Area 20 Precinct Planning Study

Riparian Assessment

Prepared for
Department of Planning

November 2010

DOCUMENT TRACKING

ITEM	DETAIL
Project Name	Area 20 Precinct Riparian Constraints Assessment
Project Number	0144-0017
Prepared by	DJ
	KL, KK
Approved by	DJ, DB
Status	Final
Version Number	1
Last saved on	11 November 2010

Contents

List of Figures

List of Tables

1 Introduction

1.1 DESCRIPTION OF THE PROJECT

Eco Logical Australia Pty Ltd (ELA) was engaged by Department of Planning (DoP) to undertake an Ecological Assessment and a Riparian Assessment of approximately 245ha that forms the Area 20 precinct in Rouse Hill. This report fulfils the riparian assessment component of the overall Biodiversity Study for the precinct. The aim of this riparian assessment is to identify key riparian constraints, assess the impact and provide recommendations for the Draft Indicative Layout Plan (herein referred to as the ILP).

In conjunction with the biodiversity assessment, the objectives of this project are to:

- Undertake a strategic biodiversity assessment including a flora and fauna study, an analysis of ecological values and identification and high-quality mapping of areas of high, moderate and low ecological value.
- 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 the Growth Centres SEPP.
- Ensure that precinct planning is consistent with the terms of any biodiversity certification granted to the SEPP.

This report demonstrates the objectives are achieved through;

- Methodology that includes a literature review of previous work, terrestrial aquatic and geomorphic field assessment, and ecological constraints analysis.
- 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 SEPP Biocertification, Water Management Act, Fisheries Management Act.

Specifically, this riparian assessment includes;

- Refinement of Department of Environment Climate Change and Water's (DECCW) strategic assessment of riparian lands
- Riparian corridor mapping
- Consultation with DECCW
- Potential planning controls for riparian lands
- Targeted assessment and recommendations for the ILP

1.2 STUDY AREA

The Area 20 precinct is located in Rouse Hill, within the eastern portion of the North West Growth Centre, and has been identified as suitable for higher density housing. The proposed North West Rail Link traverses the precinct in the south. Planning for the precinct is underway and involves the preparation of numerous planning documents, including a Development Control Plan and an amendment of the SEPP (Sydney Regional Growth Centres) to facilitate the formal rezoning of the site.

The study area includes approximately 245ha of land that is bounded to the east by Windsor Road and Schofields Road to the south with Second Ponds Creek flowing north-east through the centre of the site.

Figure 1Figure 1 illustrates the broad location of the study area. The study area incorporates a number of landowners, including Blacktown City Council, DECC (Rouse Hill Regional Parklands), Sydney Water and numerous private landowners.

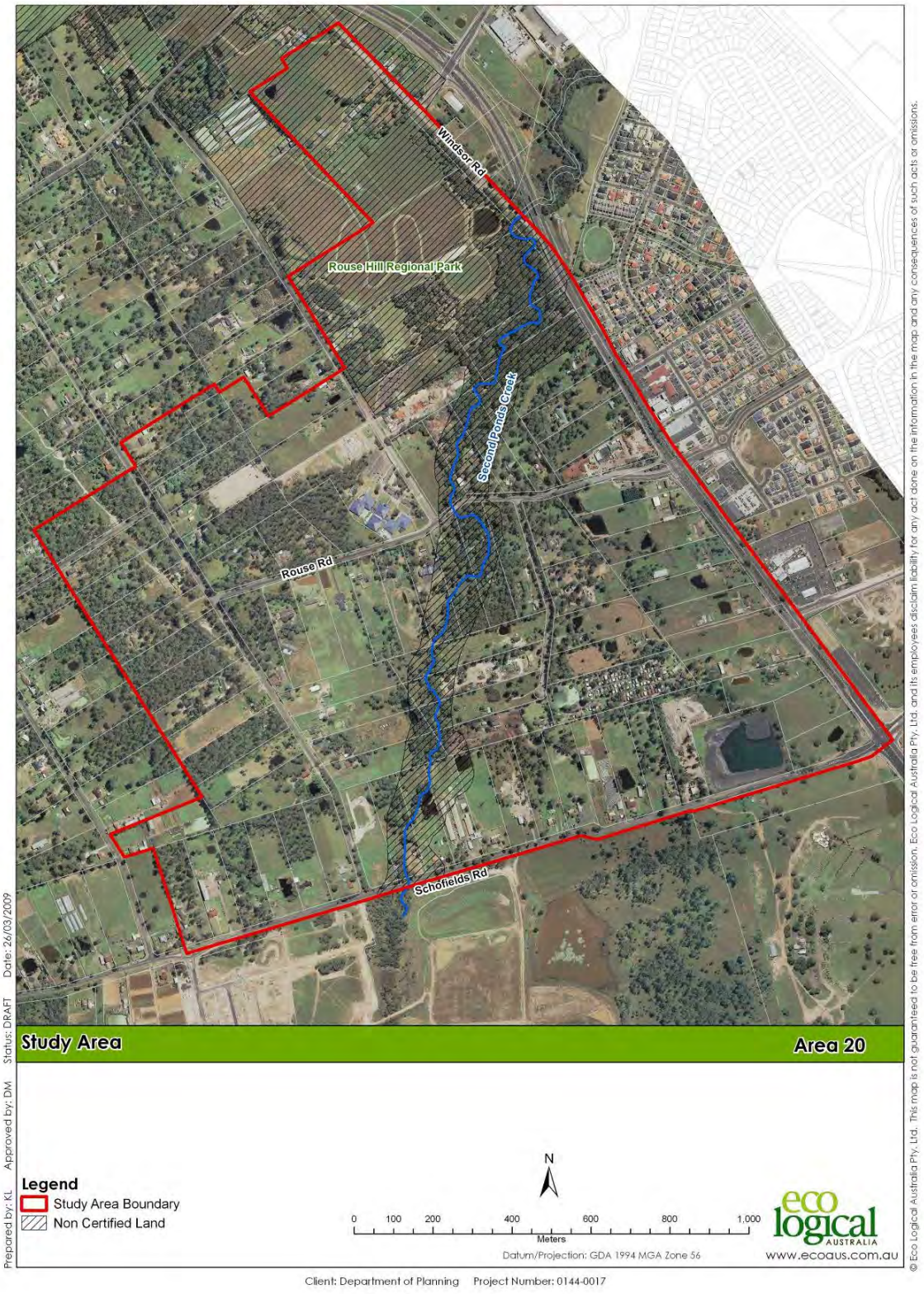


Figure 1: Study area

1.3 STATUTORY FRAMEWORK

A substantial array of legislation, policies and guidelines apply to the assessment, planning and management of ecological values within the study area. This information was reviewed and used to identify priority constraints and opportunities within the study area (Refer also to Appendix A: Detailed Statutory Framework and the ELA Biodiversity Assessment Report). Legislation and policies reviewed included:

Commonwealth

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

State

- Environmental Planning and Assessment Act 1979 (EP&A Act)
- Threatened Species Conservation Act 1995 (TSC Act)
- State Environmental Planning Policy (Sydney Region Growth Centres) 2006 (Growth Centres SEPP)
- Threatened Species Conservation Amendment (Special Provisions) Act 2008
- Fisheries Management Act 1994 (FM Act)
- Water Management Act 2000 (WM Act)
- Noxious Weeds Act 1993
- Rural Fires Act 1997 (RF Act)
- Planning for Bushfire Protection 2006
- Protection of the Environment Operations Act 1997
- Catchment Management Act 1989
- Sydney Regional Environmental Plan No 20 – Hawkesbury-Nepean River (No 2 – 1997)
- State Environmental Planning Policy No.19 – Bushland in Urban Areas
- NSW Biodiversity Strategy 1999
- Growth Centres Development Code 2006
- Growth Centres Conservation Plan 2007

Local

- Blacktown City Council Local Environmental Plan 1988
- Blacktown city Council Growth Centre Precincts Development control Plan 2010

1.3.1 Literature Review

A desktop literature review was undertaken by ELA to determine the location and extent of previous surveys, identify the potential drainage lines 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 and that would contribute to the value of the riparian corridors. 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 DECC Wildlife Atlas database

- EPBC online Protected Matters Database Search
- 'Rouse Hill Infrastructure Project, Water, Sewerage and Trunk Drainage Flora and Fauna Assessments prepared by Gunninah Environmental Consultants (2002 and 2003)
- '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).

2 Methods

2.1 FIELD INVESTIGATIONS AND DESKTOP MAPPING

The riparian categorisation and corridor mapping has been carried out in accordance with the requirements in the Growth Centres Development Code. A desktop categorisation of riparian areas across the Growth Centres was undertaken by the former DNR as part of the Managing Sydney's Urban Growth project. Eco Logical Australia has used this as the basis for validating riparian categories at the site and refined these where appropriate, in consultation with DoP, DECCW.

The key outcome of this assessment is to classify rivers that are to be retained into the categories identified below. Drainage lines that are not classified are deemed to be of limited riparian value and are therefore suitable for engineered drainage solutions.

An initial field inspection with DECCW, DoP, Blacktown City Council and Sydney Water was carried out on Monday 2nd March 2009, to determine which of the drainage lines on site are consistent with the definition of a river under the WM Act, require top of bank (TOB) survey and how they should be categorised. Refer to Figure 2 for drainage lines which were investigated. Stream number 4 and 3 (between stream 4 and Terry Road only) were found to be rivers and worthy of further investigation. Refer to Appendix B for meeting minutes.

