The Belmore Road Precinct – Riparian Assessment

CKDI Bringelly Pty Ltd atf

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Template 2.8.1

Contents

List of Figures

List of Tables

Abbreviations

Abbreviation	Description
AEP	Annual Exceedance Probability
BC Act	NSW *Biodiversity Conservation Act 2016*
BOM	Bureau of Meteorology
CEEC	Critically Endangered Ecological Community
DCP	Development Control Plan
DotEE	Department of the Environment and Energy
DPIE	Department of Planning, Industry and Environment
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
ELA	Eco Logical Australia Pty Ltd
ENV	Existing Native Vegetation
EP&A Act	*Environmental Planning and Assessment Act 1979*
FM Act	NSW Fisheries *Management Act 1994*
GDE	Groundwater Dependent Ecosystem
ILP	Indicative Layout Plan
LGA	Local Government Area
MNES	Matters of National Environmental Significance
NRAR	Natural Resources Access Regulator
NVR	Native Vegetation Retention
RPA	Riparian Protection Area
SEPP	State Environmental Planning Policy
TSC Act	NSW *Threatened Species Conservation Act 1995*
VRZ	Vegetated Riparian Zone
WM Act	NSW *Water Management Act 2000*

Executive Summary

Eco Logical Australia Pty Ltd (ELA) was engaged by CKDI Bringelly Pty Ltd atf (CKDI) to undertake a Riparian Land Assessment for Precinct Planning of the Belmore Road Precinct. The NSW Government aim to provide new sustainable, liveable and connected communities in the South West Growth Area to accommodate Sydney's population growth. The Belmore Road Precinct provides opportunities for development and the study area is being nominated by CKDI to be released for development ahead of the Department of Planning and Environment's (DPE) timeline, through the Precinct Acceleration Protocol. The aim of this report is to identify key ecological and riparian land constraints to assist the design of an Indicative Layout Plan (ILP).

ELA field-validated watercourses and riparian zones along watercourses, predominately along the southern and central portions of the site, where access was available. The creek lines were mostly altered from their natural state, with removal of native riparian vegetation for agricultural uses.

In total, there were 11 first order and two second-order watercourses that were accessible and assessed. Of the 11 first order reaches assessed, eight did not meet the definition of a 'river' under the *Water Management Act 2000* (WM Act), as they had no channel with defined bed and banks. All other reaches met the definition of a 'river'. The first order watercourses were generally in poor condition, with ephemeral or intermittent flow only and limited habitat features. The second order watercourses were in moderate condition, with geomorphic features such as pool, riffle and run sections. There was 12.2 ha of riparian corridor mapped within the Belmore Road Precinct, including desktop mapped first order creeks, of which 9.2 ha was field validated. The remainder of the site was mapped using desktop analysis only, using 0.5 m contours and guidance from field-validated areas.

The primary watercourse through the centre of the study area had riparian vegetation in good condition that was characteristic of *Cumberland Plain Woodland in the Sydney Basin Bioregion*, a Critically Endangered Ecological Community under the *Biodiversity Conservation Act 2016* (BC Act). This vegetation provided good habitat, contributed to bank stability, and shaded parts of the watercourse. It is recommended that a Riparian Protection Area be implemented along this primary creek line, with the riparian corridor being fully revegetated in accordance with a vegetation management plan.

Two areas within the study area were mapped on the Bureau of Meteorology Groundwater Dependent Ecosystem atlas as having high potential for terrestrial Groundwater Dependent Ecosystem (GDE). Field validation of these areas showed a consistency between the mapped GDE vegetation type and the vegetation on site. Assessment of the groundwater connectivity with these ecosystems is recommended, however it is unlikely that development activities would interfere with the groundwater table, as there is unlikely to be significant areas of excavation below the water table.

An ILP has been prepared that provides 13.96 hectares of riparian area. Based on the results of the desktop study and field validation where access was granted, there is a total of 12.2 ha of riparian zone on the site. Note this includes the first order watercourses within the northern portion of the site that are unlikely to be a watercourse, however, have not been field validated. Subject to field validation of the north-east part of the site and NRAR review, if these first order watercourses do not meet the definition of a watercourse, there is 10.8 ha of riparian zone on the site.

This report recommends that the protection and management of the riparian zone be achieved through:

- The use of an E2 Environmental Conservation zone
- The use of the Riparian Protection map in the *State Environmental Planning Policy (Sydney Region Growth Centres) 2006* (Sydney Region Growth Centres SEPP)[1], linked to the Camden Growth Centres Precincts Development Control Plan (DCP) clauses relating to water cycle management and native vegetation
- Preparation and implementation of Vegetation Management Plans (VMPs) concurrently with development of land adjoining the riparian corridor. The VMP is to be consistent with the objectives of the E2 zone, NRAR *Guidelines for Vegetation Management Plans on Waterfront Land*, and should allow for recreation infrastructure that does not have a significant impact on riparian values
- Vegetation management to be generally in accordance with the Riparian Management Strategy contained in this report
- Where possible, major riparian zones should be in public ownership so that public access for recreation is possible.

[1] Note the Sydney Region Growth Centres SEPP has now been repealed and replaced by the *State Environmental Planning Policy (Precincts – Western Sydney Parkland)* 2021 (Western Sydney Parkland SEPP)

1. Introduction

1.1 Description of the Project

Eco Logical Australia Pty Ltd (ELA) was engaged by CKDI Bringelly Pty Ltd atf (CKDI) to undertake a Riparian Land Assessment for Precinct Planning of the Belmore Road Precinct within the South-West Growth Area. The Belmore Road Precinct study area is being nominated by CKDI to be released for development ahead of the Department of Planning and Environment's (DPE) timeline, through the Precinct Acceleration Protocol. The aim of this assessment is to identify key ecological and riparian features and constraints of the site to inform the rezoning process, as well as to provide recommendations with respect to terrestrial and aquatic ecosystem management.

Specific objectives of this project are to:

- Undertake a Riparian Corridors Assessment to inform the precinct planning process and development of the Indicative Layout Plan (ILP)
- Work in collaboration with the Water Cycle Management Service Provider, to map riparian corridors using the Strahler system and provide recommendations and planning controls for riparian lands
- Work in collaboration with the Water Cycle Management Service Provider to identify suitable locations for stormwater management such as detention basins, stormwater outlet structures and constructed wetlands.

1.2 Study Area and Context

Figure 1 illustrates the broad location of the study area. The study area lies within the Hawkesbury-Nepean Catchment. The Hawkesbury-Nepean is the second largest in NSW and has its headwaters located within largely pristine regions including the Blue Mountains World Heritage Area and Sydney Catchment Authority's lands in the NSW Southern Highlands. These upper reaches provide over 90% of Sydney's drinking water. Once into flatter, floodplain country, the Hawkesbury River flows eastward towards the ocean through rural and semi-rural areas of western Sydney. These middle and lower reaches of the system are highly impacted and degraded, both directly through waterway modifications and indirectly through adjacent land-use practises. Hydrological and sediment regimes have been dramatically altered due to vegetation clearance and increasing urbanisation. Increasing impervious surfaces in the catchment are causing changes to hydrology which has greatly altered the geomorphology and ecology of the watercourses.

The study area is located in the South Creek / Wianamatta sub-catchment. Numerous first, second and third order tributaries are mapped within the study area. The first order watercourse at the north of the site is a tributary of Thompsons Creek that flows from south to north and the first order watercourse in the southeast corner of the study area is a tributary of Lowes Creek. The remainder of the watercourses in the study area are tributaries of South Creek / Wianamatta and flow through the site from southwest to east. The downstream extent of the third order tributary of South Creek within the site is mapped as Key Fish Habitat (Figure 1) by DPI Fisheries.

