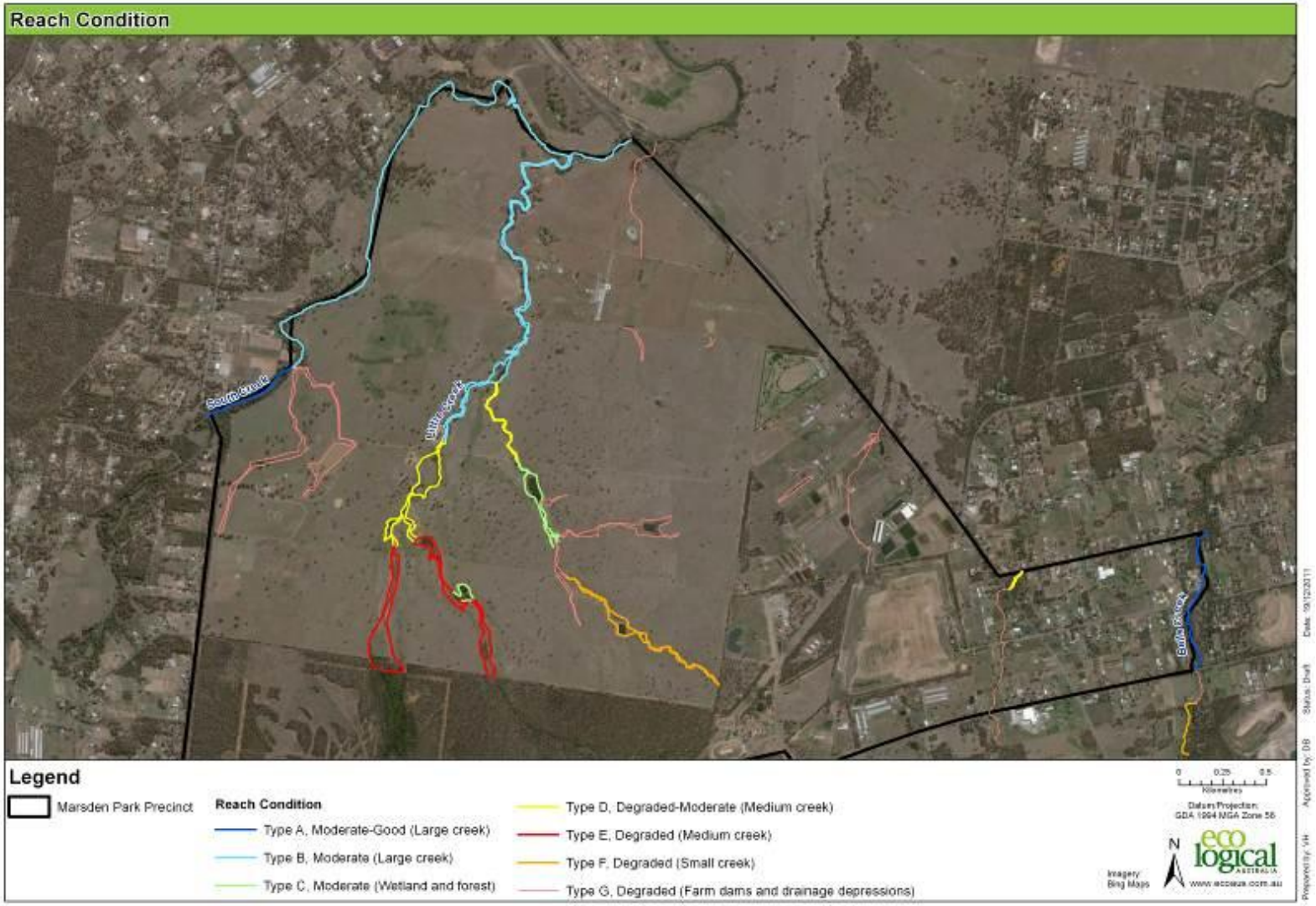

Figure 10 Watercourse Condition

Table 6 Riparian and aquatic condition

Reach Type	Hydrology	Streamside Vegetation	Physical Form	Water Quality and Aquatic Habitat	Overall Rating
Type A	Large creek forming major regional tributary. Catchment highly modified including cleared pasture land and semi-rural residential.	Good longitudinal connectivity. Riparian wide reasonable but with clearing further. All strata present. Some recruitment of dominant canopy species. Weeds common and often dominant large patches. Woody debris cover good.	Bank slope steep and stabilised by riparian trees. Erosion minor.	Water clarity turbid. Depth and width variable with riffle and pool habitats. Riffles with good pebble/cobble substrate. Fringing reeds, overhanging trees and large woody debris common.	Moderate-Good
Type B	Large creek forming major regional tributary. Catchment highly modified including cleared pasture land and semi-rural residential.	Longitudinal connectivity broken, with strips and patches of narrow riparian trees. Surrounding land heavily cleared. Most strata present where trees occur, but groundcover dominated by pasture herbs and grasses. Cattle access limits recruitment of canopy trees. Woody debris cover moderate.	Bank slope steep and moderately stabilised by riparian trees. Erosion common, especially slumps on bends and gully erosion caused by cattle access.	Water clarity turbid. Depth and width variable with riffle and pool habitats. Riffles with good pebble/cobble substrate. Fringing reeds, overhanging trees and large woody debris common.	Moderate
Type C	Small instream farm dam and associated wetland in a highly modified pastoral catchment.	Dam without fringing trees, but with a reasonable sized *Melaleuca* forest occurring adjacent. Forest with some regeneration and various age groups. Native understory shrubs common, including Threatened Species (*Grevillea juniperina*)	Banks gentle with only a small channel. Surface erosion common from overland flow and cattle trampling,	Dam habitat with numerous native macrophytes species and a variety of structure. Good open water habitat. Water birds common and nesting in dead trees (Little Pied Cormorant). *Melaleuca* forest good refuge in cleared landscape. Significant patch size near water.	Moderate

Reach Type	Hydrology	Streamside Vegetation	Physical Form	Water Quality and Aquatic Habitat	Overall Rating
Type D	Medium sized creek in a highly modified pastoral catchment.	Longitudinal connectivity broken, with strips and patches of narrow riparian trees. Surrounding land heavily cleared. Midstorey mostly missing. Groundcover dominated by pasture herbs and grasses. Cattle access limits recruitment of canopy trees. Woody debris cover moderate.	Bank slope steep and moderately stabilised by riparian trees. Erosion common, especially slumps on bends and gully erosion caused by cattle access.	Water clarity turbid. Depth and width relatively homogenous. Little variation of aquatic habitats. Mostly clay substrate. Large woody debris and macrophytes common.	Degraded - Moderate
Type E	Medium sized creek in a highly modified pastoral catchment. An upstream bund has changed the flood hydrology.	Longitudinal connectivity sparse, with few riparian trees. Surrounding land heavily cleared. Midstorey mostly missing, but with occasional native shrubs. Groundcover dominated by pasture herbs and grasses. Cattle access limits recruitment of canopy trees. Woody debris cover poor.	Bank slope steep and severely eroded. Lack of trees and unrestricted cattle access has caused poor bank stability. An upstream bund wall has modified the flood hydrology and flood patterns., possibly contributing to widening erosion.	Water clarity moderately clear, with turbid patches where cattle cross. Depth and width relatively homogenous. Little variation of aquatic habitats. Mostly clay substrate with dense emergent macrophytes. Large woody debris rare. Good frog and wetland bird habitat.	Degraded
Type F	Small creek in a highly modified pastoral catchment.	Longitudinal connectivity limited to a row of riparian trees, often with breaks in canopy. Surrounding land heavily cleared. Midstorey mostly missing. Groundcover dominated by pasture herbs and grasses. Cattle access limits recruitment of canopy trees. Woody debris cover poor.	Banks gentle slope but with patches of severe erosion due to lack of root support and cattle trampling.	Water clarity turbid. Limited aquatic value with some patches of sedges in damp areas. Riparian trees provide connection between large habitat patches.	Degraded

Reach Type	Hydrology	Streamside Vegetation	Physical Form	Water Quality and Aquatic Habitat	Overall Rating
Type G	Farm dams and shallow drainage depressions.	Limited to groundcover weeds and scattered trees.	Combination of farm dams with poorly defined overflow drainage depressions. Occasional sections of narrow eroded pools and weedy swamps.	Dams provide open water habitat and a range of macrophyte structure. Suitable for wetland birds and frogs. Water quality often turbid from cattle access. *Typha* patches common in backed-up swamps upstream of culverts.	Degraded

4.3.2 Riparian corridor widths

On 1 July 2012 new rules commenced regarding controlled activities within riparian corridors. The new approach is described in the Office of Water Controlled Activity Guidelines for Riparian Corridors (NOW 2012) which replace the previous Riparian Corridors Management Study approach described in the Growth Centres Development Code.

The new approach establishes a system for classifying rivers and their riparian corridor width. The guidelines use the Strahler method to classify the river, where-by stream classification begins at the top of the catchment with the smallest headwaters being assigned as a 1st order stream. Where two first order streams meet, they become a second order stream. Where two second order streams meet, they become a third order stream and so on. The stream order is initially determined using the NSW 1:25,000 topographic map series. Field validation of watercourses is then undertaken to confirm that the blue lines on the 1:25 000 topographic map meet the definition of a river under the Water Management Act.

The Guidelines require a Vegetated Riparian Zone (VRZ) to be established in accordance with the widths in Table 7: Vegetated Riparian Zone. The widths are measured from the top of bank.

