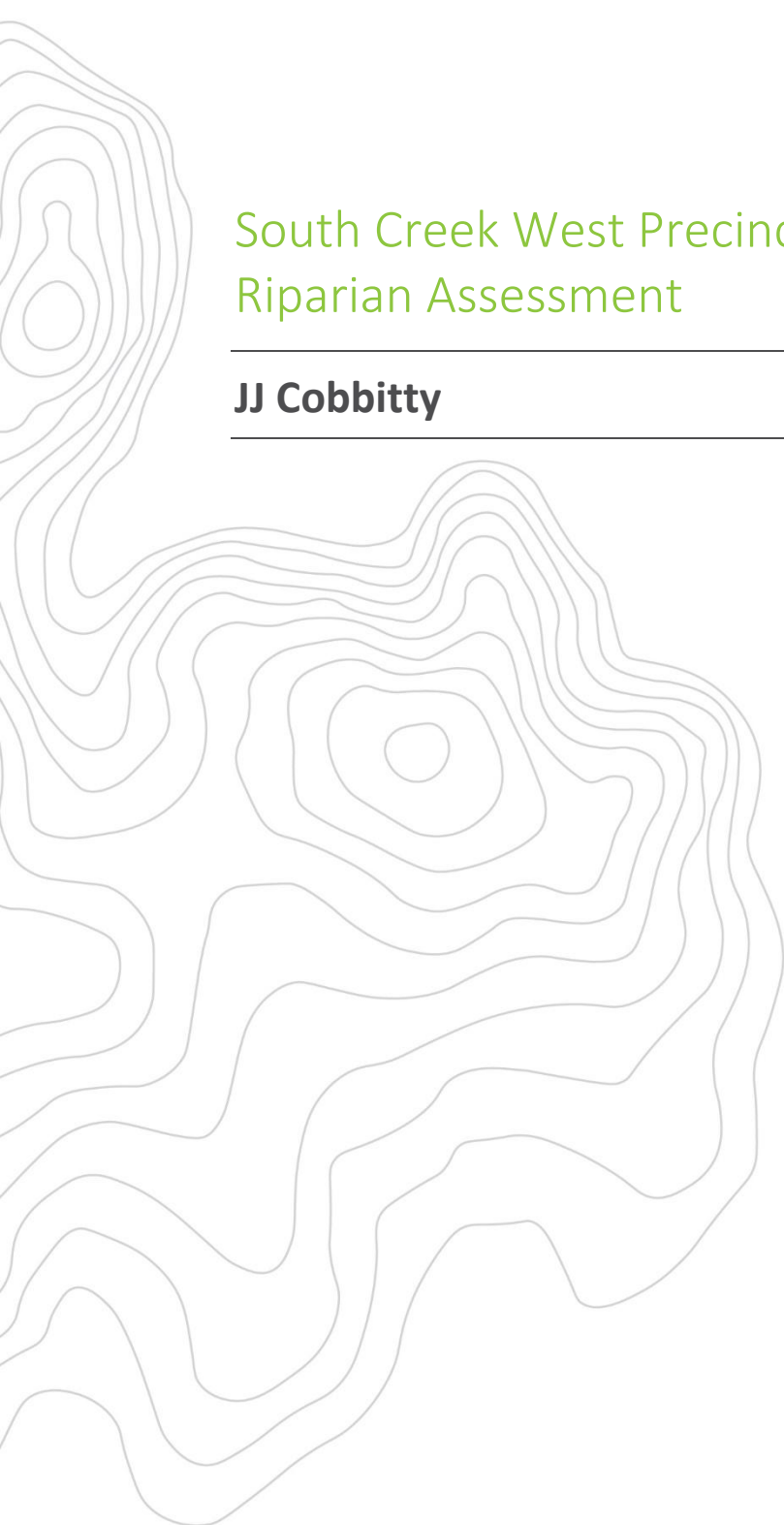


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South Creek West Precinct Riparian Assessment