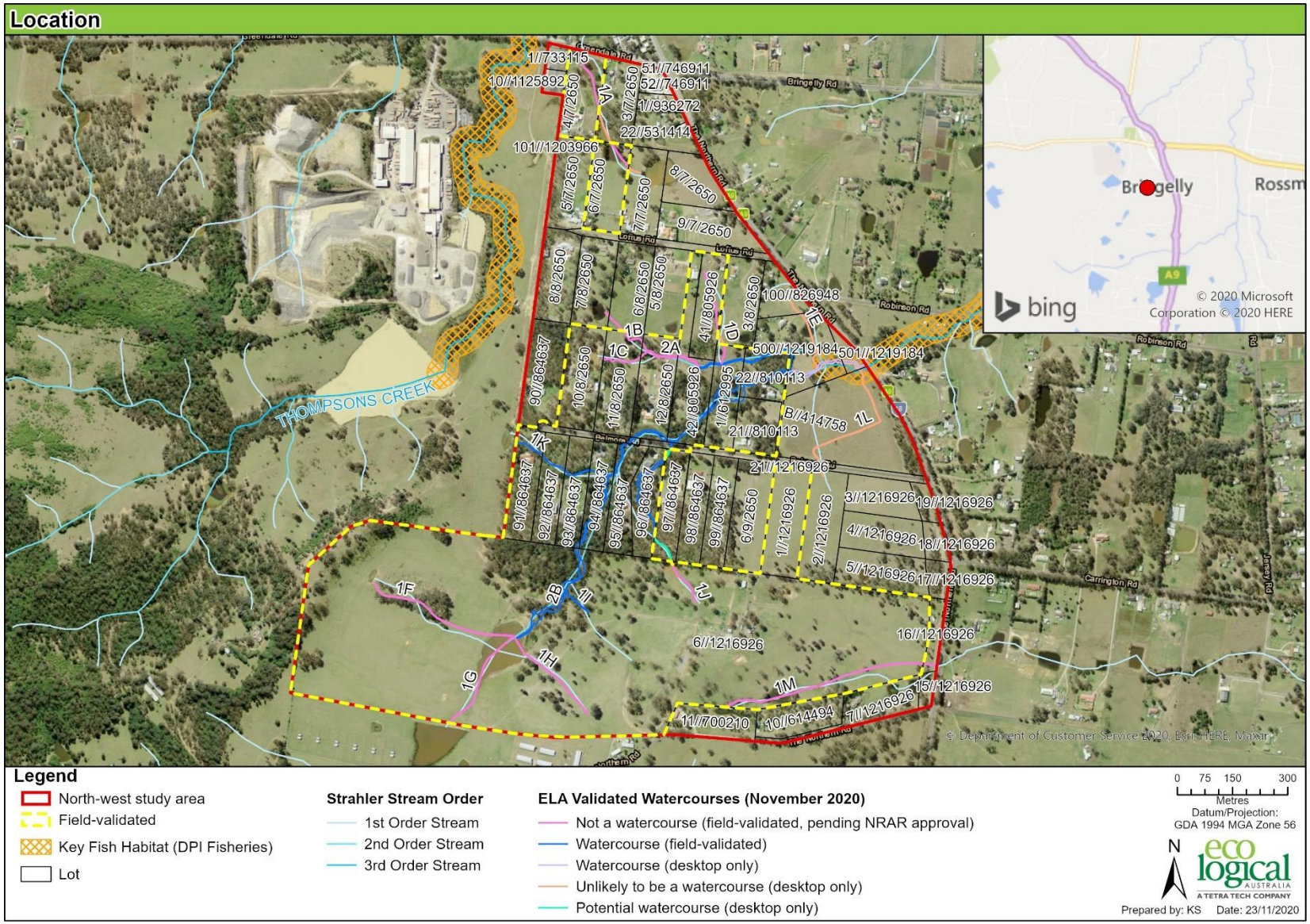

Figure 1: Study area

2. Statutory Framework

A substantial array of legislation, policies and guidelines apply to the assessment, planning and management of waterway and riparian issues within the study area. This information was reviewed and used to identify priority issues and approaches for the study area (refer to Appendix A for detailed review). 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)
- *Biodiversity Conservation Act 2016* (BC Act)
- *State Environmental Planning Policy (Sydney Region Growth Centres) 2006*[1]
- *Fisheries Management Act 1994* (FM Act)
- *Water Management Act 2000* (WM Act)
- *Biosecurity Act 2015*
- Growth Centres Development Code 2006
- *Sydney Regional Environmental Plan No 20—Hawkesbury-Nepean River (No 2—1997)*[2].

[2] Note the *Sydney Regional Environmental Plan No 20—Hawkesbury-Nepean River (No 2—1997)* has now been repealed and replaced by the *State Environmental Planning Policy (Biodiversity and Conservation) 2021* (Biodiversity and Conservation SEPP)

3. Methods

3.1 Stream Categorisation

The Strahler stream order classification was extracted from the State Government's GIS dataset. Top of bank was estimated using aerial photographs and 0.5 m contours before being field-validated on 14th February and 15th and 16th October 2020 by two aquatic ecologists, using a GPS-enabled tablet. Each watercourse that met the definition of a 'river' under the WM Act was assigned the appropriate riparian corridor width in accordance with the Strahler stream order. Riparian widths were then applied using ArcPro.

3.2 Condition Assessment

The watercourses and riparian zones were visually assessed for ecological value regarding physical form, benthic substrate, fish habitat, instream woody debris and vegetation condition.

The condition assessment was undertaken to 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. All dams were inspected for habitat, with time spent listening for frogs and observing birds at each.

Field surveys were conducted along the length of the watercourse wherever access was permitted. There were areas of the study area that were unable to be accessed due to restrictions by landholders. Figure 1 shows the area accessed and surveyed.

3.3 Groundwater Dependant Ecosystems

Groundwater Dependant Ecosystems (GDEs) were initially identified by reviewing the GDE Atlas (BOM 2020) for the site. There were no aquatic GDEs mapped in the site. There were two areas where there was high potential for terrestrial GDEs to exist.

4. Results

4.1 Aquatic and Riparian Habitat Condition Assessment

The creek lines in the study area have been altered from their natural state due to works along the creek (creation of dams and crossings), removal of native riparian vegetation to facilitate agricultural land uses, increase in impervious surfaces in the upstream catchments, increases in sediment and nutrient transport through the system and various other factors.

Nonetheless, all tributaries have value as a component of the catchment and riparian corridors that exist in the region. Where present, the tributaries of each creek 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 will be crucial to improving the condition of downstream environments

There were 13 first-order, two second order and one third order creeks mapped in the study area. Of these, 11 first order watercourses and two second order watercourses were able to be assessed. Creeks bordering the site were assessed, where possible, to determine if their riparian buffers would encroach. The location of each reach and whether it was a defined channel is shown in Figure 2. The current condition of the creeks is summarised in Section 4.3.

4.2 Confirmation of 'rivers'

The Guidelines for Riparian Corridors on Waterfront Land (Natural Resources Access Regulator (NRAR) 2018) acknowledge that some hydro-lines on topographic maps may not meet the definition of a river under the WM Act. This is generally the case where there is no defined bed or bank and no evidence of channelised flow or geomorphic processes such as erosion and deposition. ELA has identified a number of hydro-lines which do not have the characteristics of a river and should not require protection in the precinct (Figure 2). Consultation with NRAR is recommended to confirm whether NRAR support the findings described below.

NRAR must be consulted if there is intention to remove any hydro-lines which do meet the definition of a river.