Table 7: Vegetated Riparian Zone

Stream order	Vegetated Riparian Zone
1	10m
2	20m
3	30m
4+	40m

Table 8 contains a comparison of the Strahler stream order based on desktop mapping versus the field validation. The proposed stream orders and their required riparian corridors are provided in **Figure 12**.

Table 8 Proposed changes to stream order (as shown in figure 11)

Reach	Desktop Strahler	Field validated Strahler	Rationale
1	1	1	No change
2	2	2	No change
3	1	1	No change
4	3	3	No change

5	3	Remove	Small flood-runner with no defined channel. Delete
6	-	1	Not mapped on original 1:25k map, but is clearly a watercourse
8	1	1	No change
10	-	1	Not mapped on original 1:25k map, but is clearly a watercourse
11	1	Remove	No defined channel or aquatic or terrestrial habitat
12	1	Remove	No defined channel or aquatic or terrestrial habitat
13	1	Remove	No defined channel or aquatic or terrestrial habitat
14	1	1	No change
15	1	Remove	No defined channel or aquatic or terrestrial habitat
17	2	1	No branch upstream, so remains a stream order 1
18	3	Remove	No defined channel or aquatic or terrestrial habitat
19	1	1	No change
20	1	1	No change
21	2	2	No change

4.3.1 Top of bank mapping

A survey of the TOB for the identified rivers was conducted by an aquatic ecologist with a differential GPS (accuracy 50cm-70cm) in areas where access had been granted by the land owners. In areas where access was not possible, a desktop method was used to delineate TOB using Lidar data supplied by Blacktown City Council. The top of bank and riparian corridors are presented in **Figure 12**. All measurements of buffer widths required (as described in **Table 7**) are measured from the top of bank.

4.3.2 Threatened Species

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. *Grevillea juniperina sbsp juniperina* was recorded in some riparian zones.

4.3.3 Groundwater Dependant Ecosystems

Groundwater Dependent Ecosystems (GDEs) are defined as ecosystems whose current composition, structure and function are reliant on a supply of groundwater (Eamus 2009), as opposed to surface watering from overland flows.

GDEs in the Study Area are confined to riparian vegetation that may utilise groundwater-fed base flows of creeks, and freshwater wetlands positioned on low-lying ground close to shallow aquifers. Native vegetation communities that may be recognised as potential GDEs in the precinct include the Alluvial Woodland and Freshwater Wetlands in **Figure 5.** Other vegetation identified by NPWS (2002), but not having a Biometric Vegetation Type equivalent include Artificial Wetlands and Weeds and Exotics in riparian zone.

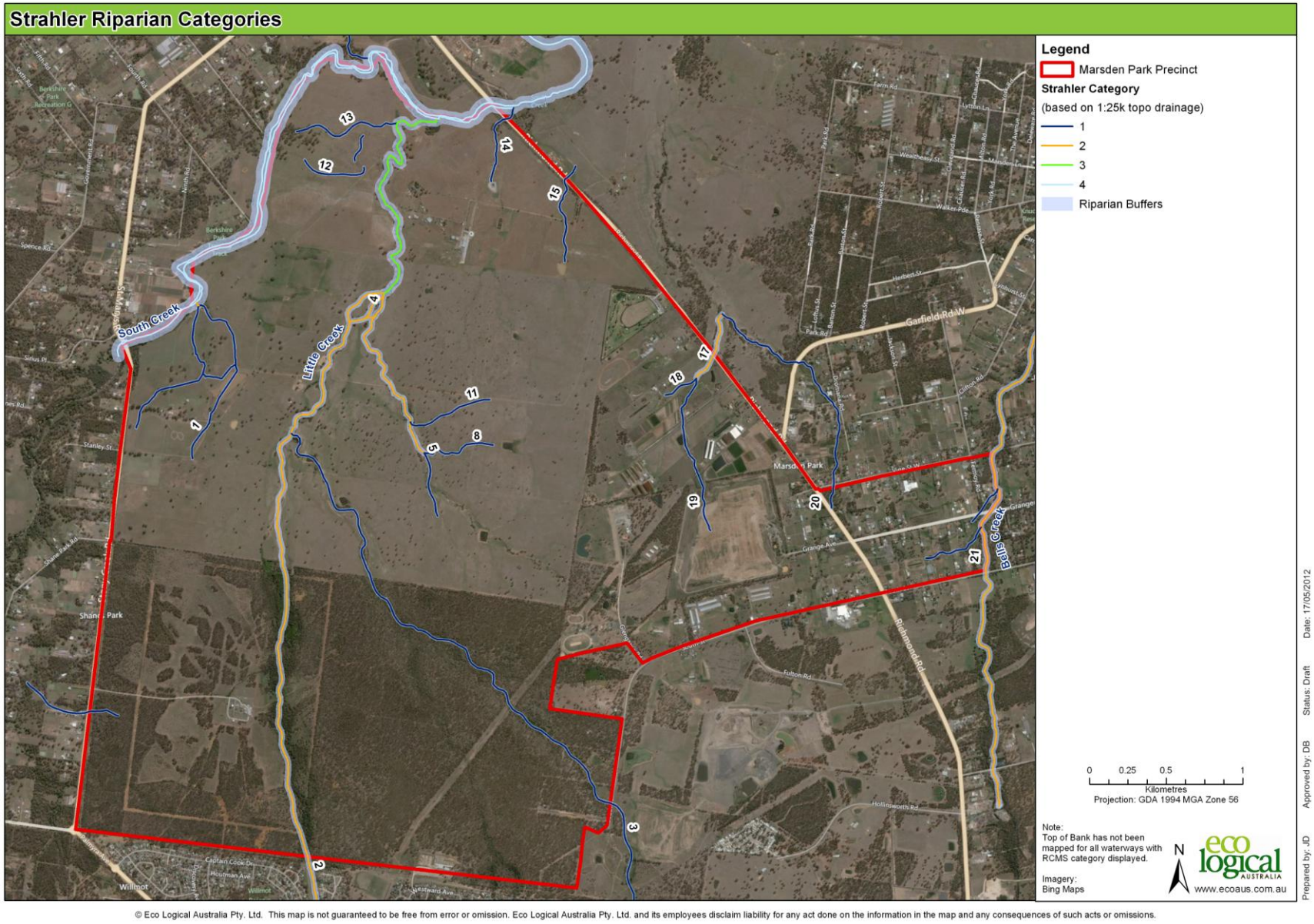

Figure 11 Strahler stream order categories based on existing 1:25,000 topographic map (as outlined in table 4)

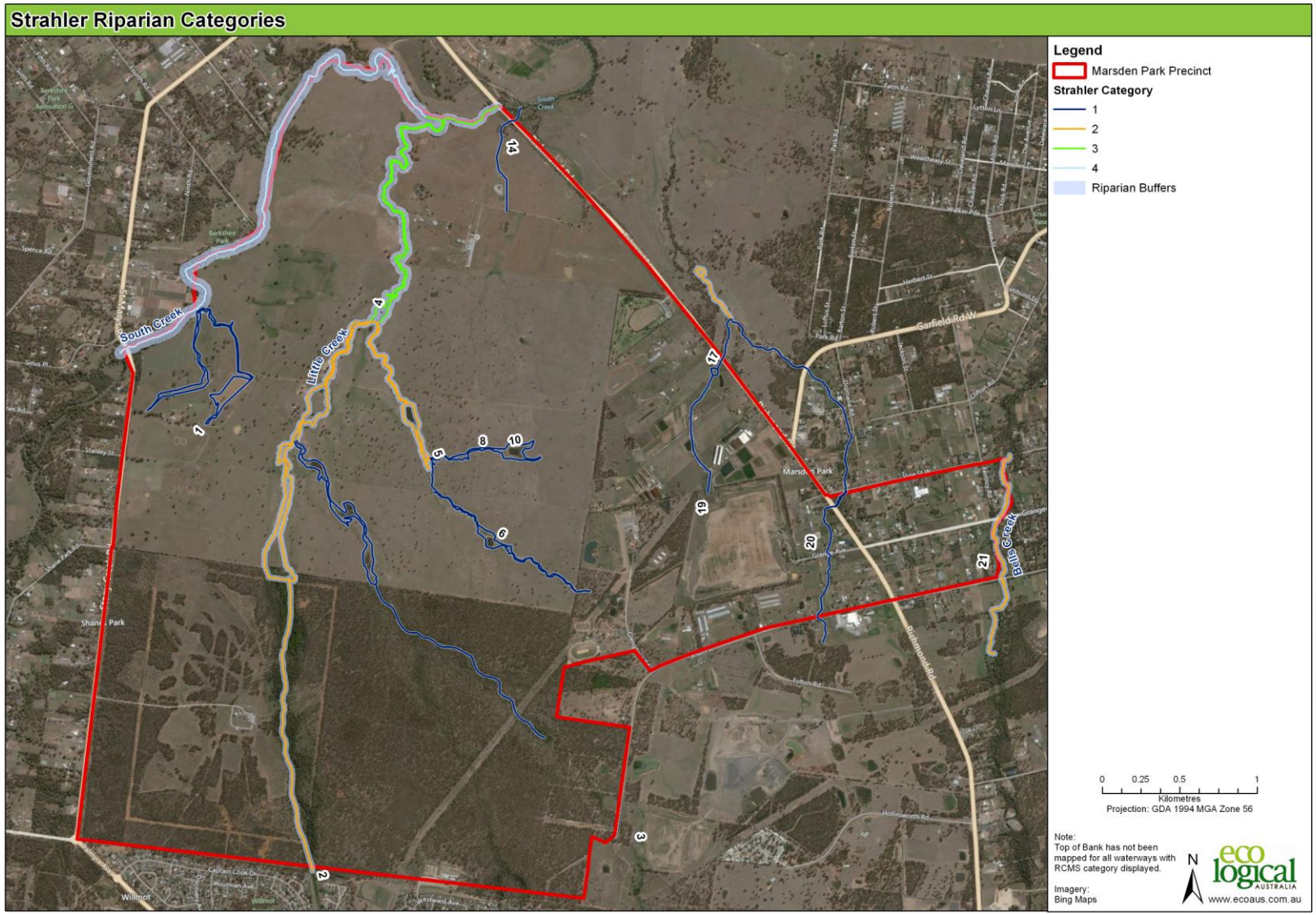

Figure 12: Stream order following field validation

5 Conservation and Management Recommendations for Indicative Layout Plan

5.1 BIODIVERSITY

To maintain parity with the Growth Centres Conservation Plan and the Biodiversity Certification Order, the Marsden Park precinct needs to protect 450 hectares of existing native vegetation (ENV). The following sections recommend how this should be achieved. Three mechanisms are recommended: zoning, development control and rehabilitation. These recommendations focus on ENV on non-certified land as protection of this vegetation is necessary for consistency with the Biodiversity Certification Order.