A survey of the TOB for the identified rivers was conducted by a geomorphologist with a differential GPS (accuracy 50cm-70cm) in areas where access had been granted by the land owner. In areas where access had not been granted at the time of the field visit a desktop method was used to delineate TOB, including the analysis of high resolution aerial photos, 50cm contours and existing topographic map data.

The TOB mapping has been used as the basis for the initial riparian buffer delineation and riparian corridor boundaries. The aquatic habitat condition was assessed, along with the condition of the river using the method outlined in Geomorphic Categorisation of Streams in the Hawkesbury Nepean Catchment (DLWC 2000) document, classifying the condition of streams into one of the following categories:

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

The streams within the study area were tagged and assigned a value from 1 to 3 that reflect their relative riparian importance within the catchment. The three riparian categories are;

Category 1 – key environmental corridor

Category 2 – terrestrial and aquatic habitat

Category 3 – bed and bank stability/water quality

The streams and their riparian corridors within the study area were classified into the three categories based on the following features that reflect the relative importance as riparian zones:

- The connectivity and continuity of riparian corridors and natural bushland
- The continuity of open/natural stream channels
- Relative length and location of piped sections
- Current and likely future development
- Potential for riparian corridor maintenance, re-instatement or restoration
- Native vegetation condition, as reflected by the conservation significance assessment carried out as part of this study
- Aquatic and terrestrial habitat value
- Presence of threatened species, populations or communities

A fourth category was created for this assessment, “Potential Engineered Drainage”. The new class is for drainage lines which were not considered to constitute a river. These drainage lines were highly modified, no longer followed any natural channel and may be suitable to become engineered drainage.

Each category has a recommended riparian corridor requirement as specified by DECCW (refer to Table 1). The core riparian zone (CRZ) is the land contained within and adjacent to the channel and the vegetated buffer (VB) is located on the outer edge of the CRZ to protect the environmental integrity of the CRZ. Each has specific objectives and management requirements (refer to Section 4 for further detail).

Calculations of area and width have also been carried out to determine the impact of amending the riparian corridor boundaries to follow the non-certified area boundary through the centre of the precinct.

Table 1: DNR Riparian Categories and Buffer Specifications

Riparian Category	Minimum Riparian Width (measured from top of bank along either side of the watercourse)
Category 1	40m CRZ + 10 m VB
Category 2	20m CRZ + 10m VB
Category 3	10m CRZ (no VB)

*CRZ = Core Riparian Zone, VB = Vegetated Buffer

In addition to the categorisation and TOB mapping, the condition of each reach of the river was also assessed as part of the aquatic habitat survey. The results are presented in this report. For a detailed description of the methodology please refer to the ELA Area 20 Biodiversity Assessment.

In conjunction with the flooding studies a typical “section” of the category 1 stream (Second Ponds Creek) will be identified and plan views and cross sections have been prepared (refer to Appendix C).

2.2 PROPOSED OWNERSHIP AND MANAGEMENT STRUCTURE

DoP carried out extensive analysis of potential ownerships and management options for Second Ponds Creek riparian corridor in order to ensure long term protection of the waterway. This was undertaken due to the overlapping requirements within the creek corridor relating to flooding, drainage, Biodiversity Certification and watercourse stability. . A key consideration in planning for riparian areas was to achieve synergies between these requirements.

In the case of Area 20, Sydney Water is the trunk drainage authority and will acquire the extent of the 100 year ARI floodplain along Second Ponds Creek between Schofields Road and Rouse Hill Regional Park. Sydney Water intends to manage the trunk drainage corridor promoting the natural creek environment, which includes rehabilitation and revegetation works where necessary. Therefore, the majority of the riparian corridor will be brought into public ownership and management in accordance with a Plan of Management for all trunk drainage lands within the Rouse Hill Development Area.

Areas outside of the Sydney Water Corporation trunk drainage corridor will remain in private ownership in the short term. It is understood that these lands may be bought into public ownership by Council and used as open space/local drainage land.

2.3 AGENCY CONSULTATION

Discussions with DECCW and DoP were undertaken to define the riparian corridor boundaries which will be consolidated into Riparian Protection Areas which will be identified in the ILP and contain specific development controls in the DCP. The discussions included the use of the non-certified boundary rather than the standard uniform buffer width requirements of the GC Development Code (further discussed in section 6)

Comments from DECCW dated 27th May 2009 have been incorporated into this report and are illustrated in the results section.

Figure 2: Drainage lines investigated within Area 20

3 Results

3.1 FIELD INVESTIGATIONS AND DESKTOP RIPARIAN CORRIDOR MAPPING

The results of TOB mapping and initial delineation of riparian buffers are provided in Figure 3. The original DNR mapping identified Second Ponds Creek as a category 1 stream. This categorisation was confirmed by field work, with an additional area of Category 1 stream identified east of Second Ponds Creek, near the intersection of Terry Road and Rouse Road.

There were a number of properties which were not accessible during the survey (refer to Figure 4). The TOB was digitised from high resolution aerial imagery and contour data for these areas.

Second Ponds Creek, and the small tributary near the corner of Terry and Rouse Roads, will be treated and managed as a category 1 watercourse with an appropriate core riparian zone width of at least 40m either side of the TOB and 10m vegetated buffer (Figure 3), allowing the corridor to provide a regional habitat function. *The precise riparian corridor boundaries are to be further negotiated with DECCW, and will also be affected by the results of the flooding analysis and masterplan layout.*

The remainder of the drainage lines on site, for which Top of Bank was not captured and which are displayed as Potential Engineered Drainage in Figure 4, were found to be heavily disturbed and modified, including many dams along the length of the drainage lines. Due to their poor condition and lack of natural channel these drainage lines were not allocated a riparian category and are considered suitable to be removed, or utilised as part of stormwater management for the site.

The condition of the overall surveyed length was generally determined to be moderate to degraded, with significant areas of weed infestation and vegetation associations were significantly modified. The channel was highly active along the length of the watercourse, particularly downstream of any in channel blockages. Water quality was also poor, with high loads of sediment present. Refer to Figure 5 and Table 2 for detailed assessment results for each reach.

The preliminary riparian corridor boundaries in Figure 3 are predominantly contained within the non-certified areas of the precinct. The additional riparian corridors situated within the certified areas may slightly reduce the developable area available within the precinct.

3.2 NEGOTIATED RIPARIAN CORRIDOR EXTENT

Following further discussions between DOP and DECCW, an agreement has been reached to the revision of the riparian corridor boundary to follow the non-certified boundary through the precinct and become the riparian protection area given that there will be net gain of riparian area. There are several additional benefits to this approach, including: simplified statutory requirements for Second Ponds Creek, integration with flood line and other uses at the riparian margin, a more regular corridor shape and adjacent road pattern, better integration with local drainage infrastructure and protection of ENV within the riparian corridor.

Figure 6 shows that overall there is a net gain of approximately 1 hectare of riparian land when taking the boundary as the non-certified land boundary. The key findings were;

- The average width of the corridor is 140 m compared to the original 100 m mapped from TOB.
- The original riparian corridor based on exactly 50m either side of TOB has a total area of 17.03ha outside the regional parkland boundary (area inside the park is 6.07ha).
- Non certified boundary area outside the regional parkland is 18.12ha.
- The width of the non-certified area outside the regional parklands ranges from about 98m to 180m with an average or approximately 140m. There will be a number of 'pinch points' along the non-certified boundary (where the TOB comes close to the boundary) of about 20m for the main creek line. The smaller tributary however will be severed.
- The entire non-certified boundary will be managed as per CRZ requirements and there will be no VB, resulting in tighter controls over the entire corridor with no encroachment of development/recreational uses into the riparian protection area.

The results are further discussed with specific reference to ongoing management and planning implications for the rezoning of the site in the following sections.