JJ Cobbitty

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Template 2.8.1

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Abbreviations

Abbreviation	Description
AHCVV	Additional High Conservation Value Vegetation
BC Act	NSW <i>Biodiversity Conservation Act 2016</i>
BOM	Bureau of Meteorology
DA	Development Application
DCCEEW	NSW Department of Climate Change, Energy, the Environment and Water
DPE	Department of Planning and Environment
DPI Fisheries	NSW Department of Primary Industries - Fisheries
EHG	Environment and Heritage Group
ELA	Eco Logical Australia Pty Ltd
EPBC Act	Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i>
FM Act	NSW <i>Fisheries Management Act 1994</i>
GDE	Groundwater Dependent Ecosystem
ILP	Indicative Layout Plan
LGA	Local Government Area
RC	Riparian corridor
SCW	South Creek West
SEPP	State Environmental Planning Policy
SWGA	South West Growth Area
VRZ	Vegetated riparian zone
WM Act	NSW <i>Water Management Act 2000</i>

Executive Summary

Eco Logical Australia Pty Ltd (ELA) was engaged by JJ Cobbitty to undertake a Riparian Assessment for Precinct Planning of the South Creek West precinct, 'Precinct 5'. The aim of this report is to identify key riparian constraints to assist design of an Indicative Layout Plan (ILP).

ELA field-validated watercourses and riparian zones along watercourses within the precinct. Ten 1st order watercourses and two 2nd order watercourses did not have a defined bed or bank and represent overland flow paths rather than 'rivers' as defined by the *Water Management Act 2000* (WM Act). The NSW Department of Climate Change, Energy, the Environment and Water – Water Group (DCCEEW – Water Group) would determine if these can be removed from the map and therefore not need to be retained in the Precinct Plan as part of their formal review of the proposal.

Seven 1st and four 2nd order reaches that did meet the definition of a river were in poor condition, with ephemeral or intermittent flow only and limited habitat features. The 3rd and 4th order watercourses were in moderate to good condition, with larger pools, aquatic vegetation, and instream features. The 3rd and 4th order watercourses are mapped as key fish habitat, and are classed as Type 2, Class 2 waterways in terms of their key fish habitat sensitivity. Riparian habitat was generally poor, lacking canopy and mid-storey cover. Along the primary creek line, which flows through the centre of the study area, there was good condition Cumberland Plain Woodland which provides good habitat, bank stabilisation and shade for the creek. Based on field validation, there is a total of 16.48 ha of riparian zone on the site, assuming a Vegetated Riparian Zone (VRZ) around each existing online farm dam.

An Indicative Layout Plan has been prepared that provides 17.02 ha of riparian area, including two online stormwater basins on second order streams to detain and slowly release water during periods of high rainfall. The proposal seeks to remove and subsequently offset the seven 1st order validated watercourses, and replace the online dam on the central 3rd order watercourse with a vegetated base-flow channel. The proposed riparian corridor would be revegetated, rehabilitated and managed under a Vegetation Management Plan developed at the Development Application stage.

The proposal is generally consistent with the NSW DPI Fisheries Policy and Guidelines for Fish Conservation and Management under the *Fisheries Management Act 1994* through the removal of the online dam which would restore fish passage in key fish habitat, and ensure the riparian corridor functions as a natural system through revegetation in lieu of a 50 m riparian buffer, as recommended by the guidelines for Type 2, Class 2 waterways. Under the DPI Fisheries guidelines, a bridge, arch structure, box culvert and ford are the preferred crossing types for the road crossings across Class 2 key fish habitat, in that order. Consistency with these guidelines in regard to road crossings would be determined at the Development Application or detailed design stage.

The proposal is also generally consistent with the DCCEEW Guidelines for Controlled Activities on Waterfront Land under the *Water Management Act 2000* through the 1:1 offset of any encroachment into the existing riparian corridor, assuming removal of the online dam, with fully-structured riparian vegetation to be implemented and managed under a Vegetation Management Plan.

Two online basins on second order watercourses are proposed. The basins are proposed to be dry and fully vegetated, with an equivalent Vegetated Riparian Zone calculated from the top of the bank of the

base-flow channel proposed through the centre of the basin. Moreover, the proposal seeks to meet the objectives under the *Water Management Act 2000*, through protecting and enhancing riparian vegetation, improving the quality and health of the retained watercourses, reducing erosion, improving bank stabilisation, and improving public access to the watercourses and connection to green space. Under the DCCEEW riparian guidelines, permitted road crossing types include a culvert or a bridge over the 3rd and 4th order watercourses. Consistency with these crossing guidelines would be determined at the Development Application stage.