5.1.1 Zoning of Existing Native Vegetation on Non-Certified land

Marsden Park precinct contains ENV that needs to be protected in order to achieve good biodiversity outcomes and maintain parity with the Biodiversity Certification Order. The area of greatest conservation value is the 600 hectare AirServices Australia site known as Shanes Park which is clearly a major ecological feature of the Western Sydney. The site contains numerous threatened species records and endangered ecological communities in moderate to good condition. The site links well to Castlereagh Nature Reserve and the St Marys ADI site. This land has been identified as having high long term viability in the Growth Centres Conservation Plan and needs to be managed to maintain these values. The Shanes Park site is currently zoned Environmental Conservation under the SEPP (Sydney Region Growth Centres).

Other vegetation of importance are the areas of ENV on non-certified land, mainly along Little Creek and South Creek. The NSW Office of Environment and Heritage have issued advice on the preferred mechanisms to be used for protecting ENV. These identify a preferred zoning and tenure as follows.

- *Protect 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.

In addition to the ENV, Marsden Park Precinct also contains native vegetation that contributes to the biodiversity values of the site. This has been mapped as Additional High Conservation Value vegetation. In areas such as Shanes Park and the riparian corridors of South Creek, Little Creek and Bells Creek, this vegetation often adjoins ENV and enhances its' ecological value as well as providing stability to watercourses that would otherwise be susceptible to erosion.

Recommendation 1: Retain the current zoning for Shanes Park

Recommendation 2: Apply the OEH hierarchy to validated ENV on non-certified land.

Recommendation 3: Protect A HCV vegetation in Shanes Park and riparian corridors using the OEH hierarchy of preference for ENV

5.1.2 Development Controls

The zoning of land however 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 also be applied to AHVC vegetation on non-certified land within the three riparian corridors of South Creek, Little Creek and Bells Creek. As this vegetation is not ENV, a little more flexibility can be provided as long as the biodiversity values of the areas can be maintained. This approach has been used in other precincts where the SEPP provides controls for the clearing of "Native Vegetation Retention Areas". Consent for clearing this vegetation can only be provided where the consent authority is satisfied that certain conditions are met.

Recommendation 4: Introduce Planning Controls via the SEPP that prevent the clearing of ENV on non-certified land.

Recommendation 5: Introduce planning controls via the SEPP to protect AHCV vegetation in the three riparian corridors.

5.1.1 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 such as those in Shanes Park and the riparian areas should either remain, or be placed in public ownership with a funding source for management. This is clearly the appropriate outcome for Shanes Park. Riparian areas are discussed in the following sections.

Recommendation 6: Prepare Plans of Management for public lands, with priority for public lands containing existing native vegetation.

5.2 RIPARIAN AREAS

Marsden Park precinct contains three significant watercourses: South Creek, Little Creek and Bells Creek. Each of these watercourses contains existing native vegetation and carried a significant amount of water during heavy rainfall.

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

- Identify whether or not there is a watercourse present and determine its order in accordance with the Strahler System.
- If a watercourse is present, define the RC/VRZ on a map in accordance with Table 1.
- Seek to maintain or rehabilitate a RC/VRZ with fully structured native vegetation in accordance with Table 1 (reproduced as Table 9 below).
- Seek to minimise disturbance and harm to the recommended RC/VRZ.
- Minimise the number of creek crossings and provide perimeter road separating development from the RC/VRZ.
- Locate services and infrastructure outside of the RC/VRZ. Within the RC/VRZ provide multiple service easements and/or utilise road crossings where possible.
- Treat stormwater run-off before discharging into the RC/VRZ.

Table 9 Riparian corridor matrix

Stream Order	VRZ	RC offset for non RC uses	Cycle and paths	Detention basins		Stormwater outlet structures and essential services	Stream Alignment	Road crossings		
				Only with 50% outer VRZ	Online			Any	Culvert	Bridge
1st	10m	•	•	•	•	•	•	•		
2nd	20m	•	•	•	•	•		•		
3rd	30m	•	•	•		•			•	•
4th +	40m	•	•	•		•			•	•

Protection of riparian corridors can be achieved through appropriate zoning, rehabilitation and ownership. The following sections make recommendations on these mechanisms.

5.2.1 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 9 Riparian corridor matrix.

Recommendation 7: Zone the riparian corridor of Stream Order 2, 3 and 4 using an E2 zone

Recommendation 8 Where an E2 zoning is not practical, use an SP2 zoning that includes protection of terrestrial and aquatic habitats as a primary objective.

5.2.2 Rehabilitation

Much of the riparian zone in Marsden Park (except for Shanes Park) has been degraded through long-term grazing. Re-establishment of native vegetation will be important to improve the stability of watercourses and improve habitat connectivity through the site. Rehabilitation recommendations will need to be determined on a site by site basis and are likely to be a requirement of any approval for works within waterfront land under the Water Management Act. This is particularly relevant in the section of Little Creek just north of the Shanes Park AirServices site where significant bed and bank erosion is occurring. If this section of land is to be fragmented in different ownerships, a strategic approach to rehabilitation will assist in rehabilitation being more cost effective and improve likelihood of success.

Recommendation 9: Prepare a Vegetation Management Strategy for the Little Creek riparian corridor, with emphasis on issues identified in Table 6

5.2.3 Ownership

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.

Recommendation 10: Stream Order 2, 3 and 4 are placed in public ownership where possible

Recommendation 11: Where public ownership is not possible, avoid fragmentation of ownership by keeping lots as large as possible.

5.3 RELEVANT BIODIVERSITY MEASURE

Design of the indicative layout plan and subsequent SEPP amendments will need to be consistent with the Relevant Biodiversity Measures of the Growth Centres Biodiversity Certification Order. The way in which this is achieved will need to be described in a Biodiversity Certification Consistency Report prepared after the ILP and SEPP amendments have been finalised.

RBM 14 of the Biodiversity Certification Order requires special consideration to be given to a patch of ENV on non-certified land adjoining Shanes Park. The purpose of the assessment is to inform a decision by the Minister for the Environment on whether the certification status of this site should change. Table 10 indicates that the patch of vegetation is an EEC and is big enough to manage for conservation.

Table 10 RBM 14 assessment

Criteria	Does the patch meet the criteria ?	
Contain an endangered ecological community as listed under the Act	Yes	Community is Shale-Gravel Transition Forest which is an EEC
Are contiguous with the ENV on the Air Services Australia site	Yes	The area is contiguous, albeit via a narrow 20-30m common boundary with the Air Services site.
Are equal to or greater than 4 hectares	Yes	The patch is 6.8 hectares
Have a 10% or greater canopy cover	Yes	The canopy cover is roughly 20% and is therefore greater than 10%
Have 30% or greater vegetation cover within: i. a 0.55km radius (for local connectivity), and ii. a1.75km radius (for regional connectivity)	Yes	Vegetation cover within a 0.55km radius is 45.85% Vegetation within a 1.75km radius is 36.76%

as measured from the centre point of each area		
Have a perimeter to area ratio that is conducive to on-going conservation management; and	Yes	At 6.8 hectares, the patch is of a size that is conducive to conservation management.
Whether after applying a 50m disturbance buffer to the edge of each area (where the edge is likely to be made available for future urban development as identified in the SEPP), the overall size of the area then falls below 4hectares	No	An internal 50m buffer of the northern and western boundaries (which are those likely to be available for urban development) would reduce the patch by 2.8 hectares, bring the size down to 4 ha.