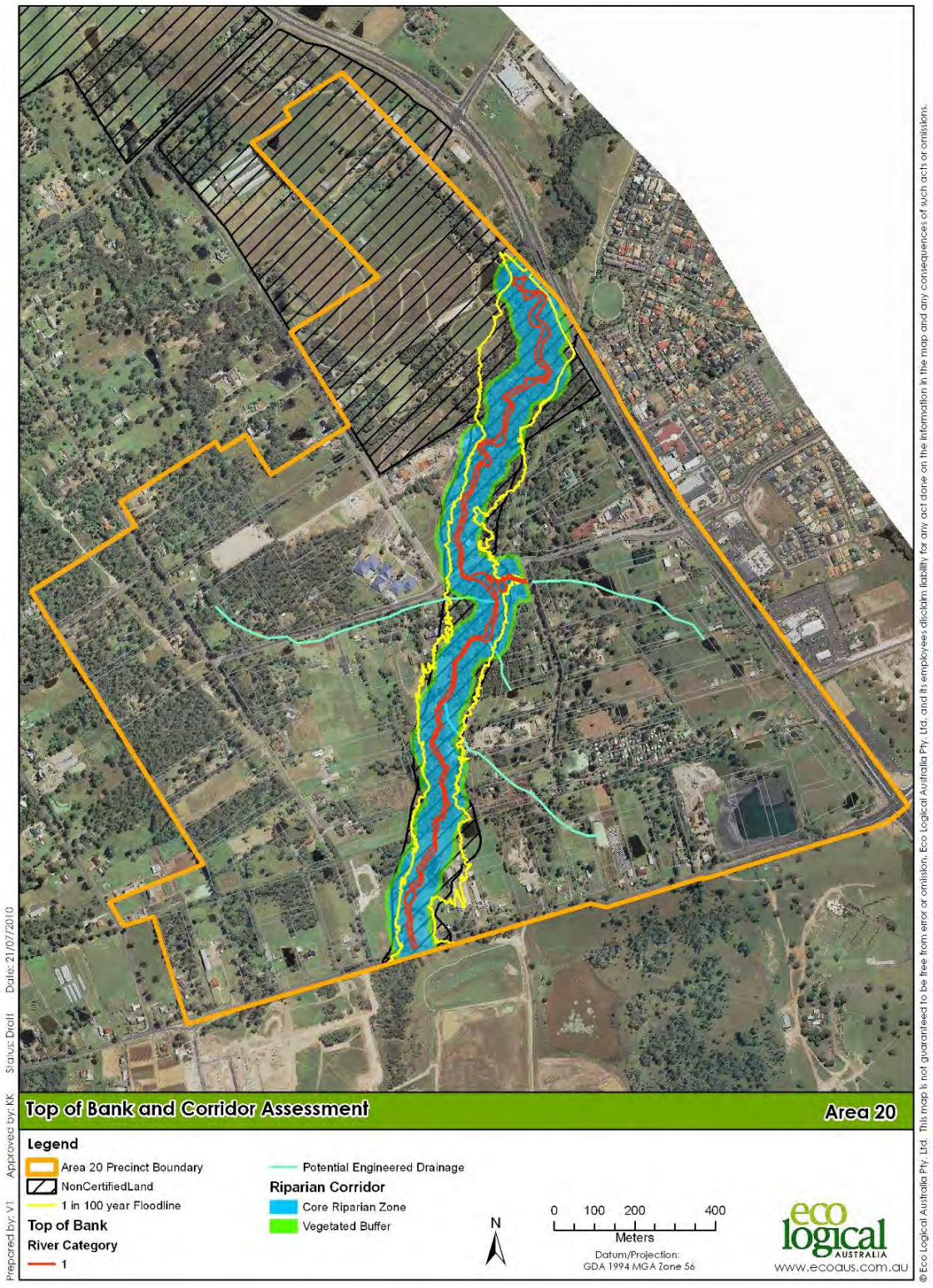


Figure 3: Top of Bank mapping and corridor assessment

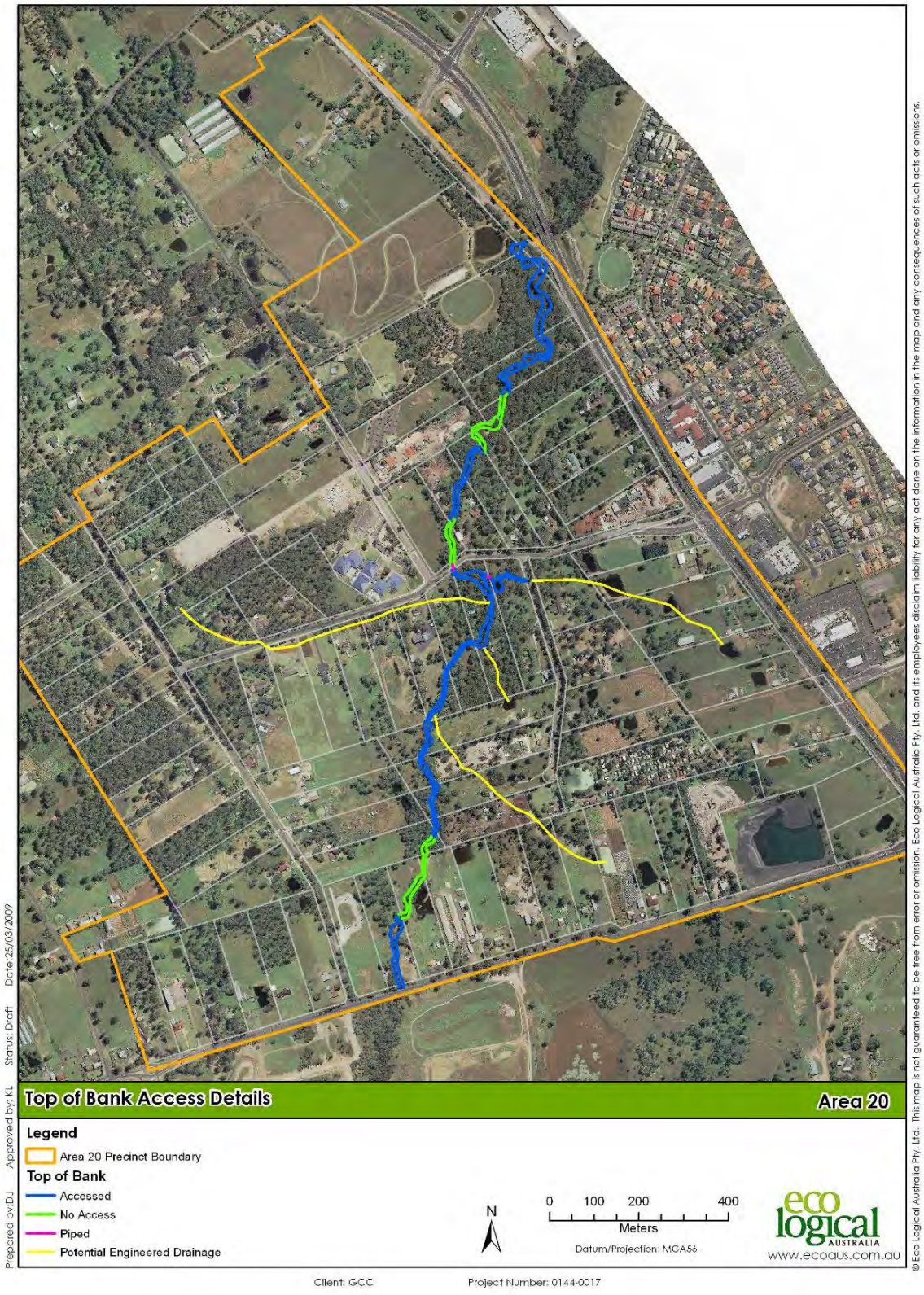


Figure 4: Segments of drainage lines accessible within Area 20

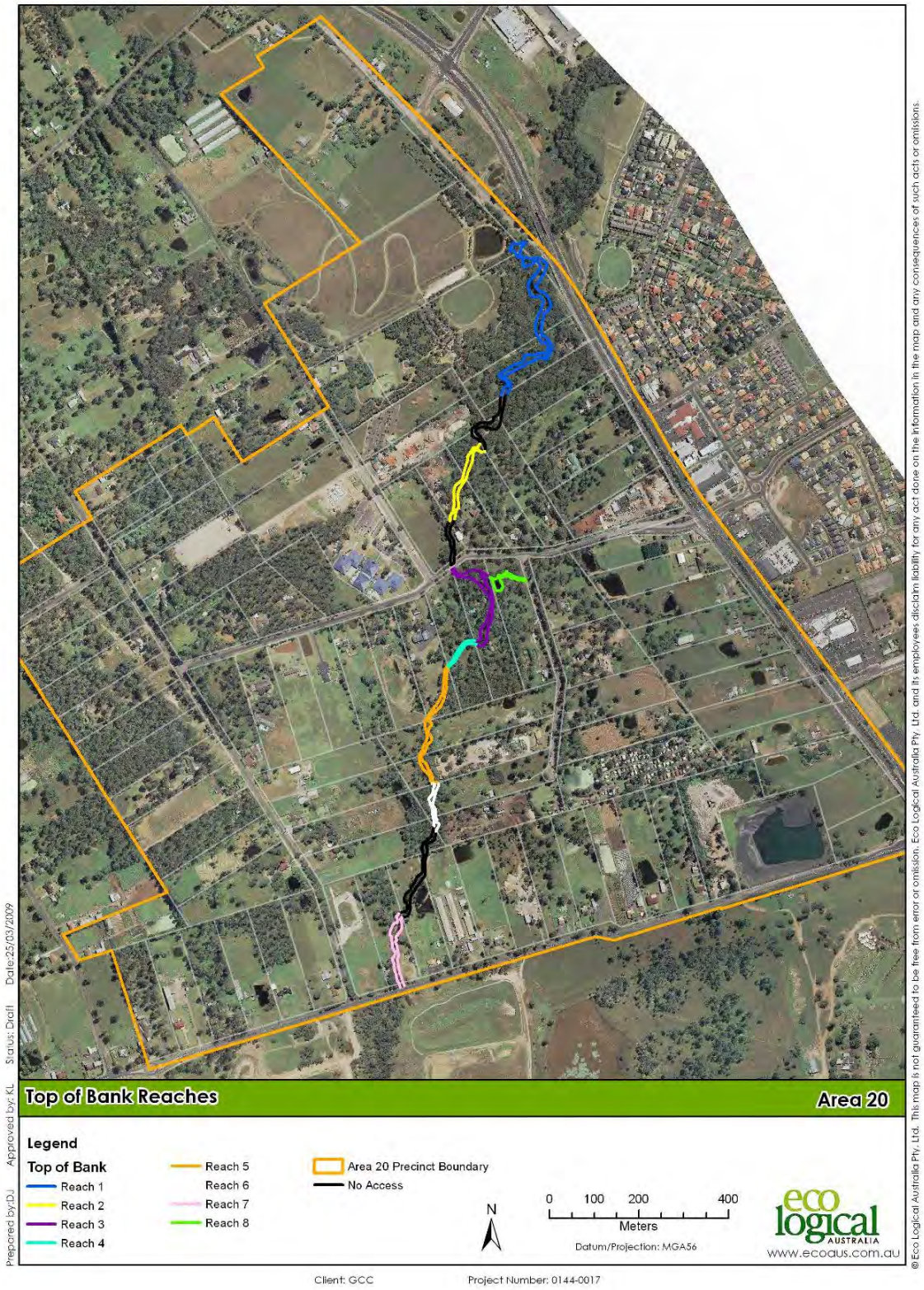


Figure 5: Reaches

Table 2: Reach condition details

Reach No.	Hydrology	Streamside Vegetation	Physical Form	Water Quality and Aquatic Habitat	Overall Rating
1	Regionally modified. Some points of the watercourse have been modified historically these appear to have a moderate effect on flow regime.	Moderate condition: Predominant ground cover is introduced *Tradescantia albiflora* however natives also present. Good native canopy cover and frequent current and past recruitment of *Casuarina glauca* but not *Eucalyptus amplifolia.* Mixed age community. Some developed tracks from recreation activities causing disturbance. Good longitudinal connectivity of canopy.	Previous historic erosion has occurred throughout site. Some continuing erosion of banks around bridge over Windsor Rd. Generally, however, only low to moderate active erosion of muddy banks which are supported by tree roots. Sandstone works have been implemented to prevent erosion along Windsor Rd.	High sediment loads from local and upstream erosion, consistent with other reaches. Bike tracks contributing to sediment loads locally. Presence of native and exotic aquatic macrophytes. Some occasional medium to large native wood offering habitat.	Moderate
2	Regionally modified. Gravel/concrete causeway road crossing affecting flow regime within reach and acting as barrier to low/medium flows.	Thin riparian strip only (approx 5m) and degraded and fragmented by road crossing. Some regeneration of *C.glauca.* Various weeds at different strata levels including Small and Large-leaved Privet and African Olive.	Previous historic erosion has occurred throughout site. Some continuing erosion of banks around road crossing. Generally, however, only low to moderate active erosion of muddy banks which are supported by tree roots.	High sediment loads from local and upstream erosion, consistent with other reaches. Some local erosion around road crossing. Limited large wood.	Moderate
3	Regionally modified. Concrete causeway downstream causing permanent pooling immediately upstream leading to thick aquatic plant growth. Concrete blocks contributing to local hydrology interruption further upstream.	Mostly poor condition of riparian vegetation however good width and extent. Weeds present at various strata levels and some thick and prolific problematic weeds limiting future canopy development in these areas.	Banks well consolidated with vegetation providing stabilisation. Good diversity of instream bed and bank features such as bars and benches.	Occasional instream large/moderate sized wood. Mixture of native and introduced aquatic macrophytes contributing to habitat availability.	Moderate

Reach No.	Hydrology	Streamside Vegetation	Physical Form	Water Quality and Aquatic Habitat	Overall Rating
4	Regionally modified. Introduced concrete pipes interrupting flow.	Thin strip of riparian vegetation on both sides with low canopy cover. Poor condition of vegetation at all strata levels with numerous weeds dominant including *Salix* spp. Some native *Bursaria spinosa* present.	Previous bank modifications have occurred throughout reach though appear moderately stable now.	Thick growth of introduced *Typha orientalis* causing degradation of instream habitat. No large wood.	Degraded