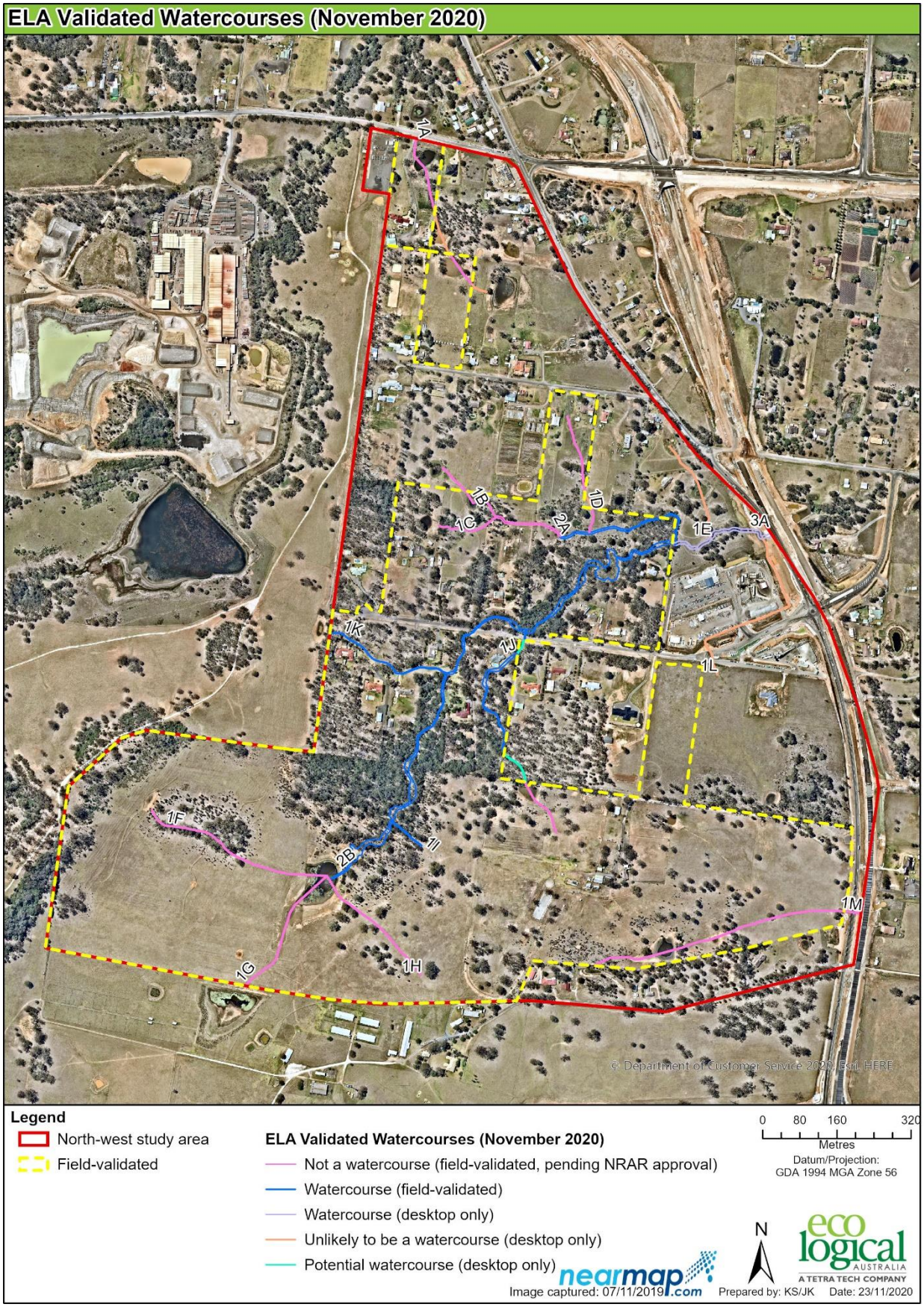

Figure 2: Watercourse reaches within study area

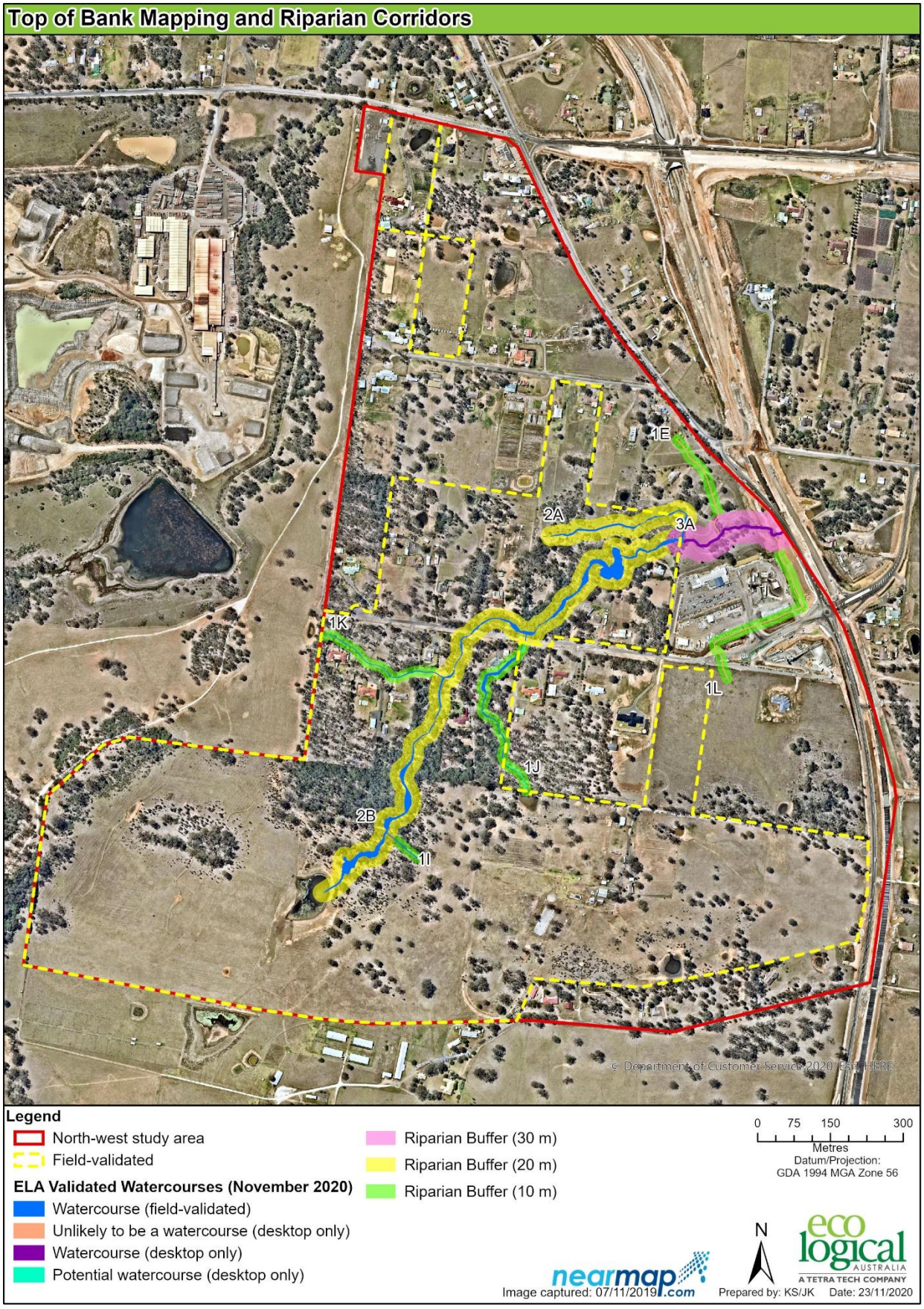

Figure 3: Recommended riparian corridor widths

4.3 Riparian Reach Descriptions

Only reaches that were field validated have been described below. Reach descriptions for first-order creeks are detailed in Table 1. Where a watercourse had defined bed and banks upstream, the downstream mapped watercourse was classified as a 'river', regardless of the presence of bed and banks. For each reach, a condition of good, moderate, or poor was applied based on the following attributes:

- Stream shape and size
- Frequency of flow (ephemeral or perennial)
- Presence of aquatic habitat (pools, riffles, large woody debris, vegetation)
- Potential for threatened or protected fish species or fauna
- Connection with other habitats.

Watercourses in good condition had clearly defined bed and banks with intermittent to semi-permanent water in pools with aquatic vegetation present. Large woody debris was present, with a range of geomorphological features such as pools and riffles that would provide good aquatic habitat. Watercourses in moderate condition had clearly defined bed and banks with ephemeral or intermittent flow after a rain event. Aquatic vegetation may or may not be present, with less instream features such as woody debris and limited or no variety of geomorphological features. These creeks would provide fish passage during rain events and refuge for fauna such as turtles. Poor condition watercourses had poorly or no defined bed and banks and were typically a dry gully or depression, lacking aquatic vegetation with no habitat for fish or other fauna.

Dams were present throughout the site and have been described in Table 2. Overall, dams provided habitat for fish, frogs, turtles and water and wader birds.

4.3.1 First-order Creeks

Table 1: First-order reach descriptions

Reach	Proposed WM Act status (pending NRAR approval)	Description	Condition	Photo facing upstream	Photo facing downstream
1A	Not a river	No defined bed or banks. Overland flow path in times of overtopping dam	Poor		
1B	Not a river	No defined bed or banks	Poor		

Reach	Proposed WM Act status (pending NRAR approval)	Description	Condition	Photo facing upstream	Photo facing downstream
1C	Not a river	No defined channel, bed or banks	Poor		
1D	Not a river	No defined bed or banks. Mown grass for almost entire length of mapped location.	Poor		
1F	Not a river	No defined bed or banks. Overland flow path at a low point only.	Poor		

Reach	Proposed WM Act status (pending NRAR approval)	Description	Condition	Photo facing upstream	Photo facing downstream
1G	Not a river	No defined bed or banks. Areas of saturated soil following recent heavy rain.	Poor		
1H	Not a river	No defined channel. Informal track near mapped location of this watercourse, likely created by stock accessing dam.	Poor		
1I	River	Defined channel approximately 1 m wide that started at a headcut about 60 m to the south east of the main channel 2B. Densely covered in *Olea europaea* subsp. *cuspidata* (African Olive) and no groundcover vegetation, allowing for easy erosion of banks and bed of channel.	Poor		

Reach	Proposed WM Act status (pending NRAR approval)	Description	Condition	Photo facing upstream	Photo facing downstream
		Right bank steeply sloped, approximately 0.5 m high. Household rubbish visible within this channel.			
1J - upper	Not a river	No defined channel upstream of the dam on this watercourse.	Poor		
1J - lower	River	Defined channel at Belmore Road. Single concrete box culvert approximately 1.5 m wide and 0.75 m high carries flow under Belmore Road to confluence with 2B.	Moderate		

Reach	Proposed WM Act status (pending NRAR approval)	Description	Condition	Photo facing upstream	Photo facing downstream
1K	River	Near the top of this watercourse, the channel had been rock lined within multiple properties. The channel was less-defined as it neared the confluence with 2B.	Poor - moderate		
1L (at Belmore Road)	River	Upstream of Belmore Road there was no defined channel, however there appears to be a constructed drainage line within the property downstream of Belmore Road where access was restricted.	Poor		
1M	Not a river	No defined channel. Overland flow paths across pasture were observed following recent rain.	Poor		

4.3.2 Second order creek

4.3.2.1 2A

Reach 2A started further downstream than was mapped on the Strahler layer. It started as a wet depression with a variety of sedges before becoming a well-defined creek where it flowed through three large pipes. On the downstream side of these pipes, the creek was heavily disturbed, with evidence of bed and bank erosion observed and building rubble within the creekline.

Facing upstream – large pipes near top of 2A

Facing downstream – eroded channel

The channel narrowed as it continued downstream, with pools of standing water observed in the creek following recent rain. The channel was shallow and narrow with no aquatic flora observed. Riparian vegetation was predominantly native, with a continuous band between the right bank of 2A and left bank of 2B.

Facing upstream

Facing downstream

Where the channel neared the confluence with 3A, it became a wide, less-defined channel. The creek is likely to have been previously modified in this area, as it had a sharp turn in it as it flowed south towards the confluence with 3A.

Facing upstream – upstream of confluence with 3A

Facing downstream

4.3.2.2 2B

Reach 2B was only field validated where it was within Lot 6 DP1216926 and where it crossed Belmore Road, where access was available.

The upstream extent of 2B was a large dam at the base of sloping fields lacking in canopy cover and densely covered in exotic pasture grasses. The dam was overflowing around the north-eastern side at a low point, rather than through a defined spillway. Downstream of the dam the channel of 2B was approximately 20 m wide in some areas. Water sheeted across this area, which was covered in short exotic grass including *Cynodon dactylon* (Couch). Some small gravels (3 – 5 mm diameter) were observed on the channel bed in this wide section of watercourse and the banks showed signs of historical erosion, likely during very high flows, and were approximately 1.5 m high. The riparian vegetation was sparse and patchy alongside this section of 2B and did not form a continuous strip of vegetation alongside the dam and overflow area.

Facing upstream – below large dam

Facing downstream – wide channel.

Approximately 100 m downstream of the dam on this reach, the dispersed flow converged at headcut within the channel. The headcut was shallow, in that it was approximately 0.3 m high, however erosion in this area had exposed large pieces of slate and tree roots. Water flowing over the headcut created a small riffle area and scattered *Juncus usitatus* was observed on the edge of the channel downstream of this riffle.

Facing upstream

Facing downstream – headcut

Upstream of the confluence of 2B and 1I, a headcut was observed on the right bank and a flood runner was evident parallel to the left bank. The channel was shallow, and the channel banks were low with a gentle grade. Leaf litter was observed on the channel bed and this litter was covered in a fine silty deposit. The channel was wide through this area, up to 15 m wide in some areas. The water was tannin-stained and still but not stagnant and there was a small amount of vegetation overhanging the edges of the channel. No aquatic vegetation was observed in this part of 2B.

Facing upstream

Facing downstream

Opposite the confluence of 2B and 1I, a well-defined overland flow path joined the main channel of 2B. There was no mapped watercourse in the location of this overland flow area, however it was approximately 3 m wide in most areas, up to 5 m at it its widest point, with banks approximately 1.5 m high. No aquatic vegetation was observed in this area and the bed had scattered gravel on the clay substrate bed.

Approximately 100 m upstream of the boundary fence between Lot 6 DP 1216926 and Lot 94 DP 864637, 2B existed as a braided channel, in that the flow was split around small instream islands containing juvenile *Eucalyptus tereticornis* (Forest Red Gum). A small area of undercutting of the right bank was observed in this area. Water in the channel was stained by tannins. The channel itself was partly shaded at the time of survey (9:30 am).

Facing upstream

Facing downstream

Facing upstream

Facing downstream

At the downstream end of the accessible portion of 2B, this watercourse was a wide, shallow creek following recent rain. A large amount of instream woody debris was present and flood debris was observed against the fence line at the northern end of this Lot. Visibility through the shallow water column was good on the day of the site survey and no odour or sheen were evident. The creek had a silty substrate, and no active areas of erosion were observed. The creek banks sloped gradually away from the channel. Riparian vegetation alongside this section of the watercourse was dense and was comprised of a native canopy with a disturbed shrub layer dominated by *Olea europaea* subsp. *cuspidata* (African Olive).

Facing upstream

Facing downstream

Two concrete box culverts, each approximately 1 m high and 1.5 m wide carried the flow under Belmore Road. No geomorphic features were observed downstream of this area, with the water flowing through a defined channel that had sandstone boulders armouring the left bank and a more gradual sloping right bank. No aquatic vegetation was observed in this area of the channel, whilst riparian vegetation was comprised of scattered *Eucalyptus* sp. with *Agapanthus praecox* subsp. *orientalis* (Agapanthus) growing on the top of the sandstone-boulder bank. Overall, this watercourse was in moderate condition, as it had a variety of instream geomorphological features and limited bed and bank erosion was observed, however macrophytes within the channel were non-existent.