The protection and management of the riparian zone be achieved through:

- The use of a C2 Environmental Conservation zone
- The use of the Riparian Protection map in the *State Environmental Planning Policy (Precincts – Western Parkland City) 2021*, 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 VMPs are to be consistent with the objectives of the C2 zone, DCCEEW *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 Vegetation 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. Introduction

1.1 Description of the project

Eco Logical Australia Pty Ltd (ELA) was engaged by JJ Cobbitty Development Pty Ltd to undertake a Riparian Land Assessment for Precinct Planning of the South Creek West Sub-Precinct 5. It accompanies a Planning Proposal for a proposed amendment to the *State Environmental Planning Policy (Precincts – Western Parkland City) 2021* for the study area located along the Northern Road and which forms part of Cobbitty Sub-Precinct 5, in the SCW Land Release Area (Figure 1).

SCW forms part of the South West Growth Area (SWGA). Given the scale of the release area, the Department of Planning and Environment (DPE) divided it into five distinct precincts numbered 1 – 5. The land to which this Planning Proposal relates to is referred to as Cobbitty Sub-Precinct 5, also known as Precinct 5. It totals approximately 303 ha and has been characterised by rural residential and agricultural land uses and activities. The Planning Proposal applies to a 172.74 ha portion of Precinct 5, defined as the study area in this report.

The precinct was released by the Minister for Planning on 24 November 2017 for urban development. The release formally commenced the rezoning process for land within the precinct, including the subject site.

The Precinct adjoins the Lowes Creek Maryland Precinct, which has been rezoned to the north, the Pondicherry precinct to the east which is in the process of being rezoned and the growing town centre and suburbs of Oran Park to the south (Figure 1).

The aim of this assessment is to identify key riparian features and constraints of the site to inform the rezoning process, as well as to provide recommendations with respect to aquatic ecosystem management in alignment with key legislation, planning instruments and guidelines, outlined in Section 2.

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.