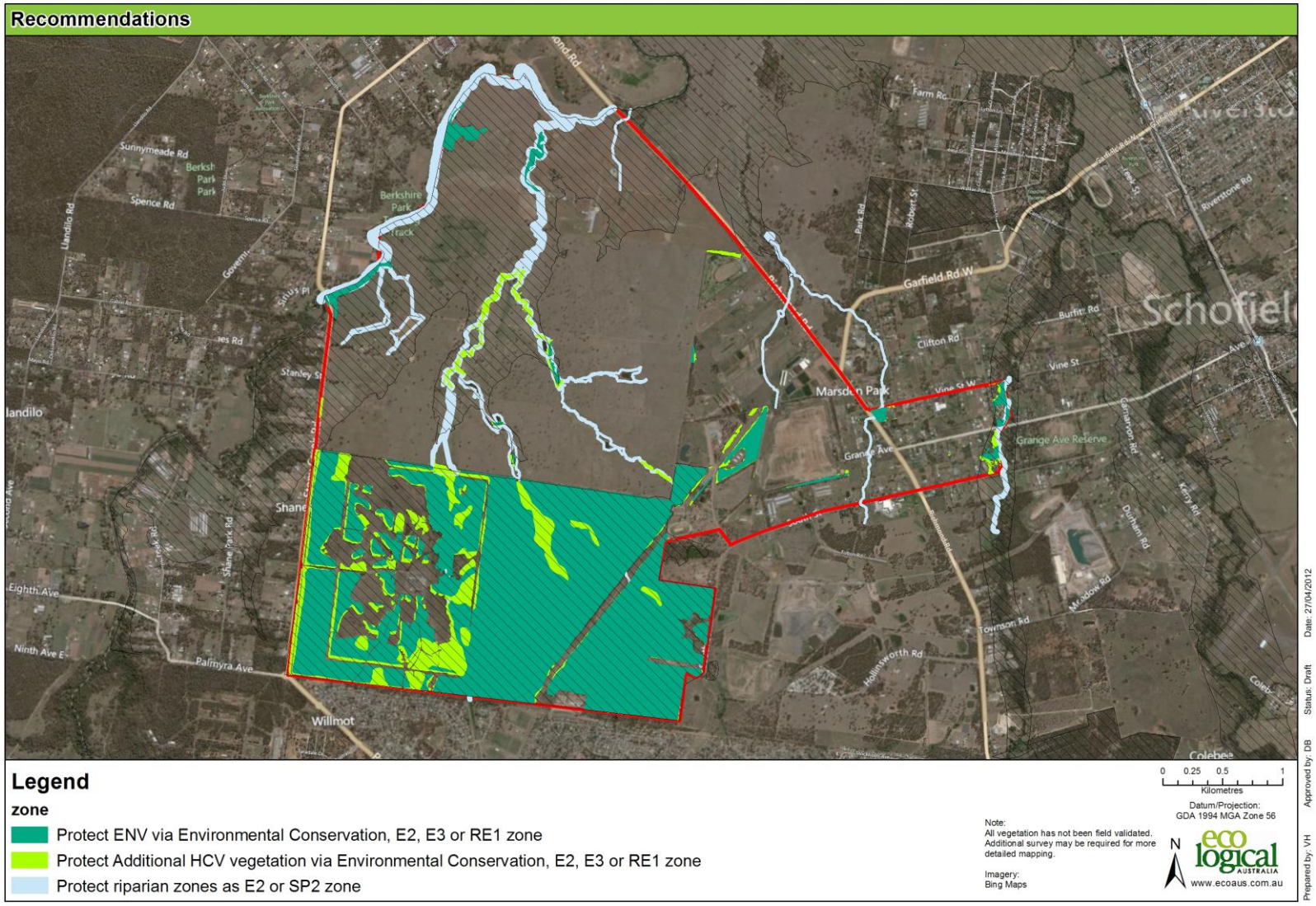

Figure 13: Marsden Park ILP recommendations

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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.

With regard to the Western Sydney Growth Centres, the Commonwealth have undertaken a Strategic Assessment under Part 10 of the EPBC Act. Subsequent to the Strategic Assessment, the Commonwealth Minister for the Environment has approved

> *All actions associated with the development of the Western Sydney Growth centres as described in the Sydney Growth Centres Strategic Assessment Program Report (NSW Government, November 2010).*

The effect of this is that provided a developer is acting in accordance with the planning framework established by NSW in the Growth Centres, separate assessment of impacts to MNES is not required.

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 Department of Environment and Climate Change (DECC) 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 the 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.

Areas within Marsden Park that are non-certified are shown in Figure 1 of the report. They comprise of a riparian area delineated by the 1 in 100 year flood lines. Each precinct needs to be assessed against the conditions of the Biodiversity Conservation Order to ensure that the planned rezoning and

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

subsequent development of the precinct complies. This will be 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.

The NSW Office of Water have released *Guidelines for Riparian corridors on waterfront land* (2012) that establish the following procedure for protecting riparian corridors:

- Identify whether or not there is a watercourse present and determine its order in accordance with the Strahler system
- If a watercourse is present, define the VRZ on a map in accordance with table
- Seek to maintain or rehabilitate a Riparian Corridor / Vegetated Riparian Zone with fully structured native vegetation in accordance with table 1
- Seek to minimise disturbance and harm to the recommended RC/VRZ
- Minimise the number of creek crossings and provide perimeter road separating development from the RC/VRZ
- Locate services and infrastructure outside of the RC/VRZ. Within the RC/VRZ, provide multiple service easements and/or utilise road crossings where possible

- Treat stormwater run-off before discharging into the RC/CRZ

The Guidelines allow for a range of works and activities on waterfront land and in riparian corridors. A dot signifies that this activity is likely to be allowable in the corridor.

Stream Order	VRZ	RC offset for non RC uses	Cycle and paths	Detention basins		Stormwater outlet structures and essential services	Stream Alignment	Road crossings		
				Only with 50% outer VRZ	Online			Any	Culvert	Bridge
1st	10m	•	•	•	•	•	•	•		
2nd	20m	•	•	•	•	•		•		
3rd	30m	•	•	•		•			•	•
4th +	40m	•	•	•		•			•	•

This categorisation and assessment of riparian areas under the WM Act replaces the former Department of Infrastructure Planning and Natural Resources (DIPNR) categorisation of watercourses that was previously applied in the Growth Centres Precincts.

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 Marsden Park 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).

Conservation Plan

Under the GCC Conservation Plan (January 2007), the vegetation within Marsden Park precinct has been identified as both 'Higher Long Term Management Viability' and 'Lower Long Term Management Viability (LMV)'. The HMV is contained within the Air Services site in the southern part of the precinct. The GC Conservation Plan specifically states that the conservation value of the Air Services site, which contains large areas of HMV and smaller areas of LMV is understated in the conservation plan. The conservation plan also notes that the value of the Air Services site is not confined to the HMV vegetation but relates to the size of the property, its resilience and regeneration capacity, its current integrity and overall condition and its proximity to other key areas such as the former ADI site.

Protection of this site in its entirety is an essential component of delivering an Improve or Maintain outcome.

The 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 including historic aerials from 1947, 1961 and 1981;
- A search of the NSW OEH 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 OEH 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 24th – 28th October 2011. Field survey consisted of validating ENV, vegetation communities and their condition, and opportunistic fauna sightings. The field survey was undertaken by Jennifer Fitzgerald and Michael Ward of Eco Logical Australia. Approximately 87 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. Some areas of the site were not access due to restrictions by landowners.

Weather conditions during field surveys

Date	Min Temp (°C)	Max Temp (°C)	Rainfall (mm)
24 October 2011	12.8	32.7	0.0
25 October 2011	19.2	20.0	0.6
26 October 2011	12.4	15.5	9.2
27 October 2011	11.5	17.8	1.2
28 October 2011	12.3	25.3	0.0

Weather observations were taken from www.bom.gov.au

The survey involved validating vegetation communities, and searching for threatened flora and fauna. Four survey techniques were used during the field surveys, including:

- Rapid flora assessments;
- Random meander targeted flora searches;
- Anabat Dection (see below); and
- Incidental fauna sightings.

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 COMMUNITY AND CONDITION ASSESSMENT

Using a combination of the NPWS Western Sydney Mapping Project and aerial photograph interpretation, 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.

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.

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).

Threatened Flora Surveys

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

- *Dillwynia tenuifolia;*
- *Grevillea juniperina subsp juniperina;*
- *Micromyrtis minutiflora;* and
- *Pultenaea parviflora.*

Threatened Fauna Surveys

Anabat surveys were undertaken within the study area to determine whether any threatened species were found within the Marsden Park Precinct. An Anabat detector equipped with ZCAIM recording device was used to record resident microchiropteran bat species on three consecutive nights. On each night of survey the Anabat was tuned to record from 1900hours to 0800 the following morning. Anabat calls were downloaded and sent to Peter Knock for identification. Certainty of bat identifications are recorded confident (C), probable (P) and possible (Po).

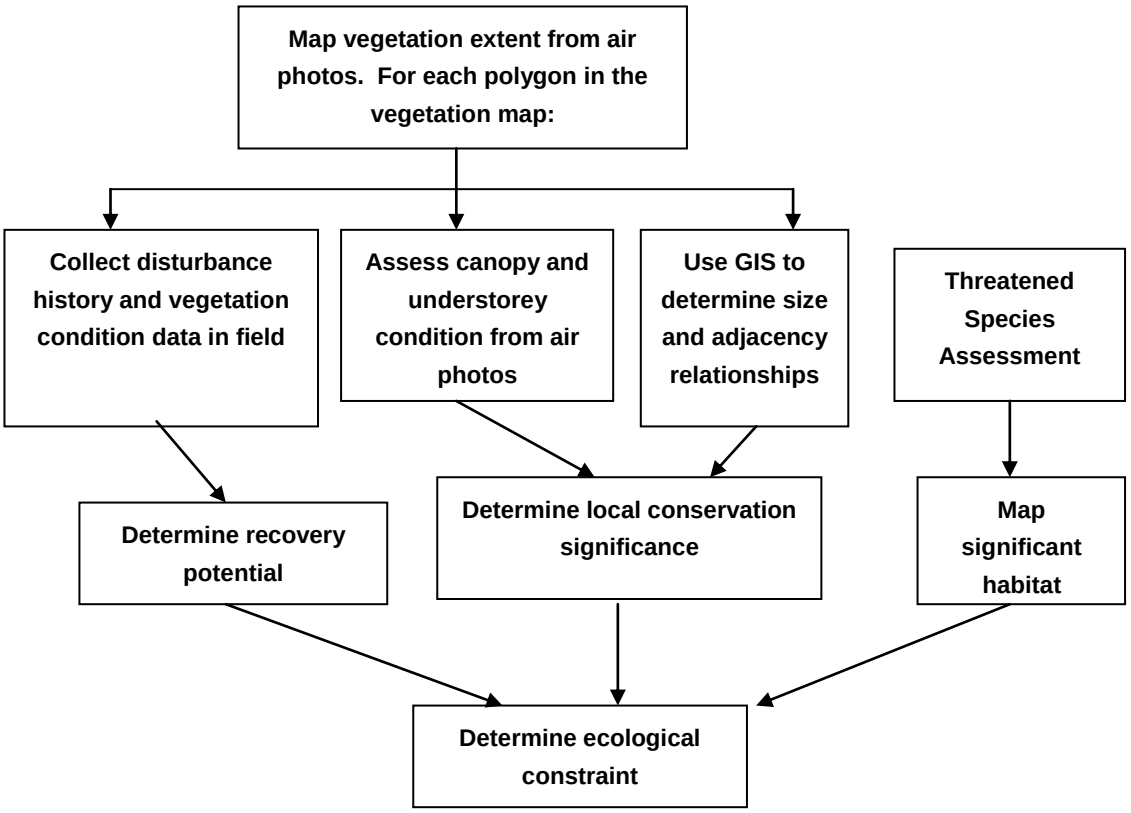
Incidental fauna sighting were also recorded (Appendix D).