5	Regionally modified. No major barriers to flow within site though there may have been historical modifications.	Relatively thin but continuous strip of riparian vegetation. Better recruitment of canopy species in this reach compared with upstream. Highly weedy ground cover.	Near vertical banks with some undercutting occurring. Generally however banks are well vegetated.	Frequent instream large wood and snags offering good habitat. Occasional aquatic macrophytes present.	Moderate
6	Regionally modified. Some barriers to flow apparently introduced to maintain water levels along sections.	High density of weeds on ground and within other strata. *Cardiospermum grandiflorum* (Balloon Vine) prolific and causing significant damage to canopy and prevention of future condition improvements. Some recruitment outside of weedy areas.	Moderate bank stability. Relatively homogenous structure within reach.	Large wood and snags present though some of these used to change flow regime. Occasional aquatic macrophytes.	Degraded
7	Regionally modified. Piped culvert upstream but does not appear to significantly influence hydrology. Causeway downstream in reach causes unnatural ponding with flow-on effects.	Thin and discontinuous strip of riparian vegetation. Various weed species present but not prolific. Some recent recruitment of *Casuarina glauca.* Mowing occurring adjacent to riparian zone.	Stream channel showing moderate erosion in sections and constriction in others as a result of modified flow and clearing. Erosion somewhat controlled by remaining trees.	Inputs and deposition of sediments and roadwork materials from nearby table drains. Area has been exposed to nearby agricultural runoff with no vegetated buffer.	Degraded

Reach No.	Hydrology	Streamside Vegetation	Physical Form	Water Quality and Aquatic Habitat	Overall Rating
8	Regional modification. Derivation of current drainage line and nearby ponded area unknown.	Weedy vegetation with little canopy cover.	Banks consolidated by thick plant cover, mainly weeds.	Occasional aquatic macrophytes including native species. Growth of filamentous algae and surface scum indicating poor water quality, however this feature acts as a natural sediment basin for downstream.	Degraded.

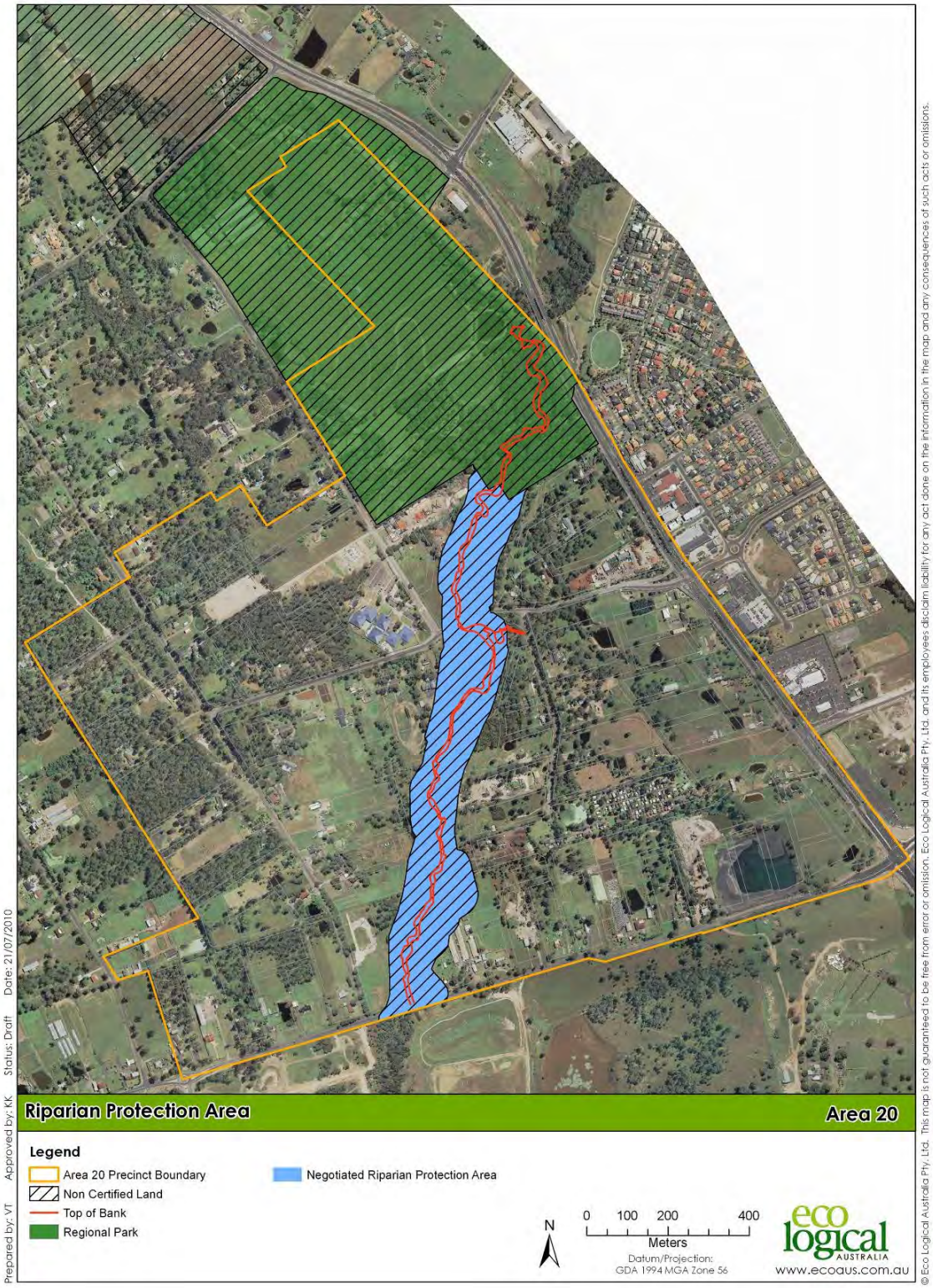


Figure 6: Confirmed Riparian Protection Area boundary

4 ILP Assessment and Recommendations

4.1 PLANNING CONTROLS AND MANAGEMENT PRINCIPLES FOR RIPARIAN PROTECTION AREAS

The riparian protection area in Area 20 is aligned with the non certified land boundary. Blacktown City Council Growth Centre Precincts Development Control Plan 2010 (BCC 2010), hereafter referred to as the BCC Growth Centre DCP, provides a set of outcomes and planning controls for the riparian protection area within the growth centres precincts that are located in Blacktown LGA. This DCP only applies to precincts that have been completed, however, it is considered that Area 20 will have a schedule within this DCP and as such it is considered that the planning controls contained within the BCC Growth Centre DCP will be applicable to Area 20 once the precinct is completed. The outcomes in the BCC Growth Centre DCP include environmental objectives that must be achieved for watercourses within the Precinct. Area 20 contains one Category 1 watercourse, Second Ponds Creek for which section 2.1 of the Appendix B of the BCC Growth Centre DCP applies. Planning controls are included in section 5 of the BCC Growth Centre DCP with additional controls in sections 3 and 4 for areas adjacent to the riparian protection area.