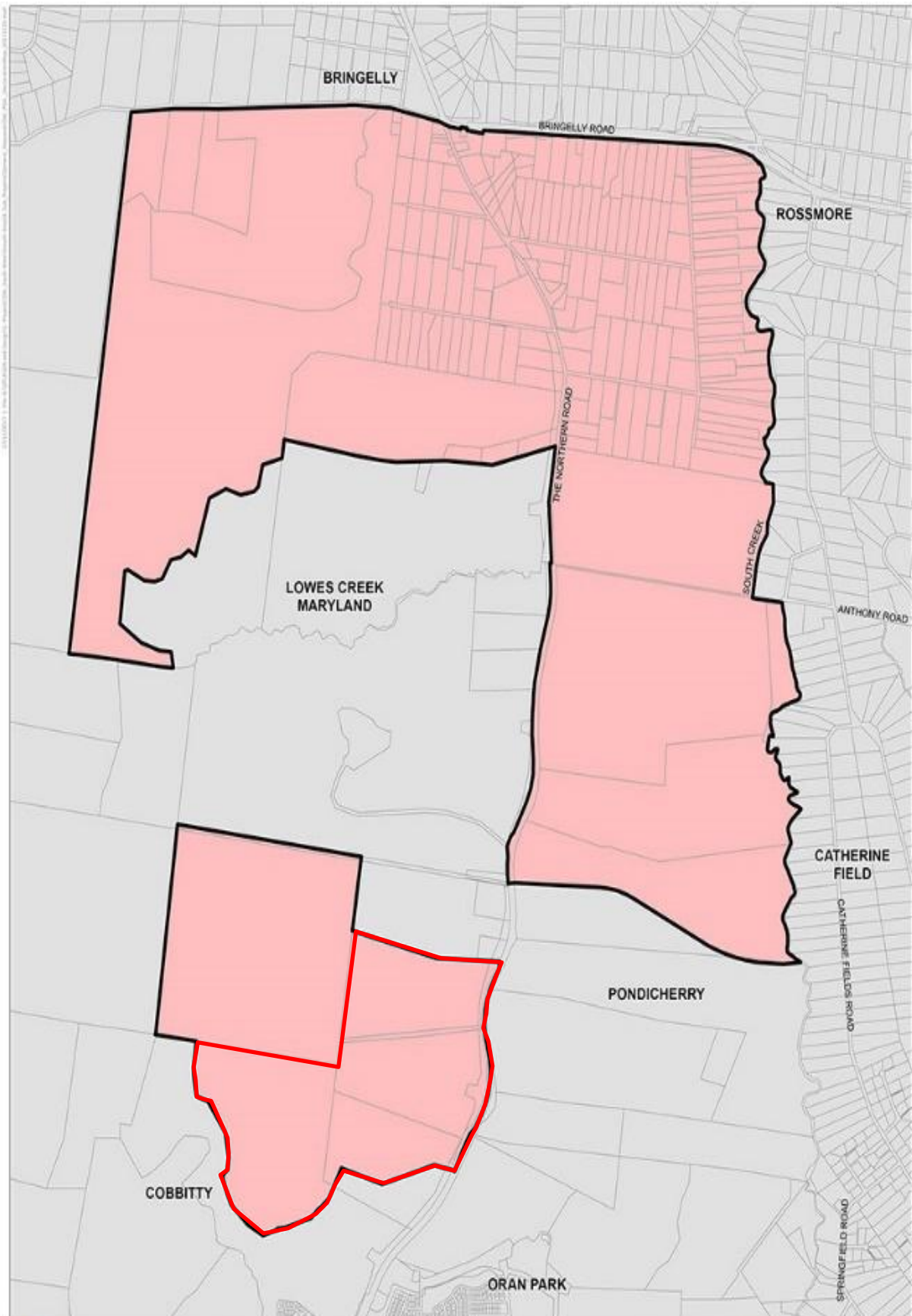


Figure 1: South Creek West release area with Sub-precinct 5 in red outline

1.2 Study area and context

The study area is located within the suburb of Cobbitty in Camden LGA and is situated within the Hawkesbury-Nepean catchment (Figure 2). The study area contains numerous unnamed tributaries of Lowes Creek which flows west-to-east into Wianamatta-South Creek, northeast of the study area. These middle and lower reaches of the Hawkesbury-Nepean catchment are generally highly impacted and degraded, both directly through waterway modifications and indirectly through adjacent land-use practices. 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. In the opinion of NSW DPI Fisheries, removal of large woody debris from NSW rivers and streams and degradation of native riparian vegetation are considered key threatening processes which adversely affect threatened species populations or ecological communities, or could cause species, populations or ecological communities in NSW that are not threatened to become threatened. Protection of riparian values at the planning proposal stage is vital not only for the hydrological function of the watercourses on site, but also for the protection of ecological values and potential threatened species habitat which may be present on site.