Ecological Constraints

An ecological constraints analysis, based on a methodology used elsewhere in Western Sydney (Eco Logical Australia 2003) was applied across the precinct. An ecological constraints analysis is a stepped analysis of the environmental values of an area. It provides a combined measure of ecological values, and is increasingly used as a basis for negotiations over locations, types and densities of land development. It includes measurement of:

- the conservation significance of vegetation communities (including legislative status);
- the structural condition of vegetation remnants;
- type and severity of disturbance and associated recovery potential;
- connectivity between remnants on and off site;
- the size of the vegetation remnant; and
- the value of the remnant as threatened species habitat.

The steps involved in this type of ecological constraints analysis are illustrated in the flowchart in the figure below. Vegetation mapping is combined with field survey work, threatened species assessment, recovery potential and the NPWS (2002) conservation significance assessment methodology to determine the relative level of ecological value or constraint across a site.


Map vegetation extent from air photos. For each polygon in the vegetation map:
Collect disturbance history and vegetation condition data in field
Assess canopy and understorey condition from air photos
Use GIS to determine size and adjacency relationships
Threatened Species Assessment
Determine recovery potential
Determine local conservation significance
Map significant habitat
Determine ecological constraint

Ecological Constraints Flowchart

Recovery Potential

Using information collected in the field 'recovery potential' is determined for each area of vegetation. This is defined as *"...the anticipated capacity of (an) area to recover to a state representative of its condition prior to the most recent disturbance event"* (IPC & AES, 2002).

The table over the page outlines the decision rules used in this step, resulting in a ranking of High, Moderate, Low or Very Low recovery potential for each vegetation remnant.

Conservation Significance

As part of the recovery planning process for Cumberland Plain vegetation communities, NPWS (2001) have classified remnant vegetation across the Plain into significance categories to assist Councils and other land use planners in making decisions about land use. Remnant woodland and forest vegetation has been ranked as one of four categories:

- 'Core Habitat'; defined as "areas that constitute the backbone of a viable conservation network across the landscape; or areas where the endangered ecological communities are at imminent risk of extinction"
- 'Support for Core Habitat'; "areas that provide a range of support values to the Core Habitat, including increasing remnant size, buffering from edge effects, and providing corridor connections"
- 'Other Remnant Vegetation'; "all native vegetation that does not fall within the above significance categories"

These decision criteria are outlined in the tables over the page.

NPWS (2002) conservation significance attribute information was assigned to the vegetation polygons mapped within Area 20. Where the classification no longer matched, changes were made.

Threatened Species Assessment

Threatened species information and field observations of habitat value were then collated for the study area and used to determine significant threatened species habitat. Each remnant vegetation patch is classed as having either Known, Likely or Nil chance of supporting threatened species.

The following criteria were adopted for categorisation;

- Known/High
    - Known occurrence of threatened flora or fauna
-
- Likely/Moderate
    - Likely occurrence of threatened flora or fauna
    - Known to coantain hollow-bearing trees

- Nil/Low
    - Foraging habitat only, for wide ranging species (e.g. bats and birds with large home ranges)

Ecological Constraint

Information derived from the recovery potential, conservation significance and threatened species calculations are combined to determine ecological constraint. The tables on the following pages show the process for combining this information.

Recovery potential matrix

Source: Eco Logical Australia (2003).

Current condition and land use	Past land use and disturbance	Soil Condition	Vegetation	Recovery Potential
Cleared (no woodland canopy). Includes *Bursaria* thickets in grassland	Recently cleared (<2 years)	Unmodified or largely natural. Uncultivated.	Native dominated	High
			Exotic dominated	Moderate
		Modified. Heavily cultivated and/or pasture improved. Imported material.	Either	Low
	Historically cleared (>2 years) and consistently managed as cleared.	Unmodified or largely natural. Uncultivated.	Native dominated	Moderate
			Exotic dominated	Low
		Modified. Heavily cultivated and/or pasture improved. Imported material.	Either	Very Low
Wooded/Native Canopy present or regenerating	No recent clearing of understorey	Unmodified or largely natural. Uncultivated.	Native understorey relatively intact or in advanced state of regeneration. Native dominated.	High
			Native understorey significantly structurally modified, absent or largely absent. Includes areas dominated by African Olive.	Moderate
			Exotic dominated	*Low*
		Moderately modified by long term grazing or mowing.	*Native dominated*	*Low*
		Modified. Heavily cultivated and/or pasture improved. Imported material.	Native understorey significantly structurally modified, absent or largely absent. Includes areas dominated by African Olive.	Very Low
			Native understorey present. Heavily weed invaded.	Low
	Understorey patchily intact	*Disturbed*	*Native dominated*	*Moderate*
			Exotic dominated	*Low*
	Recent clearing of understorey and or native understorey significantly structurally modified due to existing land use (eg. Mowing, grazing)	Unmodified or largely natural. Uncultivated.	Native dominated. If no vegetation present, assume native dominated.	High
			Exotic dominated	Moderate
		Modified. Heavily cultivated and/or pasture improved. Imported material.	Native dominated	Low
			Exotic dominated	Very Low

Conservation significance matrix

Source: NSW NPWS (2002)

Community type	Condition Code	Patch Size^	Connectivity	Code	Conservation Significance
Endangered Ecological Community (Critically endangered) ("CEEC")	ABC, TX or Txr	Any	Any	C3	Core
	Txu	Any	Any	URT	Urban remnant trees (critically endangered communities)
Endangered Ecological Community ("EEC")	ABC (with Understorey in good or moderate condition)	> 10 ha	Any	C1	Core
		< 10 ha	Adjacent to C1 or CEEC	C2	Core
			Adjacent to S1	S2	Support for core
			None	O	Other remnant vegetation
	TX or Txr, ABC (with poor Understorey condition)	Any	Adjacent to any Core	S1	Support for core
			None	O	Other remnant vegetation
	Txu	Any	Any	O	Other remnant vegetation

^ Patch size is based on a 15m adjacency analysis

Decision matrix step 1:

This step combines the recovery potential and conservation significance maps (ELA 2003).

	Recovery Potential				
Conservation Significance		**High**	**Moderate**	**Low**	**Very Low**
	Core	High	High	High	High
	Support for core	High	Moderate	Moderate	Low
	Other	Moderate	Moderate	Low	Low

Decision matrix step 2:

This step combines results from the above table with the threatened species layer to determine overall ecological value (ELA 2003).

	Combined Recovery Potential and Conservation Significance (result of Table above)			
Threatened Species Assessment		**High**	**Moderate**	**Low**
	Known (High)	High	High	High
	Likely (Moderate)	High	Moderate	Moderate
	Nil (Low)	High	Moderate	Low

Aquatic Habitat Assessment

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 OEH Wildlife Atlas database
- EPBC online Protected Matters Database Search
- NSW Government Bionet Database

STREAM CATEGORISATION

Stream classification was initially undertaken using the Riparian Corridor Management Study (RCMS) approach recommended by the NSW Office of Water NOW). Stream categories (1, 2 and 3) were confirmed during site inspections and follow-up correspondence with the NOW . In several cases, watercourses that were marked on 1:25,000 topographic maps were not evident in the field and were therefore deleted from further discussion.

On 1 July 2012 NOW released new guidelines for riparian corridors, includingthose in the growth centres. The previous RCMS approach was abandoned and replaced by a the use of the Strahler system and buffer widths described in Watercourses within the study area were categorised using guidelines developed by the NSW Office of Water and released on 1 July 2012. Streams were initially categorised using desktop analysis of stream order. Field inspections were undertaken to verify or not whether they met the definition of a river under the WM Act.

CONDITION ASSESSMENT

Field surveys were conducted along the length of the watercourse where access was permitted. 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.