Feedback from DECCW suggests that they do not agree with some of the planning controls contained within the BCC Growth Centre DCP. Further review of BCC Growth Centre DCP planning controls will need to be carried out by the major stakeholders, DECCW, Blacktown City Council and Sydney Water Corporation in order to determine any additional controls which are specific to Area 20 and can be included in a Schedule of the BCC Growth Centre DCP. In this instance, it is recommended that a Vegetation Management Plan is prepared by these stakeholders to guide future management of the watercourse. This should be based on Sydney Water's Management Plan for trunk drainage land in this area given that Sydney Water will have control of approximately 90% of the riparian corridor.

4.2 ILP ASSESSMENT

Assessment of the draft ILP against the BCC Growth Centre DCP and the SEPP (Sydney Regional Growth Centres) has been undertaken and the following points are noted.

The key riparian corridor zone which has been identified for retention as a Category 1 is along Second Ponds Creek. A full riparian corridor based on the non-certified land boundary on either side of the stream has been retained as part of the ILP (Figure 7). Meandering of the stream within the CRZ resulting in an uneven CRZ on each side of the river is permitted and has been adequately addressed within the proposed riparian corridor boundary.

It is noted that the initial riparian corridor boundary does not precisely reflect the non-certified boundary, however investigations have shown that the non-certified boundary actually provides, on average, a wider riparian corridor and an overall increase in total area from that provided by the original. In addition it is proposed that the entire corridor be managed as per CRZ requirements thus meeting the width requirements of the BCC Growth Centres DCP. The main benefits of this approach are simplified statutory requirements for Second Ponds Creek, integration with flood line and other uses at the riparian

margin, a more regular corridor shape and adjacent road pattern, better integration with local drainage infrastructure and protection of ENV within the riparian corridor.

The minimum pinch point (narrowest part of the corridor from TOB) is approximately 20m, which would result in a CRZ of 20m at these locations. For these pinch points it is recommended that the watercourse be adequately stabilised to prevent excessive erosion which may impact on surrounding land uses. Any development adjacent to these pinch points will need to be carefully assessed to ensure the integrity of the watercourse is not compromised. The draft ILP illustrates that these pinch points will be bordered by land either owned by Sydney Water as floodplain or possibly BCC as open space and drainage.

The Draft ILP includes a number of detention basins which are located outside the riparian protection area. This approach is recommended by DECCW.

It is proposed to include a number of crossings of Second Ponds Creek. The two major crossings will occur in the precinct with the realignment of Rouse Road Bridge in the north and the construction of the North West Link in the south. Up to three additional footbridges are proposed to be constructed along the length of Second Ponds Creek to improve connectivity. Crossings of Second Ponds Creek must be piered (unless for utilities).

Both the original riparian corridor delineation and the non-certified boundary create a continuous environmental corridor across the site, linking it to future rehabilitation works to the north west and southern areas outside the precinct. This central corridor will improve environmental function of Second Ponds Creek and provide a key natural aesthetic for future development.

Ongoing ownership and management of the riparian corridor is often a significant constraint to the development of Growth Centre Precincts. Having the entire riparian corridor along with adjacent flood prone land under public ownership will be beneficial for the long term integrity of the watercourse. Sydney Water Corporation will take ownership of the land out to the 1:100yr flood line, with the balance owned and managed by Blacktown City Council as recreation/open space or drainage land consistent with the management of the riparian protection area. Each landowner is committed to managing the riparian protection areas as a natural asset and should take steps to collaborate on these management initiatives. Sydney Water will be the lead authority in this regard, as they will own and manage approximately 90% of the riparian protection area.

4.3 RECOMMENDATIONS

Based on the riparian study, assessment of the ILP against the SEPP (Sydney Regional Growth Centres) and BCC Growth Centre DCP and feedback from government agencies, ELA recommend the following for the riparian protection area within Area 20:

- The riparian corridor is rehabilitated and managed in accordance with a Management Plan and in accordance with the indicative plan and cross section in Appendix C.
- No bettering is permitted within the riparian protection areas
- Piered crossings must be used (other than for utilities) thus maintaining riparian connectivity.
- Removal of farm dams and/or ensuring that dams are ‘offline’ in order to prevent any adverse impact to the riparian corridor or water quality.

- Include flood affected land adjacent to Second Ponds Creek into the riparian corridor to give additional protection and aid in offsetting some of the other impacts on site.
- Consider the location of new utility corridors and existing buildings/existing use issues in the proposed riparian areas.
- Structures for water quality and detention must be located outside the riparian protection area
- At pinch points the watercourse must be adequately stabilised to prevent excessive erosion which may impact on surrounding land uses.
- Local provenance species should be used in the rehabilitation works within the riparian protection area.
- Structures for water quality and flood detention purposes must be located outside the riparian corridor. It must also be demonstrated that the impact on riparian functions is minimal and its integrity maintained. Unless it can be demonstrated that they can be fully vegetated, and the intent of the riparian corridor is not compromised, all water quality structures must be located outside the riparian corridors
- Measures to contain and attenuate low flow events (less than 5 year) are permitted providing they are fully vegetated.
- Consideration of fish passage requirements when designing future creek crossings, water detention and water quality features in line with DECCW guidelines.

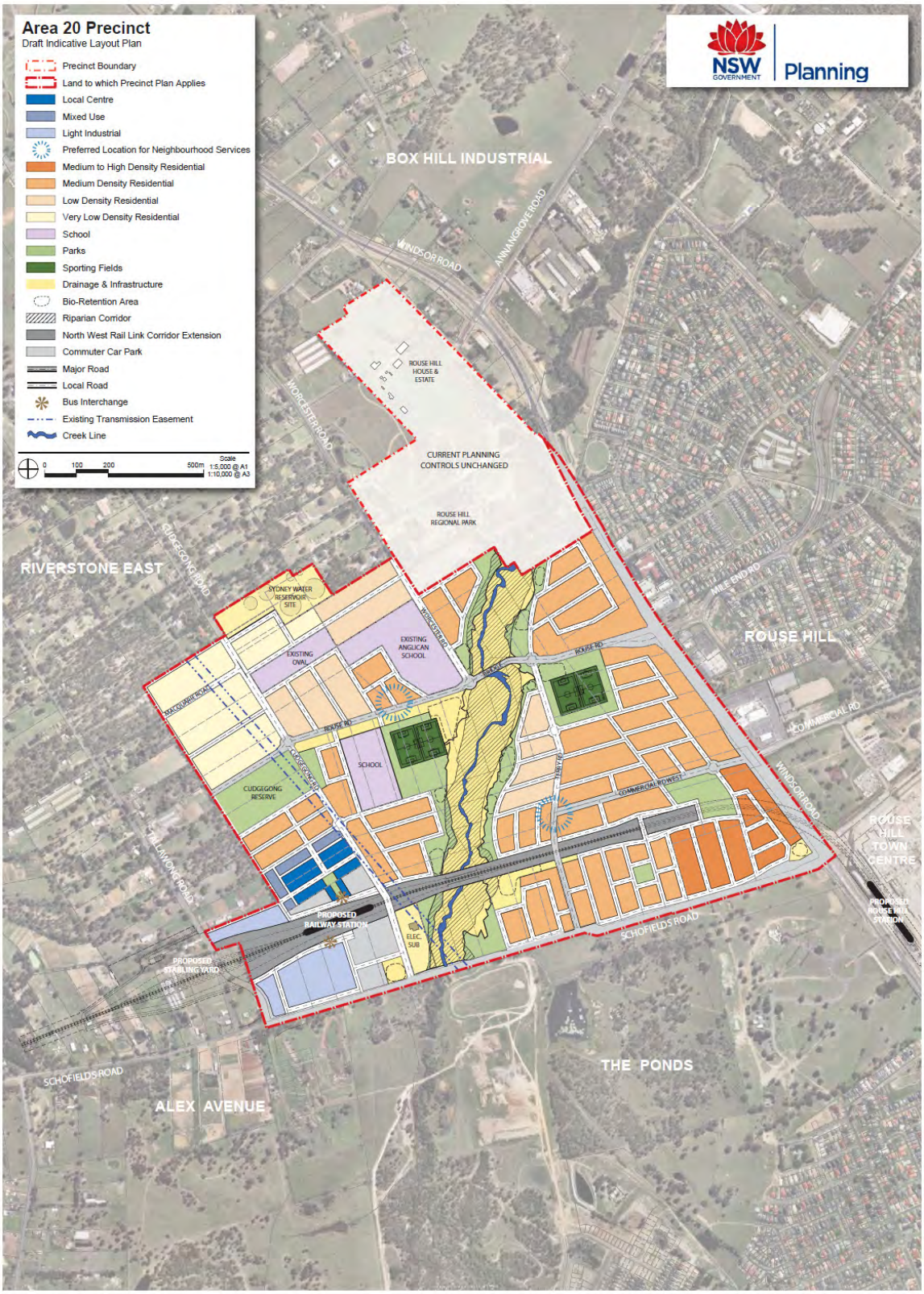


Figure 7: Draft Indicative Layout Plan

References

DECC (2008) Wildlife Atlas database online search tool. DECC [online]. Available: http://wildlifeatlas.nationalparks.nsw.gov.au/wildlifeatlas/watlas.jsp.

DEWHA (2008) EPBC online Protected Matters Database Search. DECC [online]. Available: http://www.environment.gov.au/erin/ert/epbc/imap/map.html.