Facing upstream

Facing downstream

At the rear of properties along Belmore Road, 2B was a 10 m wide channel in some areas. Emergent macrophytes including *Ludwigia peploides* were observed growing on the edge of the channel and a number of large fallen trees have created good aquatic habitat within this area. Water in the channel was tannin-stained but not turbid. At the rear of 58 Belmore Road, the creek became a wetland up to 40 m wide and covered in dense *Typha orientalis* and *Azolla* sp. *Rubus fruticosus* (Blackberry) was observed in dense clumps along the right bank of the channel.

Facing upstream

Facing downstream – large woody debris in channel

Facing upstream – wetland area

Facing downstream

Table 2: Habitat in dams

Reach	Dam number*	Description	Aquatic fauna observed	Aquatic flora observed	Representative photo
1A	1	Large dam near the upstream mapped extent of reach 1A. No defined spillway and a few sparse Eucalyptus moluccana on the edges of the dam.	*Platalea regia* (Royal Spoonbill) was observed near this dam.	No aquatic flora	
1A	2	Large dam near Greendale Road. At time of survey, water in the dam was clear with no oil sheen or odours.	No aquatic fauna observed.	Emergent macrophytes including *Persicaria strigosa*	
1F	1	No defined spillway but evidence of overflow after recent rain.	Frog eggs attached to submerged grasses.	Submerged *Typha orientalis* (Cumbungi).	

Reach	Dam number*	Description	Aquatic fauna observed	Aquatic flora observed	Representative photo
N/A		Small dam in between mapped reaches 1G and 1F. At capacity at time of site survey, overflowing to north behind artificial swale perpendicular to slope. Water was turbid and stagnant, with slight odour.	Frog eggs attached to submerged grasses.	No aquatic flora.	
1G	1	Dam located to south west of mapped location of 1G. Small dam with no fringing vegetation and raised dam wall on eastern side of dam but no defined spillway. Turbid water with submerged pasture grasses and emergent macrophytes. Vegetative debris floating on surface of water.	Frog eggs attached to submerged grasses.	No aquatic flora.	
1M	1	Dam located at top of this mapped watercourse, outside accessible area. Surrounded by scattered *Olea europaea* subsp. *cuspidata, Bursaria spinosa* and exotic pasture grasses.	No fauna observed.	No aquatic flora observed.	No photo available

Reach	Dam number*	Description	Aquatic fauna observed	Aquatic flora observed	Representative photo
1M	2	Dam at capacity following recent rain, water slightly turbid and no fringing vegetation present. Clay substrate and no defined spillway on downstream side.	*Porphyrio porphyrio* (Purple Swamphen) and *Phalacrocorax sulcirostris* (Little Black Cormorant).	*Ludwigia peploides.*	
1M	3	There were no defined banks to this dam, which appeared to be nearing capacity. No macrophytes were observed in this dam and visibility through the water column was good.	*Porphyrio porphyrio* (Purple Swamphen), *Anas castanea* (Chestnut Teal) and *Phalacrocorax sulcirostris* (Little Black Cormorant).	No aquatic flora observed.	
1M	4	Dam near bottom of mapped location of 1M, outside of accessible area. Dam nearing capacity and fringed by *Casuarina* sp.	*Porphyrio porphyrio* (Purple Swamphen) and *Litoria peronii* (Peron's Tree Frog).	No aquatic flora observed.	

Reach	Dam number*	Description	Aquatic fauna observed	Aquatic flora observed	Representative photo
N/A		Dam within Lot 5 DP1216926, at base of grassy slope with cattle grazing on edges of dam. Dam overflowing to the south on day of survey, evidence of erosion in this area. Scattered *Eucalyptus* sp. around dam.	No aquatic fauna.	Floating macrophytes observed but species could not be identified due to access.	
N/A		Dam located to south of driveway on Lot 6 DP 1216926. Not on a mapped watercourse, fenceline bisected dam with no fringing vegetation and a few scattered *Eucalyptus* sp. on western side of dam. Clay substrate with turbid water on day of survey.	No aquatic fauna.	No aquatic flora.	
1J	1	No defined edges of dam and no defined channel upstream or downstream of dam. Turbid water observed and dam near capacity on day of site survey.	*Porphyrio porphyrio* (Purple Swamphen) and *Anas castanea* (Chestnut Teal).	*Lemna disperma* (Duckweed).	

Reach	Dam number*	Description	Aquatic fauna observed	Aquatic flora observed	Representative photo
2B	1	Large dam at capacity on day of site survey, overflowing at low point on north eastern side. No defined spillway. Visibility through the water column was approximately 0.5 m. The downstream edge of the dam had a few scattered *Olea europaea* subsp. *cuspidata.* There was no dense fringing vegetation around this dam. Cattle were in the south-western end of dam at time of site survey.	*Cygnus atratus* (Black Swan), *Phalacrocorax sulcirostris* (Little Black Cormorant) and *Egretta novaehollandiae* (White-faced Heron).	*Marsilea mutica* (Rainbow Nardoo), scattered sparse *Juncus usitatus.*	
2B	2	Small online dam within Lot 12 Section 8 DP2650. Good aquatic habitat, with emergent macrophytes present in dam.	No aquatic fauna observed.	*Persicaria orientalis* (Slender Knotweed) and *Juncus usitatus.*	

*dams are numbered in order along creek: upstream to downstream

4.4 Riparian Habitat

The condition of riparian vegetation throughout the site was predominantly good. The central creekline, watercourse 2B, had a continuous vegetated riparian corridor, with the exception of in the vicinity of the dam at the upstream extent of this channel. Along watercourse 2B, the riparian vegetation was part of the BC Act listed Critically Endangered Ecological Community (CEEC) *Cumberland Plain Woodland in the Sydney Basin Bioregion* (Figure 4). Vegetation within this area was characterised by a canopy dominated by *Eucalyptus tereticornis* (Forest Red Gum) and *Eucalyptus moluccana* (Grey Box). The midstorey was dominated by *Olea europaea* subsp. *cuspidata* and scattered occurrences of *Bursaria spinosa*. The groundcover was dominated by native species including *Paspalidium distans*, *Sporobolus creber* (Western Rat-tail Grass), *Glycine tabacina* and *Einadia nutans* (Climbing Saltbush). On the western side of channel 2B, the vegetated riparian corridor was up to 160 m wide and up to 50 m wide on the eastern side of the watercourse.

In some areas, such as the riparian corridor along 1J, the lack of fully structured vegetation was contributing to the erodibility of the channel bed and banks and the deeply incised nature of the watercourse. Vegetation alongside 1J was predominantly *Olea europaea* subsp. *cuspidata* with no groundcovers providing stability to the channel bed and banks, and the resultant incised channel shape was likely due to high velocity flows over the riparian land.

Vegetation surrounding the dams on site was very limited. Most of the dams within the field-validated areas had little to no vegetation on the fringes. The water in the dams was often turbid, likely due to flows into the dams passing over bare or poorly vegetated areas and allowing for sediment to be entrained in these flows.

Following field validation of the accessible watercourses, it was calculated that approximately 14.5 ha of riparian area currently exists within the Belmore Road Precinct. This does not include riparian areas of hydrolines that are unlikely to be a river (subject to validation).

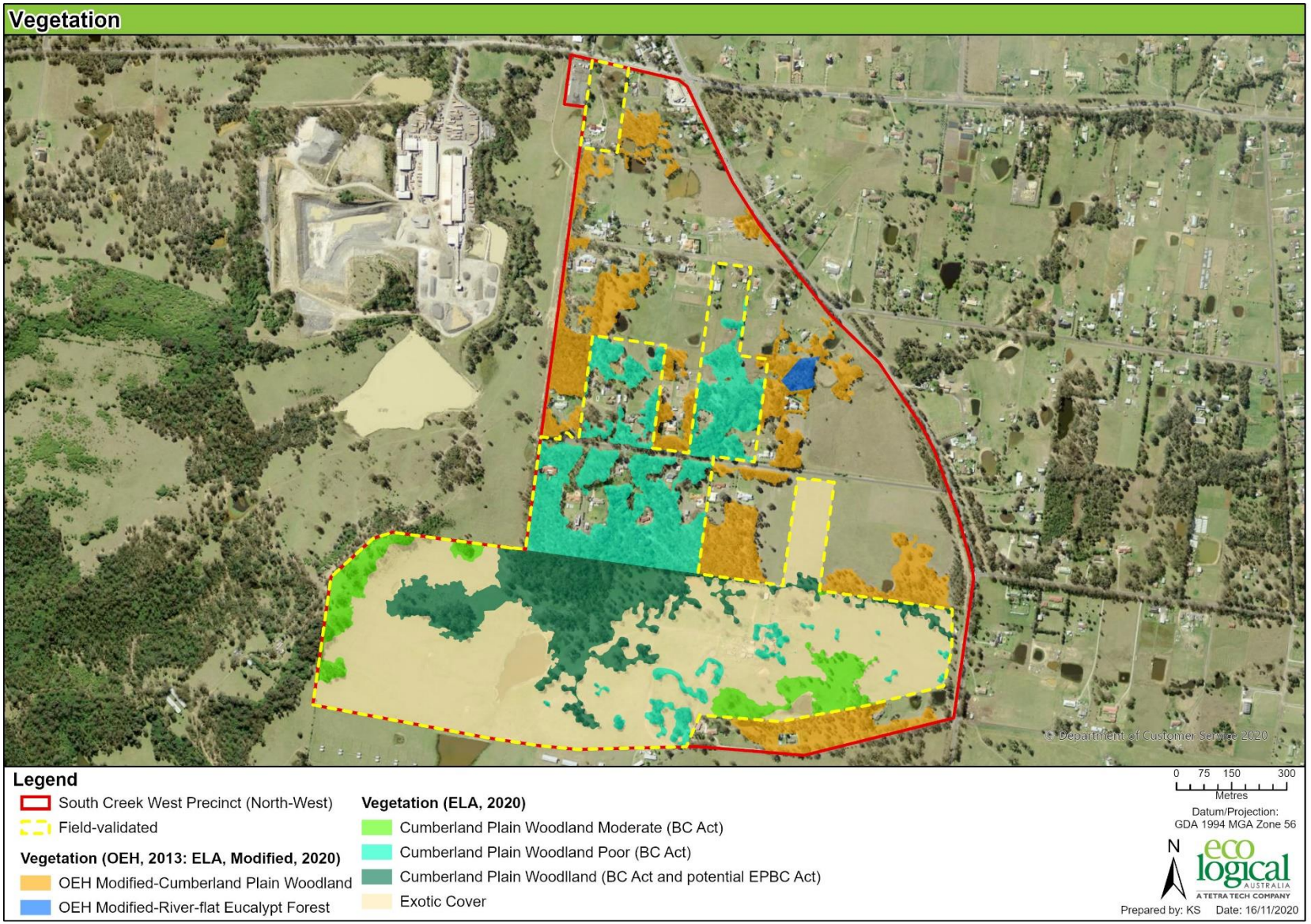

Figure 4: Validated vegetation communities and condition

4.5 Groundwater Dependant Ecosystems

There were two areas of GDE mapped in the study area (Figure 5). The BOM GDE Atlas identified that the vegetation within these areas was Cumberland Shale Plains Woodland and Cumberland Shale Hills Woodland, both of which are part of the CEEC *Cumberland Plain Woodland in the Sydney Basin Bioregion.* Vegetation validation within these areas identified that this vegetation community was present where the Atlas mapping indicated a high likelihood of GDEs to be present. However, definitive determination regarding the reliance on groundwater would require a hydrological survey to determine the level of the groundwater table.