Appendix C: Flora and Fauna Lists

FLORA LIST

FLORA LIST

Family	Botanical Name	Common Name	Noxious Weed Class
Acanthaceae	*Brunoniella australis*	Blue Trumpet	
Adiantaceae	*Adiantum aethiopicum*	Common Maidenhair	
Adiantaceae	*Cheilanthes sieberi ssp. sieberi*		
Agavaceae	*Agave americana**	Century Plant	
Alliaceae	*Nothoscordum borbonicum**	Onion Weed	
Amaranthaceae	*Alternanthera denticulata*	Lesser Joyweed	
Anthericaceae	*Arthropodium milleflorum*	Vanilla Lily	
Anthericaceae	*Dichopogon fimbriatus*	Nodding Chocolate Lily	
Apiaceae	*Centella asiatica*	Pennywort	
Apiaceae	*Foeniculum vulgare**	Fennel	
Apiaceae	*Hydrocotyle bonariensis**		
Asclepiadaceae	*Araujia sericifera**	Moth Vine	
Asparagaceae	*Asparagus aethiopicus**	Asparagus Fern, Sprengeri Fern	
Asparagaceae	*Asparagus asparagoides**	Bridal Creeper, Florist's Smilax	C4
Asparagaceae	*Asparagus officinalis**	Asparagus	
Asteraceae	*Ambrosia tenuifolia**	Lacy Ragweed	
Asteraceae	*Aster subulatus**	Wild Aster	
Asteraceae	*Bidens pilosa**	Cobbler's Pegs	
Asteraceae	*Calotis lappulacea*	Yellow Burr-Daisy	
Asteraceae	*Cirsium vulgare**	Spear Thistle	
Asteraceae	*Conyza bonariensis**	Flaxleaf Fleabane	
Asteraceae	*Cotula australis*	Common Cotula	
Asteraceae	*Crassocephalum crepidioides**	Thickhead	
Asteraceae	*Euchiton sphaericus*		
Asteraceae	*Gymnocoronis spilanthoides**	Senegal Tea	C1
Asteraceae	*Hypochaeris radicata**	Catsear	
Asteraceae	*Ozothamnus diosmifolius*	White Dogwood	
Asteraceae	*Senecio madagascariensis**	Fireweed	
Asteraceae	*Sigesbeckia orientalis*		
Asteraceae	*Solenogyne bellioides*		
Asteraceae	*Soliva sessilis**	Bindyi	
Asteraceae	*Sonchus asper**	Prickly Sowthistle	
Asteraceae	*Sonchus oleraceus**	Common Sowthistle	
Asteraceae	*Vittadinia sulcata*	Fuzzweed	
Azollaceae	*Azolla pinnata*		
Brassicaceae	*Capsella bursa-pastoris**	Shepherd's Purse	
Cactaceae	*Opuntia sp.**		
Campanulaceae	*Wahlenbergia gracilis*	Sprawling or Australian Bluebell	

Family	Botanical Name	Common Name	Noxious Weed Class
Caprifoliaceae	*Lonicera japonica**	Japanese Honeysuckle	
Casuarinaceae	*Casuarina glauca*	Swamp Oak	
Chenopodiaceae	*Chenopodium album**	Fat Hen	
Chenopodiaceae	*Einadia hastata*	Berry Saltbush	
Chenopodiaceae	*Einadia nutans ssp. linifolia*		
Chenopodiaceae	*Einadia trigonos*	Fishweed	
Clusiaceae	*Hypericum gramineum*	Small St. John's Wort	
Commelinaceae	*Commelina cyanea*	Native Wandering Jew	
Commelinaceae	*Tradescantia fluminensis**	Wandering Jew	
Convolvulaceae	*Convolvulus erubescens*		
Convolvulaceae	*Dichondra repens*	Kidney Weed	
Crassulaceae	*Crassula sieberiana*	Australian Stonecrop	
Cyperaceae	*Bolboschoenus fluviatilis*		
Cyperaceae	*Carex appressa*	Tall Sedge	
Cyperaceae	*Cyperus gracilis*	Slender Flat-sedge	
Cyperaceae	*Eleocharis cylindrostachys*		
Fabaceae (Caesalpinioideae)	*Gleditsia triacanthos**	Honey Locust	
Fabaceae (Caesalpinioideae)	*Senna pendula var. glabrata**	Cassia	
Fabaceae (Faboideae)	*Daviesia genistifolia*	Broom Bitter Pea	
Fabaceae (Faboideae)	*Desmodium varians*	Slender Tick-trefoil	
Fabaceae (Faboideae)	*Dillwynia sieberi*		
Fabaceae (Faboideae)	*Glycine tabacina*	Glycine	
Fabaceae (Faboideae)	*Hardenbergia violacea*	False Sarsaparilla	
Fabaceae (Faboideae)	*Indigofera australis*	Australian Indigo	
Fabaceae (Faboideae)	*Kennedia rubicunda*	Red Kennedy Pea	
Fabaceae (Faboideae)	*Lotus corniculatus**	Birds-foot Trefoil	
Fabaceae (Faboideae)	*Pultenaea microphylla*		
Fabaceae (Faboideae)	*Trifolium repens**	White Clover	
Fabaceae (Faboideae)	*Vicia sp.**	Vetch	
Fabaceae (Mimosoideae)	*Acacia decurrens*	Black Wattle, Green Wattle	
Fabaceae (Mimosoideae)	*Acacia falcata*		
Fabaceae (Mimosoideae)	*Acacia linifolia*	Flax-leaved Wattle	
Goodeniaceae	*Goodenia hederacea*	Ivy Goodenia	
Haloragaceae	*Myriophyllum aquaticum**	Parrots Feather, Brazilian Water-milfoil	
Juncaceae	*Juncus cognatus**		
Juncaceae	*Juncus subsecundus*		
Juncaceae	*Juncus usitatus*		
Juncaginaceae	*Triglochin microtuberosum*		
Lamiaceae	*Ajuga australis*	Austral Bugle	
Lamiaceae	*Scutellaria humilis*	Dwarf Skullcap	
Lobeliaceae	*Pratia purpurascens*	Whiteroot	
Lomandraceae	*Lomandra filiformis*		
Lomandraceae	*Lomandra longifolia*	Spiny-headed Mat-rush	
Lomandraceae	*Lomandra multiflora*	Many-flowered Mat-rush	
Malvaceae	*Malva sp.**		

Family	Botanical Name	Common Name	Noxious Weed Class
Malvaceae	*Pavonia hastata*		
Malvaceae	*Sida rhombifolia**	Paddy's Lucerne	
Meliaceae	*Melia azedarach*	White Cedar	
Myoporaceae	*Eremophila debilis*	Amulla	
Myrtaceae	*Angophora floribunda*	Rough-barked Apple	
Myrtaceae	*Callistemon salignus*	Willow Bottlebrush	
Myrtaceae	*Eucalyptus amplifolia*	Cabbage Gum	
Myrtaceae	*Eucalyptus crebra*	Narrow-leaved Ironbark	
Myrtaceae	*Eucalyptus eugenioides*	Thin-leaved Stringybark	
Myrtaceae	*Eucalyptus fibrosa*	Red Ironbark	
Myrtaceae	*Eucalyptus moluccana*	Grey Box	
Myrtaceae	*Eucalyptus tereticornis*	Forest Red Gum	
Myrtaceae	*Kunzea ambigua*	Tick Bush	
Myrtaceae	*Melaleuca decora*		
Myrtaceae	*Melaleuca linariifolia*	Flax-leaved Paperbark	
Myrtaceae	*Melaleuca styphelioides*	Prickly-leaved Tea Tree	
Oleaceae	*Ligustrum lucidum**	Large-leaved Privet	C4
Oleaceae	*Ligustrum sinense**	Small-leaved Privet	C4
Oleaceae	*Olea europaea ssp. cuspidata**	African Olive	C4
Oxalidaceae	*Oxalis corniculata**	Creeping Oxalis	
Oxalidaceae	*Oxalis perennans*		
Philydraceae	*Philydrum lanuginosum*	Frogsmouth	
Phormiaceae	*Dianella caerulea*	Blue Flax-lily	
Phormiaceae	*Dianella sp.*		
Phyllanthaceae	*Phyllanthus virgatus*		
Pittosporaceae	*Bursaria spinosa var. spinosa*		
Plantaginaceae	*Plantago gaudichaudii*		
Plantaginaceae	*Plantago lanceolata**	Lamb's Tongues	
Poaceae	*Aristida ramosa*	Purple Wiregrass	
Poaceae	*Austrodanthonia sp.*		
Poaceae	*Austrostipa sp.*		
Poaceae	*Austrostipa verticillata*	Slender Bamboo Grass	
Poaceae	*Avena barbata**	Bearded Oats	
Poaceae	*Axonopus fissifolius**	Narrow-leafed Carpet Grass	
Poaceae	*Bothriochloa macra*	Red Grass	
Poaceae	*Briza maxima**	Quaking Grass	
Poaceae	*Briza minor**	Shivery Grass	
Poaceae	*Briza subaristata**		
Poaceae	*Bromus cartharticus**	Prairie Grass	
Poaceae	*Chloris truncata*	Windmill Grass	
Poaceae	*Chloris ventricosa*	Tall Chloris	
Poaceae	*Chloris virgata**	Feathertop Rhodes Grass	
Poaceae	*Cynodon dactylon**	Common Couch	
Poaceae	*Cynosurus cristatus**	Crested Dog's Tail	
Poaceae	*Dichelachne sp.*		