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

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

Eco Logical Australia Pty Ltd (2007). Growth Centres Conservation Plan. Prepared for NSW Growth Centres Commission.

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

Gunninah Environmental Consultants (2002). *Rouse Hill Infrastructure Project Further Servicing (Stage3) Works Second Ponds Creek Area.* Prepared for Rouse Hill Infrastructure Pty Ltd.

NSW National Parks and Wildlife Service (2002a) *Interpretation guidelines for the native vegetation maps of the Cumberland Plain, Western Sydney*. Threatened Species Unit, Hurstville.

NSW National Parks and Wildlife Service (NPWS) (2002). *Native Vegetation of the Cumberland Plain, Western Sydney Vegetation Community, Condition and Conservation Significance Mapping.*

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.

Given the presence of MNES (in particular Cumberland Plain Woodland) within the precinct, it is expected that the action would normally require assessment and referral under the EPBC Act. In this instance, however, there are a number of factors that suggest an alternative course of action may be available. It is understood that the Department of Planning (DoP) and other relevant NSW Government agencies are currently in discussions with the Federal Department of the Sustainability, Environment, Water, Population and Communities (SEWPAC) (formerly DEWHA) regarding a strategic assessment of the Growth Centres SEPP.

The strategic assessment should remove the need for individual referrals under the EPBC Act for agreed development areas within the Growth Centres. If a strategic assessment is not undertaken then referral of the Area 20 development will be necessary, this should be initiated at the master planning stage.

At this time it is recommended that a decision on when to refer the development to the Federal Government be delayed until it is clear what Federal Government assessment and approval process is to occur for the Growth Centres SEPP.

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 Climate Change and Water (DECCW) 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 Area 20, which is discussed further below.

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') establishes an additional planning consideration in relation to threatened species for the Area 20 Precinct.

The Growth Centres SEPP has been 'bio-certified' by 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[1]. 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.

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.

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

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.

Guidelines have been provided for the protection of core riparian areas (CRZs) as illustrated in the table below.

Water Management Act CRZ Widths

Types of Watercourses	CRZ Width
Any first order[1] watercourse and where there is a defined channel where water flows intermittently	10 metres
Any permanent flowing first order watercourse, or any second order[1] watercourse where there is a defined channel where water flows intermittently or permanently	20 metres
Any third order[1] or greater watercourse and where there is a defined channel where water flows intermittently or permanently. Includes estuaries, wetlands and any parts of rivers influenced by tidal waters.	20 – 40 metres[2]

[1] as classified under the Strahler System of ordering watercourses and based on current 1:25,000 topographic maps.
[2] merit assessment based on riparian functionality of the river, lake or estuary, the site and long-term land use.

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.

For the purposes of bushfire constraints, an initial indicative APZ will be provided once field validation of the vegetation communities within the precinct has been completed.

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.

Growth Centres Development Code 2006

The Growth Centres Development Code was produced by the Growth Centres Commission 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, Area 20 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).

The riparian areas within the Growth Centres Precincts are assessed according to methodology included in the Growth Centres Development Code (ie: Category 1, 2 and 3 which was based on the Riparian Corridor Management Study (DIPNR, March 2004). produced for the Wollongong LGA and Calderwood Valley in the Shellharbour LGA). The Growth Centres Development Code methodology has been used for this study. The riparian corridors that exist within the Area 20 have been mapped according to their watercourse classification and riparian corridor boundaries negotiated with DECCW.

Draft Growth Centres Conservation Plan 2007

Under the Draft Growth Centres Conservation Plan (January 2007), the vegetation within Area 20 has been identified as 'Lower Long Term Management Viability (LMV)' and have 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.

Blacktown City Council Growth Centre Precinct Development Control Plan 2010

This DCP only applies to precincts that have been completed, however, it is considered that Area 20 will have a schedule within this DCP and as such it is considered that the planning controls contained within the BCC Growth Centre DCP will be applicable to Area 20 once the precinct is completed. The purpose of the plan is

- to communicate planning design and environmental objectives and controls against which to asses DAs;
- consolidate and simplify planning controls;
- Ensure orderly efficient and environmentally sensitive design; and
- Promote high quality urban design outcomes.

Blacktown City Council Growth Centre Precincts Development Control Plan 2010 provides a set of outcomes and planning controls for the riparian protection area (DCP Appendix B) within the growth centres precincts that are located in Blacktown LGA.

Appendix B: DECCW Consultation Notes

MINUTES - Area 20 Riparian Site Visit

TITLE	Area 20 Riparian Site Visit
LOCATION	Area 20 Site, Rouse Hill
DATE	2 March 2009
TIME	10:00am
ATTENDEES	Steven House (ELA), Paul Frazier (ELA), Lee Mulvey (DoP), Greg Brady (DECCW)
APOLOGIES	

Notes

Objective of the site visit was to validate the desktop generated drainage lines (refer to attached map) and determine which drainage lines are considered “rivers”. Any drainage lines which were considered a river would be further assessed by ELA geomorphologists to assess condition, map top of bank (TOB) and delineate appropriate riparian buffer areas.

Outcomes

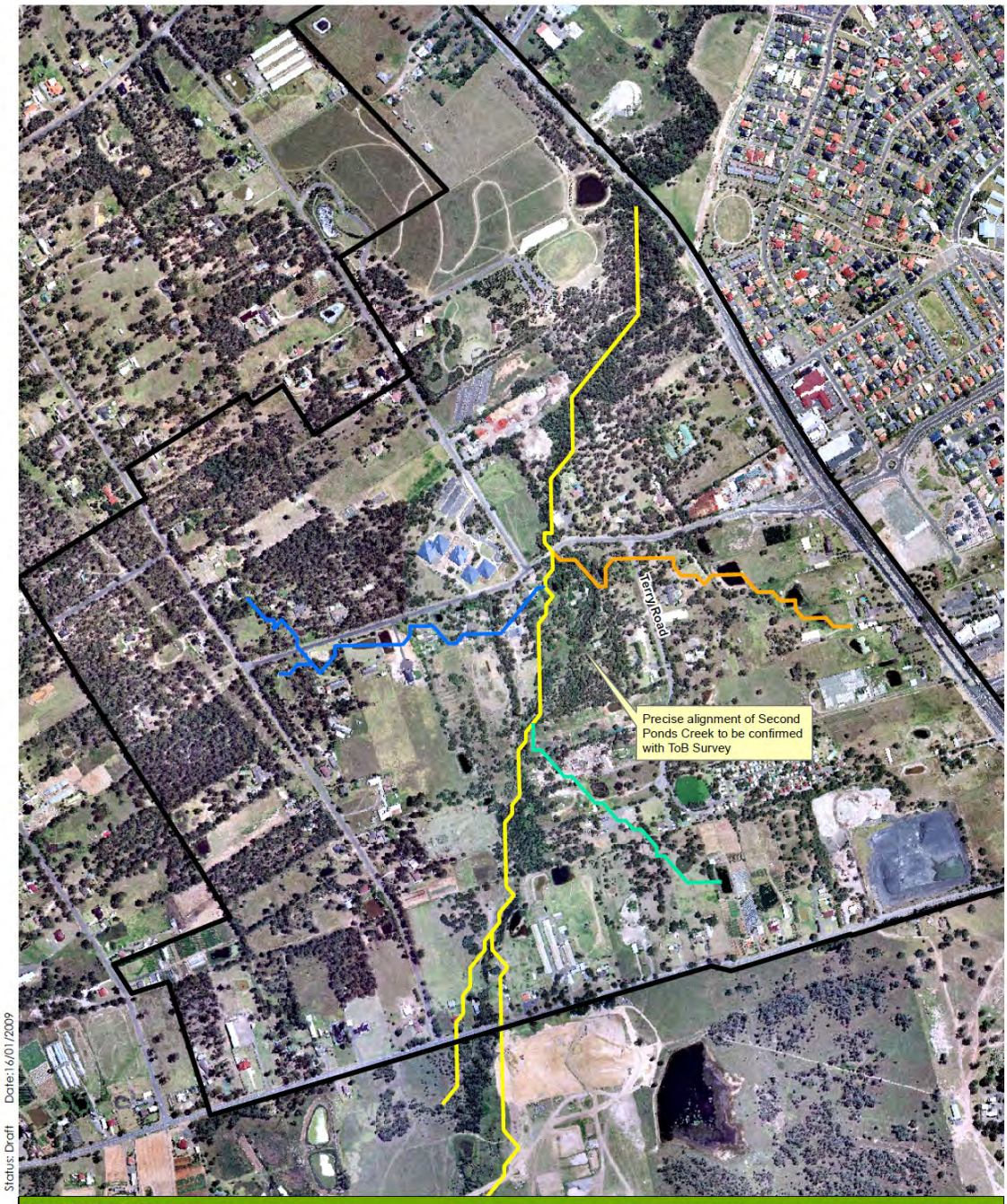
1. Creek 1: No river above Cudgegong Road. East of Rouse Road is highly degraded. Whether or not it is a river dependant on Bannerman property on west side of Rouse Road, access to Bannerman property achieved, Greg Brady confirmed that Creek 1 is not a 'river'.

2. Creek 2: Significant disturbance from machinery yards evident. No stream apparent at confluence with Ponds Creek. Greg Brady confirmed is not a 'river'.

3. Creek 3: No creek on the eastern side of Terry Road. Greg Brady confirms there is no 'river' on eastern side of Terry Road Creek present. On western side of Terry Road Greg Brady recommends that the creek is a river and should be categorised as category 1. Given highly degraded nature of western side of the creek, Steven House suggest that there could be some passive recreation activities in areas that are currently covered in kikuyu.