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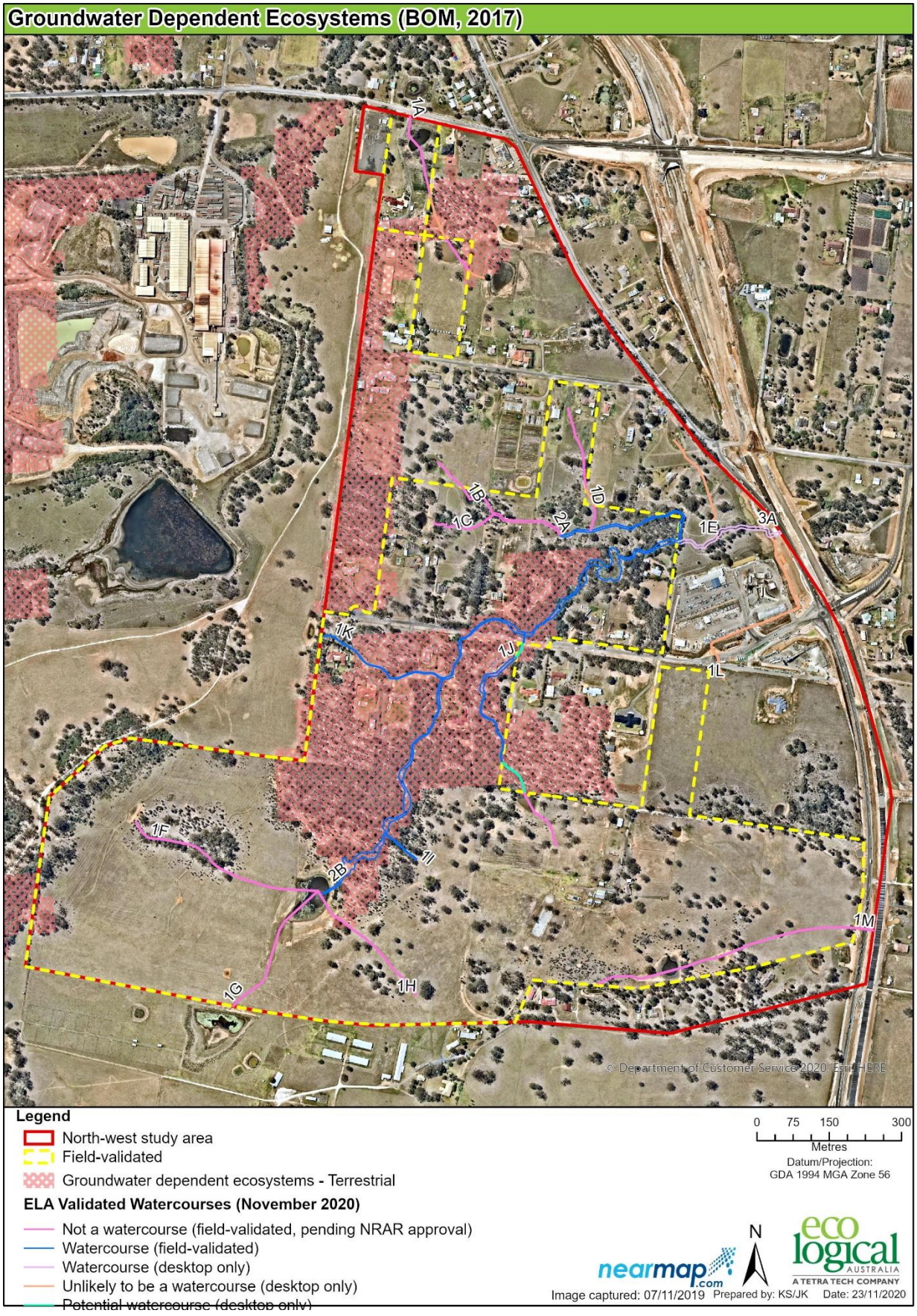

Figure 5: Potential Groundwater Dependent Ecosystems mapped within study area

5. Recommendations

5.1 Indicative layout plan

As outlined within the Western City District Plan (Greater Sydney Commission, 2018), improving sustainability is at the forefront of future strategic planning and development. Such improvements are focused on incorporating natural landscape features into the urban environment and protecting and managing natural systems. It is recognised that all aspects of sustainability rely on maintaining and managing green infrastructure such as waterways and remnant patches of native vegetation. Therefore, optimising and protecting existing assets will be essential in ensuring the ongoing health and sustainability of the Belmore Road Precinct.

An initial indicative layout plan (ILP) has been developed (Figure 8). The ILP proposes to retain13.96 ha of riparian corridor.

The primary creek corridor, consisting of 2A, 2B and 3A in the centre of the site has been proposed to be retained and rehabilitated. The ILP proposes removal of all other creeks and dams. The proposed ILP will therefore provide an opportunity to:

- Improve the necessary health and quality of the existing waterways and riparian corridors within the Precinct
- Improve public access to, and along, the riparian corridors; providing connected green space
- Protect and enhance flora, fauna and urban bushland
- Reduce erosion and sedimentation and improve bank stability
- Provide riparian vegetation buffers; allowing the recovery and reinstatement of more natural conditions within currently highly modified waterways.

The ILP proposes to retain the areas of watercourse and riparian land that were in moderate to good condition at the time of the survey and have the highest recovery potential.

Based on the results of the desktop study and field validation where access was granted, there is a total of 12.2 ha of riparian zone on the site. Note this includes the first order watercourses within the northern portion of the site that are unlikely to be a watercourse, however, have not been field validated. Subject to field validation of the northern part of the site and NRAR review, if these first order watercourses do not meet the definition of a watercourse, there is 10.8 ha of riparian zone on the site. The ILP proposes to protect 13.96 ha therefore, regardless of if the first order watercourses that were not accessible meet the definition of a watercourse or not, the ILP meets the NRAR averaging rule. This is summarised in Table 3 below.

Table 3: Total riparian zone areas

	Riparian Zone (ha)	ILP Riparian Protection (ha)	Averaging Rule Met (Y/N)
Option One: If non-field validated watercourses meet the definition of a watercourse	12.2	13.96	Yes (1.76 ha surplus)
Option Two: If non-field validated watercourses do not meet the definition of a watercourse	10.8	13.96	Yes (3.16 ha surplus)

In addition, these existing riparian areas are not actively managed as vegetated riparian zones. Under the proposed ILP, these retained riparian areas would be maintained and revegetated where applicable as part of a Riparian Management Strategy and future vegetation management plans.

Where proposed works are not consistent with the *Guidelines for Controlled Activities on Waterfront Land* (NRAR, 2018), the principles of the WM Act can guide activities that are to take place on waterfront land and be used to provide a merit-based assessment of the proposed development.

The principles set out in this section are the water management principles of this Act.

Generally:

a. *water sources, floodplains and dependent ecosystems (including groundwater and wetlands) should be protected and restored and, where possible, land should not be degraded, and*
b. *habitats, animals and plants that benefit from water or are potentially affected by managed activities should be protected and (in the case of habitats) restored, and*
c. *the water quality of all water sources should be protected and, wherever possible, enhanced, and*
d. *the cumulative impacts of water management licences and approvals and other activities on water sources and their dependent ecosystems, should be considered and minimised, and*
e. *geographical and other features of Aboriginal significance should be protected, and*
f. *geographical and other features of major cultural, heritage or spiritual significance should be protected, and*
g. *the social and economic benefits to the community should be maximised, and*
h. *the principles of adaptive management should be applied, which should be responsive to monitoring and improvements in understanding of ecological water requirements.*

In relation to controlled activities:

a. *the carrying out of controlled activities must avoid or minimise land degradation, including soil erosion, compaction, geomorphic instability, contamination, acidity, waterlogging, decline of native vegetation or, where appropriate, salinity and, where possible, land must be rehabilitated, and*
b. *the impacts of the carrying out of controlled activities on other water users must be avoided or minimised.*

While the total area of riparian corridors to be retained under the ILP is less than what exists on site currently (assuming the first order watercourses that were not field validated meet the definition of a watercourse), the ILP allows for protected and rehabilitated watercourses to be established. Under the Riparian Management Strategy and future vegetation management plans, these vegetated channels will become protected waterways within the new precinct which is an improvement on the current condition, as they receive no observable maintenance and exotic flora species dominate some areas of the riparian buffer.

Watercourse protection also allows for an improvement in water quality within the precinct, as stable beds and banks would be created and the revegetation and weed control of riparian areas would allow for a buffer between the residential areas proposed for the site and the waterway itself.

Within the proposed riparian corridor shown on the ILP (the majority of which is a second order watercourse), an online detention basin is proposed. No excavation is required in the channels in order to allow these basins to be developed. In accordance with Table 2 of the *Guidelines for Controlled Activities on Waterfront Land* (NRAR, 2018), an online basin on a second order watercourse is permissible if the requirements in Table 4 are met.