Family	Botanical Name	Common Name	Noxious Weed Class
Poaceae	*Echinopogon caespitosus*	Bushy Hedgehog Grass	
Poaceae	*Echinopogon ovatus*	Forest Hedgehog Grass	
Poaceae	*Ehrharta erecta**	Panic Veldtgrass	
Poaceae	*Eragrostis brownii*	Brown's Lovegrass	
Poaceae	*Eragrostis curvula**	African Lovegrass	
Poaceae	*Eragrostis leptostachya*	Paddock Lovegrass	
Poaceae	*Lachnagrostis filiformis*	Blown Grass	
Poaceae	*Lolium perenne**	Perennial Ryegrass	
Poaceae	*Microlaena stipoides var. stipoides*		
Poaceae	*Paspalum dilatatum**	Paspalum	
Poaceae	*Pennisetum clandestinum**	Kikuyu Grass	
Poaceae	*Sporobolus creber*	Slender Rat's Tail Grass	
Poaceae	*Themeda australis*	Kangaroo Grass	
Polygonaceae	*Persicaria decipiens*	Spotted Knotweed	
Polygonaceae	*Rumex crispus**	Curled Dock	
Pontederiaceae	*Eichhornia crassipes**	Water Hyacinth	C3
Primulaceae	*Anagallis arvensis**	Scarlet/Blue Pimpernel	
Proteaceae	*Grevillea juniperina subsp. juniperina*	Juniper-leaved Grevillea	
Proteaceae	*Grevillea robusta*	Silky Oak	
Proteaceae	*Hakea sericea*	Needlebush	
Ranunculaceae	*Clematis aristata*	Old Man's Beard	
Rosaceae	*Rosa rubiginosa**	Sweet Briar	
Rosaceae	*Rubus fruticosus sp. agg.**	Blackberry complex	C4
Rubiaceae	*Asperula conferta*		
Rubiaceae	*Opercularia diphylla*		
Salicaceae	*Salix sp.**	Willow	C5
Santalaceae	*Exocarpus cupressiformis*	Native Cherry	
Sapindaceae	*Dodonaea viscosa sp. cuneata*		
Scrophulariaceae	*Veronica plebeia*	Trailing Speedwell	
Solanaceae	*Cestrum parqui**	Green Cestrum	C3
Solanaceae	*Lycium ferocissimum**	African Boxthorn	C4
Solanaceae	*Solanum linnaeanum**	Apple of Sodom	
Solanaceae	*Solanum mauritianum**	Wild Tobacco Bush	
Solanaceae	*Solanum nigrum**	Black-berry Nightshade	
Solanaceae	*Solanum prinophyllum*	Forest Nightshade	
Solanaceae	*Solanum pseudocapsicum**	Madeira Winter Cherry	
Stackhousiaceae	*Stackhousia viminea*	Slender Stackhousia	
Verbenaceae	*Verbena bonariensis**	Purpletop	
Verbenaceae	*Verbena rigida**	Veined Verbena	

* denotes exotic species

FAUNA LIST

Fauna Group	Scientific Name	Common Name
	Crinia signifera	Common Eastern Froglet
Frogs	*Limnodynastes peronii*	Brown-striped Frog
Birds	*Acridotheres tristis*	Common Myna
	Ardea picata	Pied Heron
	Cacatua galerita	Sulphur-crested Cockatoo
	Cacatua sanguinea	Little Corella
	Chenonetta jubata	Australian Wood Duck
	Corcorax melanorhamphos	White-winged Chough
	Cygnus atratus	Black Swan
	Dacelo novaeguineae	Laughing Kookaburra
	Eolophus roseicapillus	Galah
	Falco cenchroides	Nankeen Kestrel
	Gallinula tenebrosa	Dusky Moorhen
	Hirundo neoxena	Welcome Swallow
	Manorina melanocephala	Noisy Miner
	Platalea flavipes	Yellow-billed Spoonbill
	Podargus strigoides	Tawny Frogmouth
	Rhipidura leucophrys	Willie Wagtail
	Strepera graculina	Pied Currawong
	Threskiornis molucca	Australian White Ibis
	Trichoglossus haematodus	Rainbow Lorikeet
	Turdus merula	Eurasian Blackbird
	Vanellus miles	Masked Lapwing
	Austronomus australis	
	Chalinolobus gouldii	Gould's Wattled Bat
	Chalinolobus morio	Chocolate Wattled Bat
	Miniopterus schreibersii oceanensis	Eastern Bentwing-bat
	Mormopterus norfolkensis	Eastern Freetail-bat
	Mormopterus planiceps	Little Mastiff-bat
	Mormopterus spp.	
	Myotis macropus	Southern Myotis
	Nyctophilus spp	
	*Oryctolagus cuniculus**	Rabbit
	Scoteanax rueppellii	Greater Broad-nosed Bat
Mammals	*Vulpes vulpes**	Fox
Reptiles	*Lampropholis delicata*	Dark-flecked Garden Sunskink

* denotes exotic species

Appendix E Likelihood Table for Threatened Species

This table contains an assessment of the likelihood of

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
Acacia bynoeana	Bynoe's Wattle	E	V	The species is found in central eastern NSW, from the Hunter District (Morisset) south to the Southern Highlands and west to the Blue Mountains. It has recently been found in the Colymea and Parma Creek areas west of Nowra (DECC 2007). It is found in heath and dry sclerophyll forest, typically on a sand or sandy clay substrate, often with ironstone gravels (DECC 2007). The species seems to prefer open and sometimes slightly disturbed sites (DECC 2007). Characteristic overstorey species include: *Corymbia gummifera*, *Eucalyptus haemastoma*, *E. gummifera, E. parramattensis*, *E. sclerophylla*, *Banksia serrata* and *Angophora bakeri*. Shrubs often associated with the species include *B. spinulosa*, *B. serrata, A. oxycedrus*, *A. myrtifolia* and *Kunzea* spp. (Winning 1992; James 1997). It flowers from September to March and fruits mature in November.	Unlikely
Acacia pubescens		V	V	Associated with on Cumberland Plains Woodlands, Shale / Gravel Forest and Shale / Sandstone Transition Forest. Clay soils, often with ironstone gravel (NPWS 1997, Benson and McDougall 1996).	Potential
Allocasuarina glareicola		E	E	Grows on tertiary alluvial gravels, with yellow clayey subsoil and lateritic soil. These soils are low in fertility and are strongly to very strongly acidic. It is found in the Castlereagh open woodland community, *with Eucalyptus parramattensis, E. fibrosa, E. sclerophylla, Angophora bakeri* and *Melaleuca decora*.	Unlikely

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
Dillwynia tenuifolia		V	V	It 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 (DECC 2007). May also be common in the ecotone between these areas and Castlereagh Scribbly Gum Woodland (*ibid.*).	Previously recorded on site (Wildlife Atlas)
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 (NSW Scientific Committee 2000).	Recorded onsite
Marsdenia viridiflora subsp. *viridiflora*	*Marsdenia viridiflora* R. Br. subsp. *viridiflora* population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas	E2		This Endangered Population of *Marsdenia viridiflora* subsp. *viridiflora* occurs in the Prospect, Bankstown, Smithfield, Cabramatta Creek and St Marys areas of western Sydney. It grows in vine thickets and open shale woodland (DEC 2005).	Unlikely
Melaleuca deanei	Deane's Paperbark	V	V	Found in heath on sandstone (DECC 2007), and also associated with woodland on broad ridge tops and slopes on sandy loam and lateritic soils (Benson and McDougall 1998).	Unlikely
Micromyrtus minutiflora		E	V	Grows in Castlereagh Scribbly Gum Woodland, Ironbark Forest, Shale/Gravel Transition Forest, open forest on tertiary alluvium and consolidated river sediments (DEC, 2007).	Previously recorded on site (Wildlife Atlas)
Persoonia nutans		E	E	Associated with dry woodland, Castlereagh Scribbly Gum Woodland, Agnes Banks Woodland and sandy soils associated with tertiary alluvium, occasionally poorly drained (Benson and McDougall 2000). Endemic to the Western Sydney (Benson and McDougall 2000).	Potential

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
Pimelea curviflora var curviflora		V	-	Associated with the Duffys Forest Community, shale lenses on ridges in Hawkesbury sandstone geology (Pittwater Council 2000).	Unlikely
Pimelea spicata		E	E	In western Sydney, it occurs on an undulating topography of well structured clay soils, derived from Wianamatta shale (DEC 2004). 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.*).	Potential
Pultenaea parviflora		E	V	May be locally abundant, particularly within scrubby/dry heath areas within Castlereagh Ironbark Forest and Shale Gravel Transition Forest on tertiary alluvium or laterised clays (DECC 2007). May also be common in ecotone between these communities and Castlereagh Scribbly Gum Woodland (*ibid.*). *Eucalyptus fibrosa* is usually the dominant canopy species (*ibid.*). *E. globoidea, E. longifolia, E. parramattensis, E. sclerophylla and E. sideroxylon* may also be present or co-dominant, with *Melaleuca decora* frequently forming a secondary canopy layer (*ibid.*). Associated species may include *Allocasuarina littoralis, Angophora bakeri, Aristida spp. Banksia spinulosa, Cryptandra spp., Daviesia ulicifolia, Entolasia stricta, Hakea sericea, Lissanthe strigosa, M. nodosa, Ozothamnus diosmifolius* and *Themeda australis* (*ibid.*). Often found in association with other threatened species such as *Dillwynia tenuifolia, Dodonaea falcata, Grevillea juniperina, Micromyrtus minutiflora, Persoonia nutans* and *Styphelia laeta* (*ibid.*).	Previously recorded on site (Wildlife Atlas)
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 (Environment Australia 2000).	Unlikely