4. Creek 4: Second Ponds Creek, is a river and will remain as a category 1 watercourse.

ACTIONS	ELA to carry out TOB mapping, categorisation of rivers and map associated riparian corridor areas (Core Riparian Zones and Vegetated Buffers)



Validated Creeks

Area 20 Precinct Planning Biodiversity Study

Legend

Area20 Precinct Boundary

ArcHydro Drainage (2m Contours)

Stream Number

1

2

3

4

N

0 100 200 400

Meters

Datum/Projection: MGA56

eco logical AUSTRALIA

www.ecoaus.com.au

Prepared by:DJ Approved by: Status: Draft Date:16/01/2009

Client: GCC Project Number: 0144-0017

NSW GOVERNMENT
Office of the
Hawkesbury-Nepean

Contact: Greg Brady
Phone: 02 47298134
Fax:
Email: greg.brady@ohn.nsw.gov.au

Our ref: 10 ERM2009/0555
File No:
Your Ref:

Precinct Project Manager
Area 20 Precinct
Department of Planning
PO Box 1457
Parramatta NSW 2124

Attention: Lee Mulvey

27 May 2009

Dear Sir

Re: Riparian Constraints Assessment Report, Area 20 Precinct, Rouse Hill, Blacktown Council LGA

The Office has reviewed the document and endorses the stream classification as represented in Figure 3 "Riparian categories within Area 20" of the Riparian Constraints Assessment, (dated 8 May 2009) prepared by Ecological Australia. DWE confirms that Second Ponds Creek is a Category 1 watercourse.

To assist in the endorsement of any Precinct Waterfront Land Strategy and thereby exempt works in relation to a Controlled Activity Approval (CAA) issued under the *Water Management Act 2000*, the following comments in relation to outcomes and future processes and methodologies for this precinct need to be addressed.

It is noted that the final location of the riparian area and boundary have not yet been negotiated as other matters such as areas predicted to be flooded, and more closely aligning with the biocertification boundary have not yet been determined/discussed. In principle, having the riparian boundary and the biocertification boundary, (as shown in Figure 3) the same would appear to be a reasonable solution.

(1). Plan/s at a suitable scale that enable the clear and precise identification of the riparian lands and the agreed riparian boundary (measured from top of bank) and area must be provided. These maps, once endorsed by the DWE/ Office, can then form the basis for the preparation of an Indicative Layout Plan for the precinct and the Riparian Protection Area Map that will be produced for the Precinct planning rezoning process.

(2). The proposed Vegetation Management Strategy (VMS), for the riparian areas, is not to be based on the DWE February 2008 guidelines for Controlled Activities which are published on the web. The VMS is to be based on the detailed guidelines that have been included in the Oran Park and Turner Road Waterfront Land Strategy. However these guidelines may themselves be further modified, reflecting any possible issues that Camden Council may experience in applying the strategies. This has not yet been tested.

Level 4, 2-6 Station Street, Penrith PO Box 323 Penrith NSW 2751 Australia

t 1300 440 692 | f 4729 8141 | e information@ohn.nsw.gov.au

www.ohn.nsw.gov.au

Firstly: the stream categorisation of watercourses in the Growth Centres is based on the Department's Riparian Corridor Objective Setting (RCOS) stream classification system and not the *DWE (February 2008) Guidelines for Controlled Activities Riparian Corridors*. It should be noted the RCOS was incorporated in the Growth Centres Development Code (October 2006)

Secondly: the DWE February 2008 Controlled Activities guidelines are very general and DWE as part of the granting any CAA ensures that any plan/strategy is an outcomes focused document: for easy and unambiguous assessment of the outcomes achieved by the protection, establishment and maintenance phases. As DWE will not be part of any CAA assessment process, these elements must be detailed within the VMS and the Waterfront Land Strategy for the precinct.

Thirdly: while some land uses were located within the riparian corridors at the Oran Park and Turner Road precincts DWE have stated they require the remaining Growth Centre precincts to locate such uses outside the riparian corridors. DWE's recent submissions (dated 15 and 18 May 2009) to DOP on the exhibited plans for the Alex Avenue and Riverstone precincts and the Riverstone West precinct reiterate this advice.

The precinct planning for Area 20 will need to locate inappropriate uses such as pathways/recreational open space, stormwater treatment measures, perimeter roads, service utilities, walking and cycle paths, parks and other recreational facilities outside the Core Riparian Zone (CRZ) and the Vegetated Buffer (VB). These issues need to be clarified early in the precinct planning process as it may impact upon location of cycle paths, basins etc.

(3). The environmental objectives for the riparian protection areas, only relate to the vegetation of those areas. This is limiting to the intent of environmental outcomes for those areas, as outcomes need to also address the watercourse itself and water quality outcomes (in relation to improving the health of the Hawkesbury Nepean River).

As there are no Category 2 and 3 watercourses in the Area 20 precinct, these categories do not need to be included in any further documentation.

It should also be noted that once the Riparian Protect Map is produced and agreed to by DWE and the Office for the precinct planning process, these are then the endorsed footprint for the entirety of the life of the precinct.

The following objectives are similar to the Oran Park and Turner Road Water Front Land Strategy, with modifications to clarify the intent of final outcome.

(1) Provide, emulate and maintain a stable naturally functioning watercourse that supports a viable naturally occurring local aquatic community.

(2) Provide, restore, rehabilitate and maintain the riparian corridor with the local provenance vegetation community.

(3) Provide a continuous riparian corridor that:

- Generally is a riparian corridor of 100m width, (including Core Riparian Zone (CRZ) of an average of 80m (40 m each side of watercourse) measured from top of bank (TOB) and an additional width that equals the width of the channel between the top of banks and a 10 m wide Vegetated buffer (VB) either side of the CRZ.
- Linkages to stands of remnant vegetation where applicable,

- Provides extensive habitat and connectivity for naturally occurring terrestrial fauna.

(4) Ensure vegetation in the CRZ and VB is at a density that would occur naturally for the riparian ecotone.

(5) Ensure that the VB protects the integrity of the CRZ, by emulating the CRZ vegetation.

(6) Minimise the number of road crossings to maintain riparian connectivity.

(7) Use piered crossings (other than for utilities) to maintain riparian connectivity.

(4). A number of the draft environmental controls listed in the Riparian Constraints Assessment need to be amended.

Controls 4 and 5, for instance refer to the 40 % rule which was negotiated with DWE as part of Oran Park and Turner Road Precincts' and 40% of the vegetated buffer being available for such things as passive recreation and use as APZ. DWE does not accept the application of the 40 % rule in the remaining precincts including Area 20.

In relation to Control 6, the DWE has previously been advised by the development industry that water quality structures can not be fully vegetated. Unless it can be demonstrated that the basins can be fully vegetated, and the intent of the CRZ is not compromised, the water quality structures must be located outside the riparian corridors (CRZ and VB).

Controls 8, 12 and 13 make reference to using the DWE February 2008 guidelines for Controlled Activities. As noted above, the precinct planning should use the detailed guidelines that have been incorporated in the Oran Park and Turner Road Waterfront Land Strategy including any modifications due to Camden Council's experiences.

Control 14 also needs to be amended as DWE requires battering to be located outside both the CRZ and the VB. The VB should not be used for battering, unless the batters can be demonstrated to be fully vegetated.

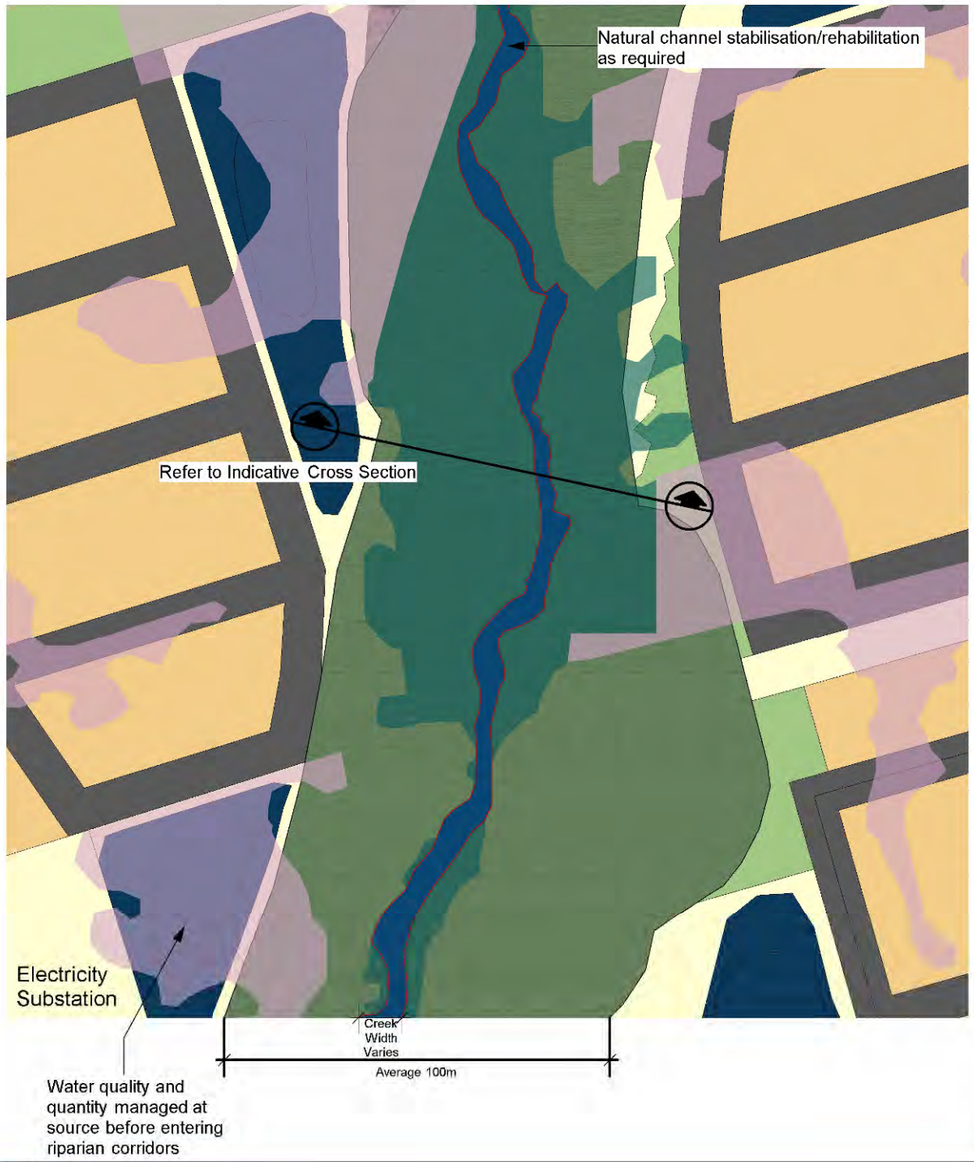
Controls (1, 2, 3, and 11) appear reasonable at this stage and will require little or no amendments/additions.