Table 4: NRAR guidelines requirements for online basins

Requirement	Comment
Online detention basins must be dry and vegetated.	The proposed basins will operate as dry detention basins and will be fully vegetated. Current riparian vegetation includes both the Cumberland Plain Woodland and River-flat Eucalypt Forest vegetation communities, and the existing watercourses are predominantly ephemeral. The hydraulic model allows for a fully structured riparian corridor to form part of the new development with a Manning's n value of 0.12 for flood levels less than 0.5 m deep and 0.03 for flood levels greater than 0.5 m deep, when it is likely that shrub and grass vegetation would fold over and offer limited resistance. The VRZ is expected to be periodically inundated as shown in Figure 6 and Figure 7 below. This may result in a change in species composition to include species that are adapted to longer periods of inundation, such as those typically found in within the River-flat Eucalypt Forest vegetation community. It is possible that species in both the Melaleuca and Casuarina genus may establish in the future. It is therefore recommended that revegetation works in the currently cleared areas within the riparian corridor consist of species typically found within the River-flat Eucalypt Forest vegetation community.
Online detention basins must be for temporary flood detention only, with no permanent water holding.	Modelling for 1% and 50% Annual Exceedance Probability (AEP) events has been completed by J Wyndham Prince (2021). Modelling shows the basins empty relatively quickly, with only the natural low points within the watercourse at the outlet structure remaining inundated for more than 4 hours in the more frequent 50% AEP event (Figure 6). In a rarer 1% AEP, only the lower portion of the downstream extent of the riparian corridor would be inundated for more than 2 hours, and the entire basin would empty within 15 hours (Figure 7).
Online detention basins must have an equivalent VRZ for the corresponding watercourse order.	The existing VRZ area is 12.2 ha, assuming that all mapped first order watercourses that haven't been able inspected meet the definition of a 'river' under the WM Act. The area of VRZ proposed to be retained under the ILP is 13.96 ha, which is greater than the existing VRZ area.

Requirement	Comment
Online detention basins must not be used for water quality treatment purposes.	The water quality management is undertaken in separate stand-alone devices outside the outer 50% VRZ. The location of these structures is shown in Figure 8.

In general, the ILP is consistent with the objectives of the WM Act and aims to apply the principles of ecological development by rehabilitating areas with the highest recovery potential to restore natural ecological processes along the primary watercourses. It considers the site in terms of the broader catchment and focusses on rehabilitating areas that have the highest potential for recovery.

Figure 6: Detention basin time of inundation map for 50% AEP developed conditions (J. Wyndham Prince, 2021)

Figure 7: Detention basin time of inundation map for 1% AEP developed conditions (J. Wyndham Prince, 2021)

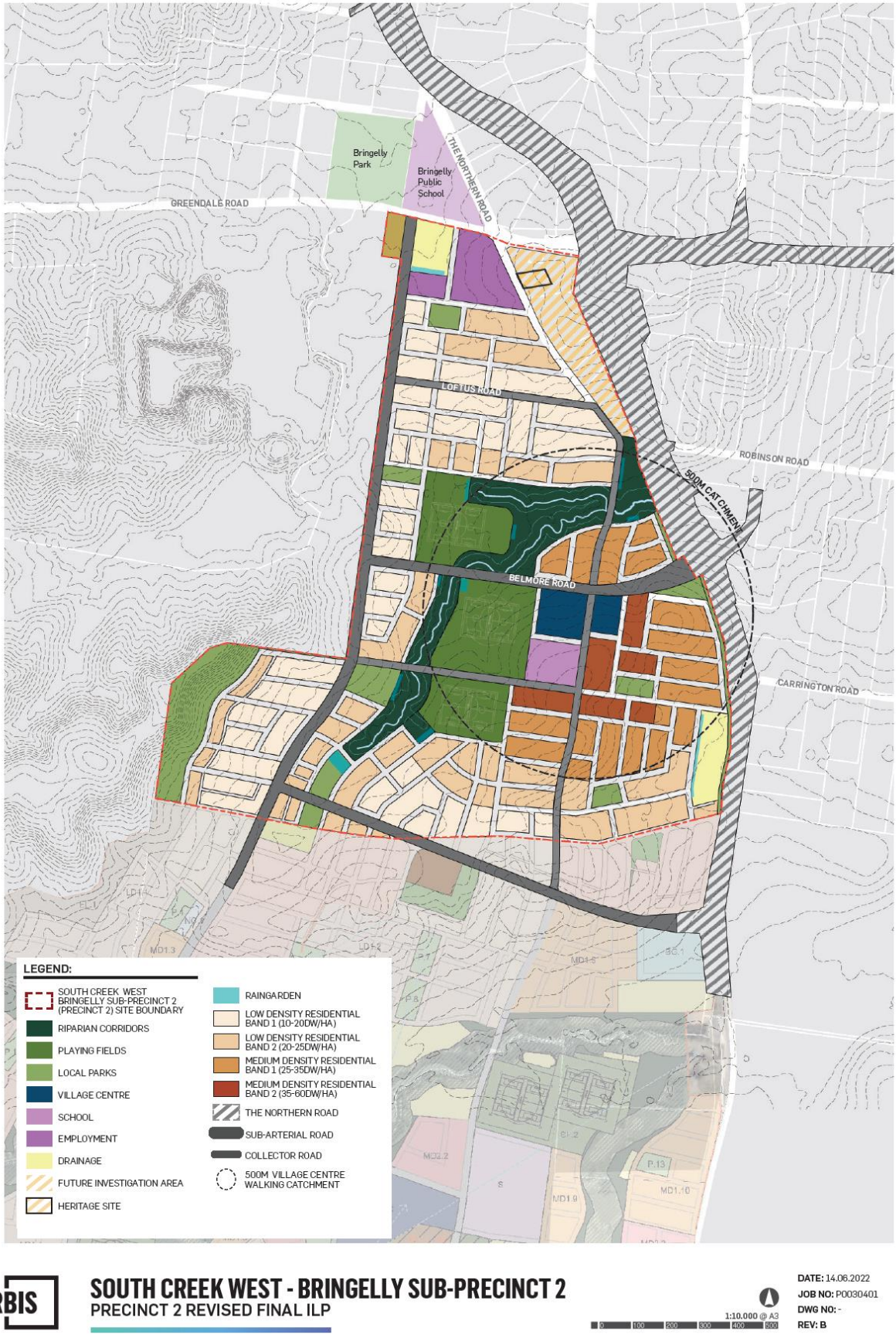

Figure 8: Draft Indicative Layout Plan (Urbis, 2022)

5.2 Watercourses

The aim of this report is to identify key riparian constraints to assist the design of the ILP and the principles of the legislation addressed in Section 2 and Appendix A, are to provide for the sustainable and integrated management of the waterways of the state.

There were 13 first order reaches in the study area, of which eight did not meet the definition of a 'river' under the WM Act, as they had no defined bed and banks. NRAR should be consulted to confirm that these do not require protection under the WM Act.

Assuming the above 'watercourses' are removed from the mapping, there would be 12.2 ha of riparian corridor within the north-west site. This includes first-order watercourses that may not meet the definition of a river but have not been field-validated. Watercourses that meet the definition of a river in moderate or good condition should be retained where possible. The ILP aligns with this current position, by retaining the central creek system which had the highest habitat value of assessed watercourses.

In general, NRAR's policy requires management and rehabilitation of the riparian land to a functional community, fully protected and vegetated with native endemic riparian plant species, creating a Vegetated Riparian Zone (VRZ). If, however, the intention is to manage the vegetation for non-riparian purposes, such as Asset Protection Zones in the outer 50%, the riparian offsetting guidelines would apply to compensate the reduced VRZ. The inner 50% would still require protection. If offsets are required elsewhere, the average width of the riparian zone would need to be maintained to meet the NRAR's guidelines. There is the opportunity to rehabilitate the VRZ with native riparian species which will ultimately improve the instream habitat.

5.3 Groundwater Dependant Ecosystems

The mapped GDEs were confirmed to be vegetated areas of Cumberland Plain Woodland on site, as was mapped in the GDE Atlas. The degree to which these ecosystems rely on groundwater for their survival is unknown and additional groundwater assessment is recommended. In areas where the Cumberland Plain Woodland is to be retained under the ILP (primarily along the second order watercourses) activities that involve interception of the water table, such as deep excavation, should be avoided to prevent changes in the groundwater characteristics.

5.4 Riparian Management Strategy

The subject site is dominated by Cumberland Plain Woodland in varying conditions. The southern portion of the site also contains large areas of Exotic Cover, predominantly where the land has been used for grazing stock.

While all of the Cumberland Plain Woodland within the subject site meets the description of the critically endangered ecological community listed under the BC Act, 15.66 ha meets the definition of the federally listed Cumberland Plain Shale Woodland and Shale Gravel Transition Forest. This potentially EPBC Act listed vegetation is located along the main creek line, where a vegetated riparian corridor is to be retained. The overarching riparian management strategy outlines future restoration potential of native vegetation along riparian zones in the precinct with broad objectives to re-establish characteristic diversity of indigenous plants and communities whilst reducing exotic weed cover.

5.4.1 Averaging rule

As discussed in Section 5.2, NRAR's guidelines provide an Averaging Rule, which allows non-riparian works / activities to be carried out within the outer riparian corridor provided that the average width of the riparian zone can be achieved over the length of the watercourse within the development site. Under this rule, the outer 50% of the riparian corridor may be used for development lots, infrastructure, and other non-riparian uses provided that an equivalent area connected to the riparian corridor is offset on the site. The inner 50% of the riparian corridor must be protected and fully revegetated.

The future riparian management areas are based on the locations of existing riparian corridors, that have the highest likelihood of full rehabilitation but may vary be varied in the future subject to detailed designs.

5.4.2 Recovery potential

Recovery potential relates to the degree, manner, and pace of an area to recovery after disturbance or stress and is impacted by factors including vegetation composition, structure and function of remaining vegetation, biodiversity and presence of key weed species. A moderate to good recovery potential allows the land to be managed for an improvement in the condition of the remnant vegetation and to increase linkages (wildlife corridor) between extant stands of vegetation.

With appropriate management actions, areas identified as having a moderate recovery potential would improve the condition of threatened species habitat and ecosystem connectivity within the precinct. Management actions would need to be on-going and facilitate the natural regeneration of the over-storey and/or regeneration of native species (grasses, herbs, and forbs) in the seed bank.