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
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 (DECC 2007). 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 (DECC 2007). 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) (DECC 2007).	Unlikely
BIRDS					
Anthochaera phrygia	Regent Honeyeater	E	E	Associated with temperate eucalypt woodland and open forest including forest edges, wooded farmland and urban areas with mature eucalypts, and riparian forests of River Oak (*Casuarina cunninghamiana*) (Garnett 1993). Areas containing Swamp Mahogany (*Eucalyptus robusta*) in coastal areas have been observed to be utilised (NPWS 1997). The Regent Honeyeater primarily feeds on nectar from box and ironbark eucalypts and occasionally from banksias and mistletoes (NPWS 1995). As such it is reliant on locally abundant nectar sources with different flowering times to provide reliable supply of nectar (Environment Australia 2000).	Potential
Botaurus poiciloptilus	Australasian Bittern	V	-	Terrestrial wetlands with tall dense vegetation, occasionally estuarine habitats (Marchant & Higgins 1993). Reedbeds, swamps, streams, estuaries (Simpson & Day 1999).	Unlikely

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
Calyptorhynchus lathami	Glossy Black-Cockatoo	V	—	Associated with a variety of forest types containing Allocasuarina species, usually reflecting the poor nutrient status of underlying soils (Environment Australia 2000; NPWS 1997; DECC 2007). Intact drier forest types with less rugged landscapes are preferred (DECC 2007). Nests in large trees with large hollows (Environment Australia 2000).	Unlikely
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 (BIB, 2006)	Potential
Ephippiorhynchus asiaticus	Black-necked Stork	E	—	Associated with tropical and warm temperate terrestrial wetlands, estuarine and littoral habitats, and occasionally woodlands and grasslands floodplains (Marchant & Higgins 1993). Forages in fresh or saline waters up to 0.5m deep, mainly in open fresh waters, extensive sheets of shallow water over grasslands or sedgeland, mangroves, mudflats, shallow swamps with short emergent vegetation and permanent billabongs and pools on floodplains (Marchant & Higgins 1993; DECC 2007).	Unlikely
Glossopsitta pusilla	Little Lorikeet	V	—	In New South Wales Little Lorikeets are distributed in forests and woodlands from the coast to the western slopes of the Great Dividing Range, extending westwards to the vicinity of Albury, Parkes, Dubbo and Narrabri. Little Lorikeets mostly occur in dry, open eucalypt forests and woodlands. They have been recorded from both old-growth and logged forests in the eastern part of their range, and in remnant woodland patches and roadside vegetation on the western slopes. They feed primarily on nectar and pollen in the tree canopy, particularly on profusely-flowering eucalypts, but also on a variety of other species including melaleucas and mistletoes. On the western slopes and tablelands White Box Eucalyptus albens and Yellow Box E. melliodora are particularly important food sources for pollen and nectar respectively.	Unlikely

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
Grantiella picta	Painted Honeyeater	V	—	A nomadic species that typically inhabits Boree, Brigalow and Box-Gum Woodlands and Box-Ironbark Forests with abundant mistletoe (DECC 2007). It is a specialist feeder on the fruits of mistletoes growing on woodland eucalypts and acacias, preferring Amyema sp mistletoe (DECC 2007).	Unlikely
Hieraaetus morphnoides	Little Eagle	V	—	The Little Eagle is widespread in mainland Australia, central and eastern New Guinea. The Little Eagle is seen over woodland and forested lands and open country, extending into the arid zone. It tends to avoid rainforest and heavy forest (BIB, 2006).	Potential
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)* (DECC 2007).	Potential
Lophoictinia isura	Square-tailed Kite	V	-	In coastal areas associated tropical and temperate forests and woodlands on fertile soils with an abundance of passerine birds (Marchant & Higgins 1993, DECC 2007). May be recorded inland along timbered watercourses (DECC 2007). In NSW it is commonly associated with ridge or gully forests dominated by Woollybutt (*Eucalyptus logifloria*), Spotted Gum (*E. maculata*), or Peppermint Gum (*E. elata, E. smithii*) (DECC 2007).	Unlikely
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)	V	-	Predominantly associated with box-ironbark association woodlands and River Red Gum (NSW Scientific Committee, 2001). Also associated with drier coastal woodlands of the Cumberland Plain and the Hunter, Richmond and Clarence Valleys (NSW Scientific Committee, 2001).	Unlikely
Ninox strenua	Powerful Owl	V	-	Pairs occupy large, probably permanent home ranges in forests to woodlands. Nest in large hollow.	Unlikely

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
Oxyura australis	Blue-billed Duck	V	—	The Blue-billed Duck prefers deep water in large permanent wetlands and swamps with dense aquatic vegetation (DECC 2007). The species is completely aquatic, swimming low in the water along the edge of dense cover (DECC 2007). It will fly if disturbed, but prefers to dive if approached (DECC 2007). Blue-billed Ducks are partly migratory, with short-distance movements between breeding swamps and over-wintering lakes with some long-distance dispersal to breed during spring and early summer (DECC 2007). Young birds disperse in April-May from their breeding swamps in inland NSW to non-breeding areas on the Murray River system and coastal lakes (DECC 2007).	Unlikely
Petroica boodang	Scarlet Robin	V	—	The Scarlet Robin is found in south-eastern and south-western Australia, as well as on Norfolk Island. In Australia, it is found south of latitude 25°S, from south-eastern Queensland along the coast of New South Wales (and inland to western slopes of Great Dividing Range) to Victoria and Tasmania, and west to Eyre Peninsula, South Australia; it is also found in south-west Western Australia. The Scarlet Robin lives in open forests and woodlands in Australia, while it prefers rainforest habitats on Norfolk Island. During winter, it will visit more open habitats such as grasslands and will be seen in farmland and urban parks and gardens at this time (BIB, 2006).	Potential
Petroica phoenicea	Flame Robin	V	—	Breeds in upland tall moist eucalypt forests and woodlands, often on ridges and slopes, often on ridges and slopes, in NSW. Prefers clearings or areas with open understoreys, and grassy groundlayer for breeding habitat. Will often occur in recently burnt areas. Shrub density does not appear to be an important habitat factor. Many birds move to the inland slopes and plains in winter, or to drier more open habitats in the lowlands.	Unlikely

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
Pyrrholaemus sagittatus	Speckled Warbler	V	—	Occupies a wide range of eucalypt dominated communities with a grassy understorey, often on rocky ridges or in gullies (DECC 2007). Typical habitat would include scattered native tussock grasses, a sparse shrub layer, some eucalypt regrowth and an open canopy (DECC 2007). Large, relatively undisturbed remnants are required for the species to persist in an area (DECC 2007). Pairs are sedentary and occupy a breeding territory of about ten hectares, with a slightly larger home-range when not breeding (DECC 2007).	Unlikely
Tyto tenebricosa	Sooty Owl	V	—	Sooty Owls are associated with tall wet old growth forest on fertile soil with a dense understorey and emergent tall Eucalyptus species (Environment Australia 2000, Debus 1994). Pairs roost in the daytime amongst dense vegetation, in tree hollows and sometimes in caves. The Sooty Owl is typically associated with an abundant and diverse supply of prey items and a selection of large tree hollows (Debus 1994, Garnett 1993, Hyem 1979).	Unlikely
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; DECC 2007j), 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 (DECC 2007). Maternal den sites are logs with cryptic entrances; rock outcrops; windrows; burrows (Environment Australia 2000).	Unlikely
Phascolarctos cinereus	Koala	V	—	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. Some preferred Eucalyptus species are *Eucalyptus tereticornis, E. punctata, E. cypellocarpa, E. viminalis.*	Unlikely

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
Petaurus australis	Yellow-bellied Glider	V	-	This species is restricted to tall mature forests, preferring productive tall open sclerophyll forests with a mosaic of tree species including some that flower in winter (Environment Australia 2000, Braithwaite 1984, Davey 1984, Kavanagh 1984; DECC 2007). Large hollows within mature trees are required for shelter, nesting and breeding (Henry and Craig 1984; DECC 2007).	Unlikely
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; DECC 2007). 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; DECC 2007).	Unlikely
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	—	Prefers moist habitats with trees taller than 20m (DECC 2007). Roosts in tree hollows but has also been found roosting in buildings or under loose bark (DECC 2007).	Unlikely
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 (Environment Australia 2000, Dwyer 1995).	Recorded on site
Mormopterus norfolkensis	East Coast 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).	Recorded on site

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
Myotis macropus	Large-footed Myotis	V	—	Will occupy most habitat types such as mangroves, paperbark swamps, riverine monsoon forest, rainforest, wet and dry sclerophyll forest, open woodland and River Red Gum woodland, as long as they are close to water (Churchill 1998). While roosting is most commonly associated with caves, this species has been observed to roost in tree hollows, amongst vegetation, in clumps of Pandanus, under bridges, in mines, tunnels and stormwater drains (Churchill 1998). However the species apparently has specific roost requirements, and only a small percentage of available caves, mines, tunnels and culverts are used (Richards 1998).	Recorded on site
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).	Likely
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	—	Found in almost all habitats, from wet and dry sclerophyll forest, open woodland (Churchill 1998), open country, mallee, rainforests, heathland and waterbodies (SFNSW 1995). Roosts in tree hollows; may also use caves; has also been recorded in a tree hollow in a paddock (Environment Australia 2000) and in abandoned sugar glider nests (Churchill 1998). The Yellow-bellied Sheathtail-bat is dependent on suitable hollow-bearing trees to provide roost sites, which may be a limiting factor on populations in cleared or fragmented habitats (Environment Australia 2000).	Unlikely
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).	Recorded on site
INVERTEBRATES					

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
Meridolum corneovirens	Cumberland Plain 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 (NSW NPWS 1997; Rudman 1998).	Previously recorded on site (Wildlife Atlas)
Disclaimer: Data extracted from the Atlas of NSW Wildlife is only indicative and cannot be considered a comprehensive inventory.					
E = Endangered; E2 = Endangered Population; V = Vulnerable					

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