Further considerations in relation to the location of new utility corridors and existing buildings/existing use issues in the proposed riparian areas need to be addressed also.

Yours sincerely

Greg Brady
Natural Resource Officer
Office of Hawkesbury Nepean

Appendix C: Indicative Riparian Plan View and Cross Section



Indicative Plant Species

Second Ponds Creek is considered to be a category 1 watercourse, planning of the Area 20 precinct rezoning will provide a continuous, viable Core Riparian Zone (CRZ) at an average width of 50m either side of the top of bank, to emulate the native vegetation communities in the area to facilitate a stable watercourse and to protect the environmental integrity of the CRZ from weed invasion, microclimate changes, litter, trampling and pollution.

Vegetation remaining within the riparian corridors of the site consists of patches of both good and poor condition 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 Forest)*, which is listed on Schedule 1 of the TSC Act.

The riparian corridors will be subject to a VMS which will form the strategic framework for detailed riparian vegetation management plans, to be put together at later stages of the development process.

The VMS will aim to:

- Conserve existing native vegetation communities
- Control non-native species, especially weeds
- Revegetate cleared areas using local provenance native species consistent with the natural vegetation communities found in the locality
- Minimise impacts of construction activities
- Establish a viable habitat corridor for terrestrial and aquatic native fauna through habitat creation, restoration and connectivity
- Maintain and enhance biodiversity
- Minimise impacts associated with nearby urban land use

Objectives	Approach
Increase biodiversity by removing invasive weed species and re-introducing native species	Remove and control environmental weeds prior to revegetation Maintenance weed removal Revegetate areas of low natural recovery potential
Improve ecological health and integrity by revegetating with native species	Revegetate the terrestrial, creek, riparian and wetland areas with appropriate species Maintain plant health until established Maintenance weed removal
Enhance habitat values	Protect and enhance exisiting terrestrial and aquatic habitat Consolidate corridor Use restoration techniques that facilitate fish passage Increase native plant cover
Stabilise bed and banks	Utilise native vegetation planting and large woody debris to assist in stabilisation In high erosion areas construct rock-rip raps, drop structures or undertake bank armouring

Plan View **Area 20**

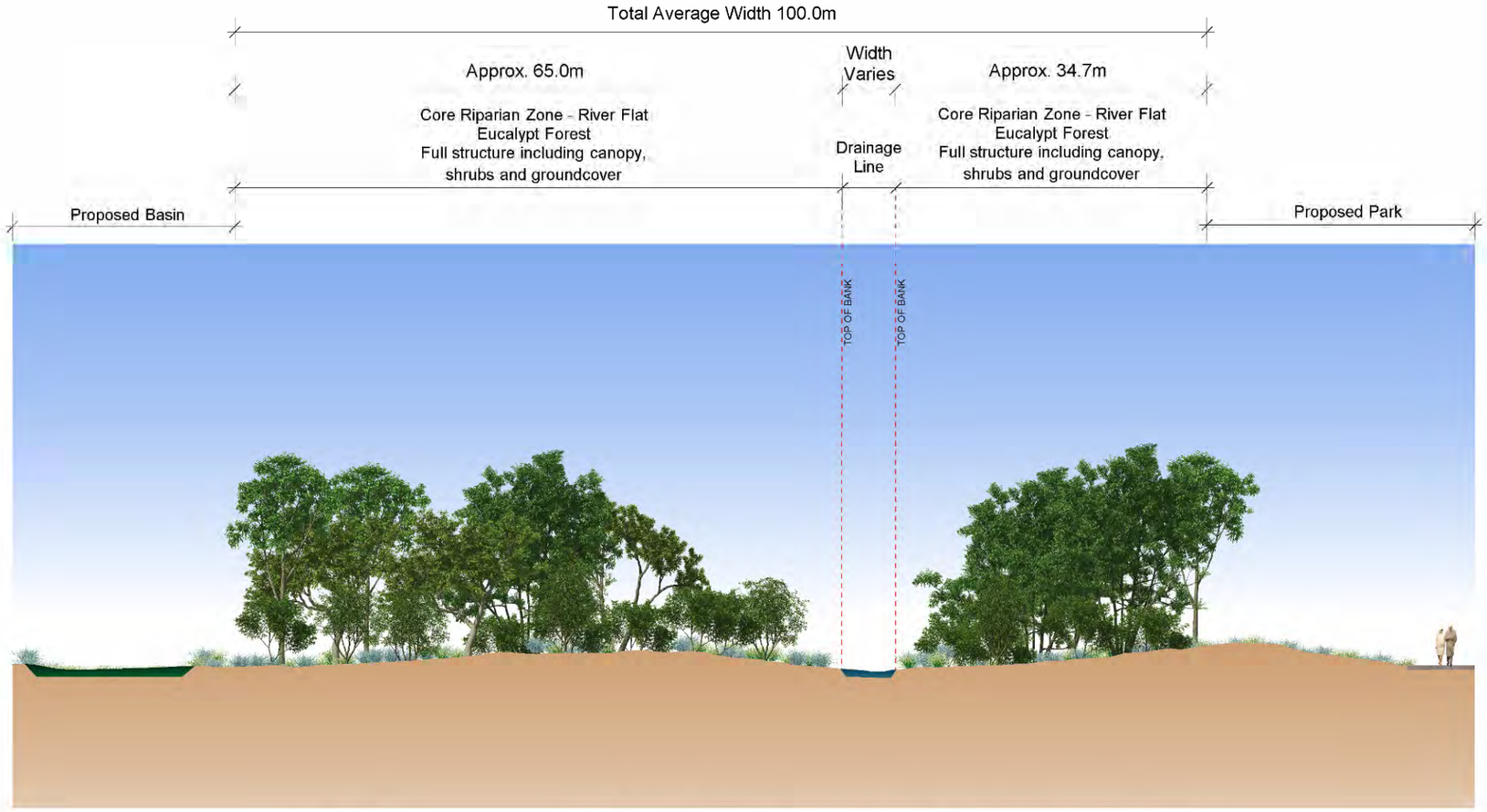
Legend

Core Riparian Zone · Channel · Top of Bank · Proposed Roads · Proposed Basins · Proposed Parks · Drainage & Infrastructure Zone · Proposed Low Density Residential · Good Condition Vegetation (GCC ENV) · Poor Condition Vegetation

N

eco logical AUSTRALIA
www.ecoaus.com.au

Prepare by: VT Approved By: KL Status: Draft Date: 17/03/2010



Species	Indicative Density
Canopy	
Acacia parramattensis	1 plant/ 20 m²
Casuarina cunninghamiana subsp Cunninghamiana	1 plant/ 20 m²
Eucalyptus amplifolia	1 plant/ 20 m²
Midstorey	
Bursaria spinosa	1 plant/ 1.5 m²
Ground layer	
Oplismenus aemulus	4 plants/m²
Entolasia marginata	4 plants/m²
Echinopogon ovatus	4 plants/m²
Solanum prinophyllum	4 plants/m²
Dichondra repens	4 plants/m²
Microlaena stipoides var.stipoides	4 plants/m²
Cheilanthus sieberi subsp. sieberi	4 plants/m²
Pratia purporascens	4 plants/m²
Themeda australis	4 plants/m²
Commelina cyanea	4 plants/m²
Desmodium varians	4 plants/m²
Lomandra longifolia	4 plants/m²
Oxalis perennans	4 plants/m²
Brunoniella australis	4 plants/m²
Alisma plantago-aquatica	4 plants/m²
Samolus valerandi	4 plants/m²
Bolboschoenus caldwellii	4 plants/m²
Centipeda cunninghamiai	4 plants/m²
Cyperus trinervis	4 plants/m²
Fimbristylis velata	4 plants/m²
Myriophyllum variifolium	4 plants/m²
Persicaria subsessilis	4 plants/m²
Scutellaria mollis	4 plants/m²
Glycine tabacina	4 plants/m²
Glycine clandestina	4 plants/m²

Indicative Riparian Cross Section **Area 20**

eco logical AUSTRALIA
www.ecoaus.com.au

Prepared by: VT Approved By: KL Status: Draft Date: 16/03/2010

eco logical AUSTRALIA

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

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

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

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

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

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

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

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

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

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

WOLLONGONG
Level 2
25 Atchison Street
Wollongong NSW 2500
T 02 8536 8615
F 02 4254 6699