The following four classes of recovery potential have been identified within the subject site (Figure 9):

- High Recovery Potential – native vegetation mapped as areas which generally have native canopy cover of greater than 10% and contained native species in each structural layer
- Moderate Recovery Potential – other areas of native vegetation with some canopy, less structural complexity, and a higher level of weed infestation or ongoing disturbance
- Low Recovery Potential –areas which show some potential for natural regeneration. Some native species present in some structural layers, very high level of weed infestations, not all structural layers present
- Very Low Recovery Potential – all other areas including cleared and heavily cultivated and/or pasture improved areas.

Areas along the central creek line have high recovery potential which indicates that rehabilitating the riparian corridor along watercourses 2A, 2B and 3A has a high feasibility of obtaining a functioning, fully structured native vegetated corridor. The recommended areas of rehabilitation target the watercourses that already have moderate to good condition vegetation established, for example around 2A, 2B and3A. Actively managing these vegetated areas through weed control and revegetation where required connectivity of wildlife corridors and overall creek condition. This would incidentally facilitate the recovery of the creek systems to a high-functioning natural waterway.

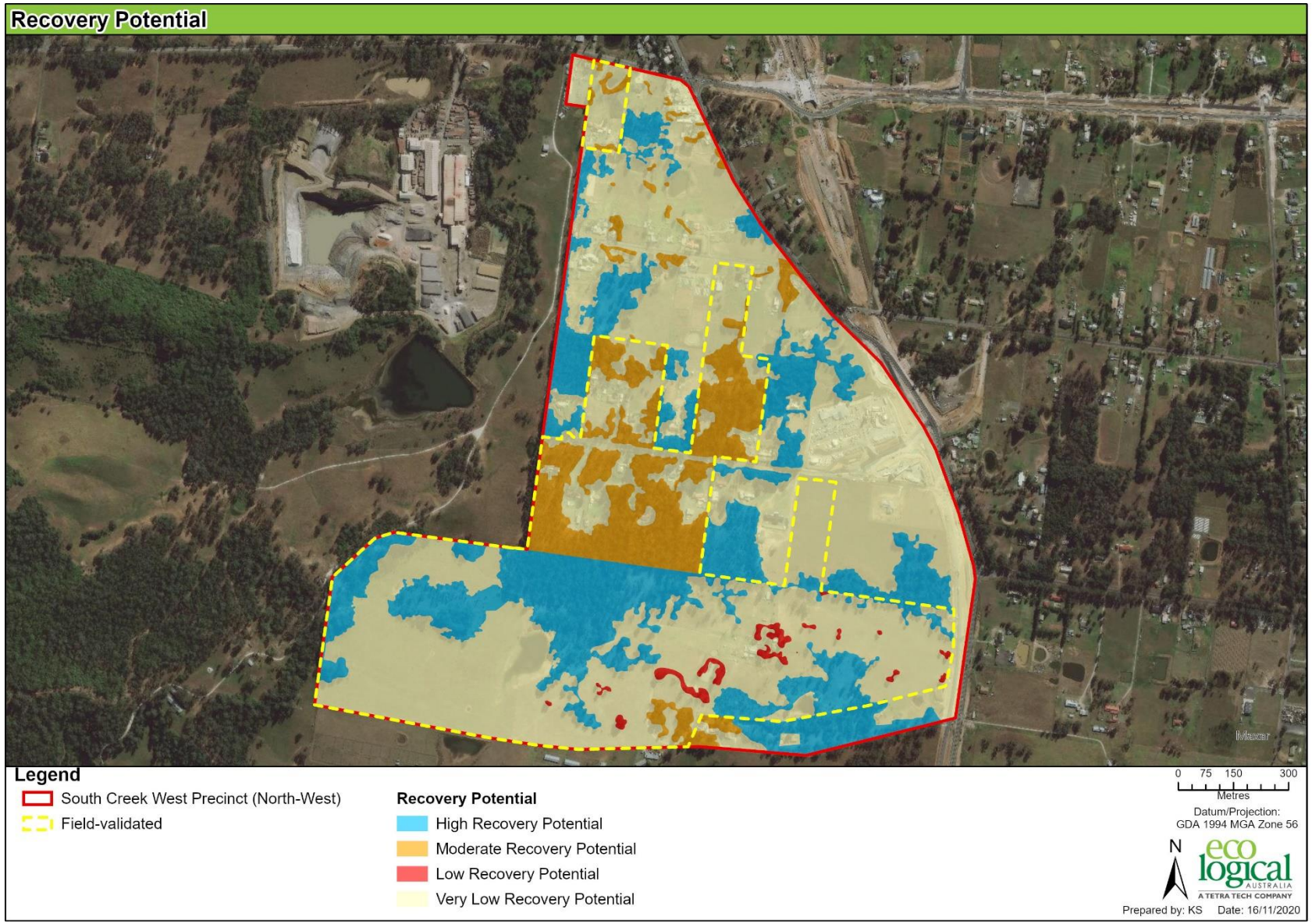

Figure 9: Recovery potential of areas within study area

5.4.3 Management Zones

The area of the riparian corridor proposed to be retained within the ILP is approximately 13.96 ha and is proposed to be entirely managed. The rehabilitation works for the riparian corridor will be focused on weed control, assisted regeneration and revegetation. The riparian corridor consists of two management zones as identified below and in Figure 10.

- Zone 1: Weed Control and Rehabilitation
- Zone 2: Weed Control and Revegetation.

An assessment of the native resilience and weed densities was conducted during field surveys. The vegetation within the riparian corridor is generally in moderate condition with high weed densities in the shrub layer where African Olive was present. At the interface between good quality Cumberland Plain Woodland and areas of exotic cover, ongoing management would be required to supress the spread of these exotic species into good quality riparian vegetation.

5.4.3.1 Management Zone 1 (MZ1): Weed Control and Rehabilitation

The key management priorities and required management actions are:

- Target removal of priority and environmental weeds
- Control of exotic grasses and other exotic species
- Monitor native vegetation and weed densities.

5.4.3.2 Management Zone 2 (MZ2): Weed control and Revegetation

The key management priorities and required management actions are:

- Target removal of priority and environmental weeds
- Control of exotic grasses and other exotic species
- Tubestock planting following weed control in areas of low resilience. Tubestock planting in areas of regular inundation should be diagnostic of the River-flat Eucalypt Forest vegetation community.
- Monitor native vegetation and weed densities.

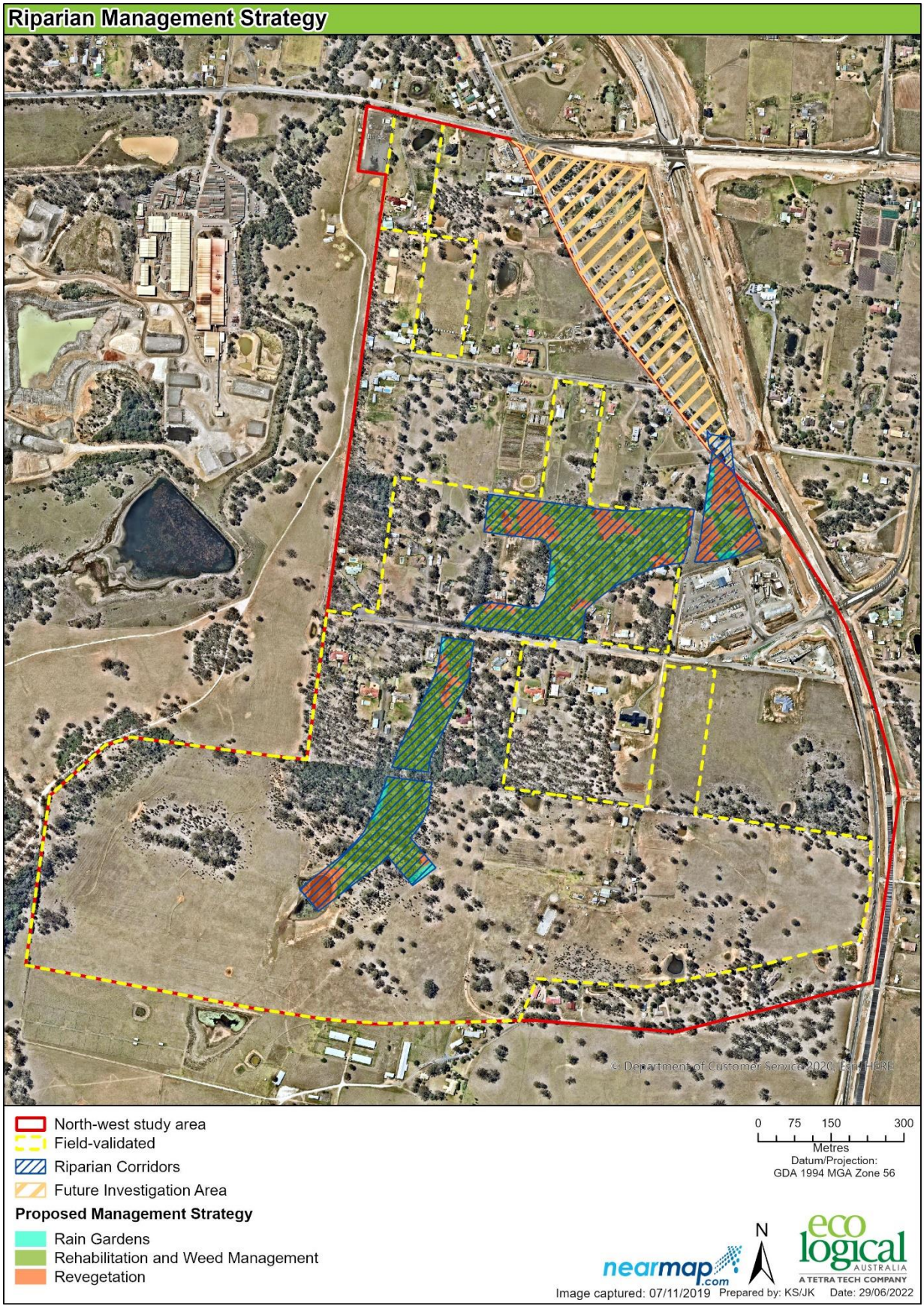

Figure 10: Riparian Management Strategy zones

5.4.4 Zoning, Development Controls, Ownership and Management

Using previous precincts within the Growth Centres as examples, riparian corridors proposed for conservation are generally mapped within a native vegetation protection layer and either considered Existing Native Vegetation (ENV) or Native Vegetation Retention (NVR). The following development controls may therefore be relevant:

Existing Native Vegetation

The consent authority must not grant development consent for development on land to which this clause applies unless it is satisfied that the proposed development will not result in the clearing of any existing native vegetation (within the meaning of the relevant biodiversity measures under Part 7 of Schedule 7 to the *Threatened Species Conservation Act 1995*).

Native Vegetation Retention

Development consent under this clause is not to be granted unless the consent authority is satisfied of the following in relation to the disturbance of native vegetation—

a. that there is no reasonable alternative available to the disturbance of the native vegetation,
b. that as little native vegetation as possible will be disturbed,
c. that the disturbance of the native vegetation will not increase salinity,
d. that native vegetation disturbed for the purposes of construction will be reinstated where possible on completion of construction,
e. that the loss of remnant native vegetation caused by the disturbance will be compensated by revegetation on or near the land to avoid any net loss of remnant native vegetation,
f. that no more than 0.5 hectares of native vegetation will be cleared unless the clearing is essential for a previously permitted use of the land.

Riparian corridors are also generally mapped as Riparian Protection Areas (RPA). The development controls for these areas differ between precincts, however, generally have the following same objectives within the relevant Growth Centre Development Control Plans (DCPs):

- Within land that is in a RPA, native vegetation is to be conserved and managed in accordance with the Guidelines for riparian corridors on waterfront land prepared by the NRAR
- Development on land that adjoins land zoned Environmental Conservation is to ensure that there are no significant detrimental impacts to the native vegetation and ecological values of the Environmental Conservation zone.

Areas of ENV, NVR or RPA are generally also zoned as Environmental Conservation in other Precinct Plans. However, there are also cases where mapped RPA is zoned as Public Recreation or Infrastructure. DPIE has generally not been supportive of these unless they were also placed in public ownership and conservation of the RPA was a clear priority for the site. The permissible uses within the Environmental Conservation zones are shown below.

Zone	Permitted without consent	Permitted with consent	Prohibited
Environmental Conservation	Nil	Drainage; Earthworks; Environmental facilities; Environmental protection works; Flood mitigation works; Information and education facilities; Kiosks; Recreation areas; Roads; Signage; Waterbodies (artificial)	Business premises; Hotel or motel accommodation; Industries; Multi dwelling housing; Recreation facilities (major); Residential flat buildings; Restricted premises; Retail premises; Seniors housing; Service stations; Warehouse or distribution centres; Any development not specified in item 2 or 3.

Some precinct plans under the Sydney Region Growth Centres SEPP[1] (e.g. Blacktown Growth Centres Precinct Plan) require a Vegetation Management Plan to be prepared and implemented when residential land adjoining Environmental Conservation zoned land is developed. If such a clause were to be included in the Belmore Road Precinct plan, it would have significant cost implications for the site. It is therefore prudent to understand the government's expectations for these lands and developing a preferred outcome. Whilst not an exhaustive list, some options would be:

- maintain land in current ownership with little/no development entitlements
- subdivide land so that Environmental Conservation zoned land is attached to a small number of properties which have a dwelling entitlement so that the Environmental Conservation zone land can be sold
- public ownership: either state or local authority.

The decision on which of these is preferred may depend on what the on-going management expectations are for the land. If the government expects that weeds will be removed and degraded areas are rehabilitated, there will be significant cost involved. If so, discussions should be held with the DPIE to determine whether funds from the growth centres Offset Scheme (or other sources) would be available to pay for the management.

6. Conclusions

The aim of this report is to identify key riparian constraints to assist the design of an ILP. The principles of the legislation addressed in Section 2 and Appendix A are to provide for the sustainable and integrated management of the waterways of the state.

There were 13 first-order, two second order and one third order creeks mapped in the study area. Of these, 11 first order watercourses and two second order watercourses were able to be assessed. Of these 11 watercourses, eight did not meet the definition of a 'river' under the WM Act, as they had no defined bed and banks and no evidence of geomorphological processes. There were two second order watercourses within the study area, both of which were able to be assessed for condition and habitat. The third order watercourse within the study area was not able to be assessed due to access restrictions. NRAR should be engaged to support the removal of creeks which did not meet the definition of a 'river', and therefore, the need to address these areas as waterfront land would be negated.

Two areas within the study area were mapped on the BOM GDE atlas as having high potential for terrestrial GDE. Field validation of these areas showed a consistency between the mapped GDE vegetation type and the vegetation on site. Assessment of the groundwater connectivity with these ecosystems is recommended, however it is unlikely that development activities would interfere with the groundwater table, as there is unlikely to be significant areas of excavation below the water table.

There is 12.2 ha of riparian corridor mapped within the entire Belmore Road Precinct site. There is a possibility that the existing riparian corridor area could be lower than this figure, if first-order creeks that were desktop mapped as watercourses don't meet the definition of a river under the WM Act and therefore can have their riparian corridor removed from the mapping. This would reduce the existing riparian area by 1.4 ha, to 10.8 ha. The ILP plans to retain 13.96 ha of riparian corridor, which is in accordance with NRAR's averaging rule. In addition, retained riparian corridors in the ILP would be actively managed as vegetated riparian zones under a Riparian Management Strategy, whereas currently there is no active management of riparian corridors.

Other areas of the ILP are consistent with NRAR's guidelines and meet the objectives of the WM Act, by enhancing and rehabilitating riparian corridors along degraded watercourses to restore their natural function and improve their habitat for endemic flora and fauna.

Appendix A Detailed Statutory Framework

Commonwealth

Environment Protection & Biodiversity Conservation Act 1999

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

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

State

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

The NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) is the principal planning legislation for the state, providing a framework for the overall environmental planning and assessment of development proposals. Various legislative instruments 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

Biodiversity Conservation Act 2016 (BC Act)

In November 2016 the NSW parliament passed the *Biodiversity Conservation Act 2016* (BC Act). This new legislation repealed the *Threatened Species Conservation Act* 1995 (TSC Act) and took effect 25 August 2017. Among other things, the BC Act introduces new requirements for biodiversity assessment

and requires proponents to offset significant biodiversity impacts through the purchase and retirement of biodiversity credits. The government has recently exhibited regulations that provide further detail on the changes as well as establish the transitional arrangements.

Similar to the TSC Act, the BC Act aims to protect and encourage the recovery of threatened species, populations and communities listed under the Act. The BC 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 BC 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. Under the new BC Act, existing biodiversity certified areas remain valid following the repealed TSC Act.

The effect of granting certification is that any development or activity requiring consent (Under Part 4 and 5 of the EP&A Act) is automatically 'development that is not likely to significantly affect threatened species'. This certification removes the need to address threatened species considerations and the test of significance (s.7.3 of the BC Act), including the preparation of species impact statements (SIS) for Part 5 activities or triggering the Biodiversity Offset Scheme for Part 4 developments.

State Environmental Planning Policy (Sydney Region Growth Centres) 2006 (Growth Centres SEPP)[1]

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*. Under the new BC Act, existing biodiversity certified areas remain valid following the repealed 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 the test of significance.

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

Fisheries Management Act 1994 (FM Act)

The *Fisheries Management Act 1994* (FM Act) aims to conserve, develop and share the fishery resources of NSW for the benefit of present and future generations. The FM Act defines 'fish' as any marine, estuarine or freshwater fish or other aquatic animal life at any stage of their life history. This includes

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

insects, molluscs (e.g. oysters), crustaceans, echinoderms, and aquatic polychaetes (e.g. beachworms), but does not include whales, mammals, reptiles, birds, amphibians or species specifically excluded (e.g. some dragonflies are protected under the BC Act instead of the FM Act). Under this act, if any activity occurs in the third order creek mapped as key fish habitat (Figure 1) that will block fish passage, involve dredging or reclamation of channel bed or banks or involve use of explosives in the waterway, then a permit under Part 7 of this Act will be required.

Water Management Act 2000 (WM Act)

The *Water Management Act 2000* (WM Act) controls 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 WM 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 (40 m) 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 riparian corridors that exist within the Belmore Road Precinct have been mapped according to their stream order.

Biosecurity Act 2015

The *Noxious Weed Act 1993* was repealed and replaced with the *Biosecurity Act 2015*. Under the *Biosecurity Act 2015* all plants are regulated with a general biosecurity duty to prevent, eliminate or minimise any biosecurity risk they may pose. Any person who deals with any plant, who knows (or ought to know) of any biosecurity risk, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable.

Specific legal requirements apply to State determined priorities under the Greater Sydney Regional Strategic Weed Management Plan 2017-2022. Weeds listed as 'other weeds of regional concern' warrant resources for local control or management programs and are a priority to keep out of the region. Inclusion in this list may assist Local Control Authorities and/or land managers to prioritise action in certain circumstances where it can be demonstrated the weed poses a threat to the environment, human health, agriculture etc.

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 Areas.

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 Belmore Road Precinct will need to demonstrate how the biodiversity and other values of areas identified by the SEPP will be protected, maintained and enhanced. The Development Code identifies the need to minimise the impacts of stormwater on the environment through the integration of Water Sensitive Urban Design into the planning precinct.

Sydney Regional Environmental Plan No 20—Hawkesbury-Nepean River (No 2—1997)

The study area is within the area to which the SREP – Hawkesbury Nepean River applies. Part 3, Clause 11 sets out particulars for the development controls imposed by this part:

(15) Land uses in or near the river

Definition:

All uses in the river or a tributary of the river, or within 40 metres of the high-water mark of the river or a tributary of the river where it is tidal or within 40 metres of the bank where it is non-tidal. This includes clearing and the construction and use of piers, wharves, boat sheds or other structures which have direct structural connection to the bank or bed of the river or a tributary of the river.

Consent required.

Additional matters for consideration by the consent authority:

(a) The need to locate access points where riverbanks are stable, away from river shallows and major beds of attached aquatic plants, away from fishing grounds and fish breeding areas, where the proposed activities do not conflict with surrounding recreational activities, and where significant fauna and wetland habitats will not be adversely affected.

(b) The need to require remedial works, such as the re-establishment of flora and fauna habitats.

(c) The potential for use of the land as a buffer to filter water entering the river.

(d) The need for an Erosion and Sediment Control Plan.

(e) The need for a Vegetation Management Plan.

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