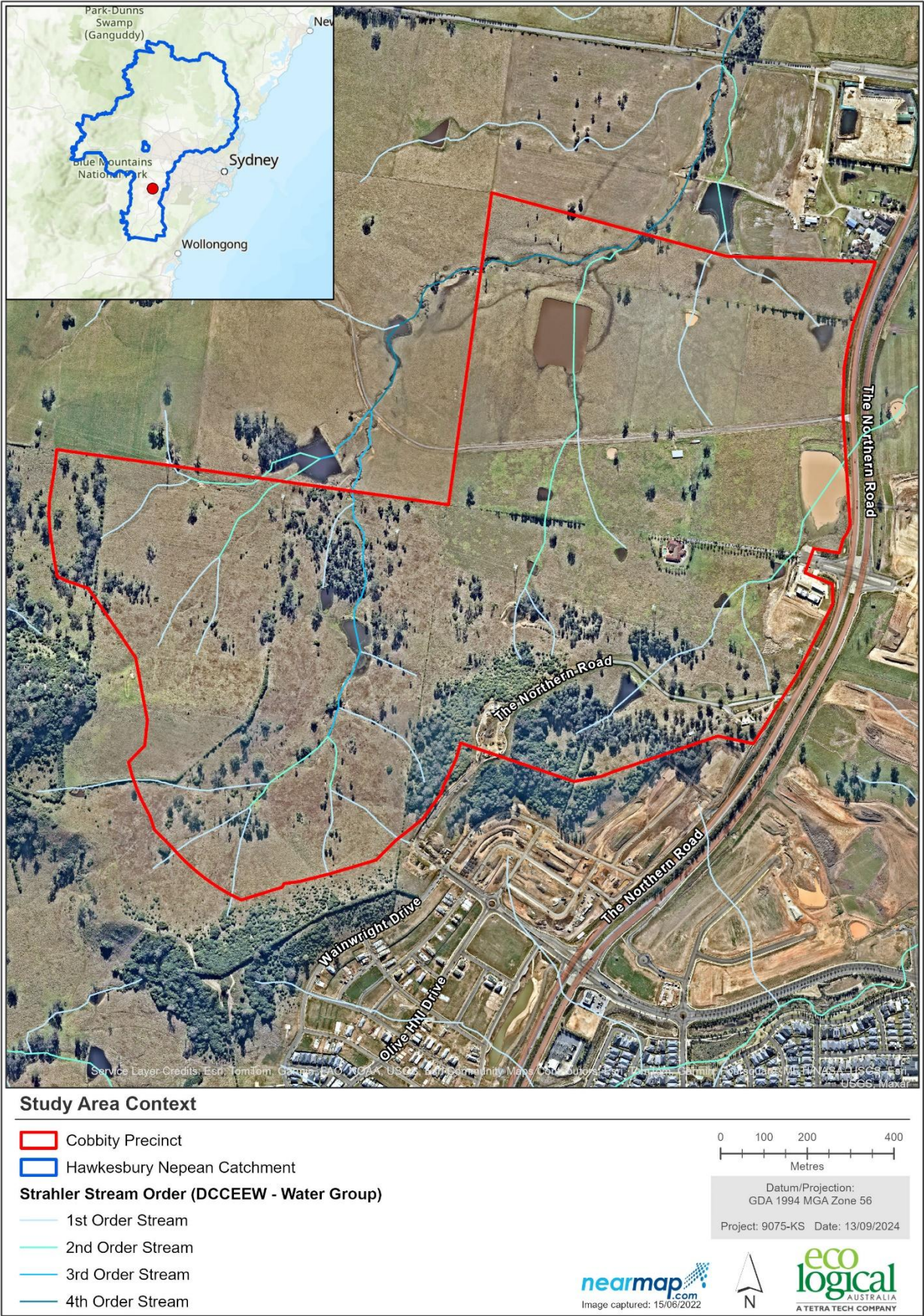


Figure 2: Location of the study area

1.3 Proposal

JJ Cobbitty, as the major landholder in the precinct, seeks to initiate the preparation of a planning proposal for the rezoning of Precinct 5 in accordance with the proposed Draft ILP (Figure 3). This is to facilitate the orderly redevelopment of Precinct 5 into a residential community.

The intended outcome of this Planning Proposal is to amend the current *State Environmental Planning Policy (Precincts – Western Parkland City) 2021* to facilitate the urban development of Precinct 5 as part of the South West Growth Centre as envisaged in the Greater Sydney Commission's Regional Plan and District Plan.

The Draft ILP has been prepared to support the planning proposal and precinct rezoning and has been informed by extensive specialist consultant studies. The site will comprise approximately 2,650 dwellings and a population of approximately 8,049 people within a thriving community supported by:

- 18.90 ha of active and passive open space
- Prominent creeks and riparian areas that retain water in the local environment
- Protection of ridgelines, creeks, and views through Connecting with Country design principles
- Integrated stormwater and services infrastructure that improve local amenity

The proposed new planning controls comprise amendments to *State Environmental Planning Policy (Precincts – Western Parkland City) 2021* and associated environmental planning instruments including the rezoning of the precinct to reflect land uses shown in the Draft ILP.

This Planning Proposal also seeks to introduce a site-specific Schedule to the *Camden Growth Centre Precincts Development Control Plan* to support the Precincts development in accordance with the Draft ILP and supporting technical investigations.

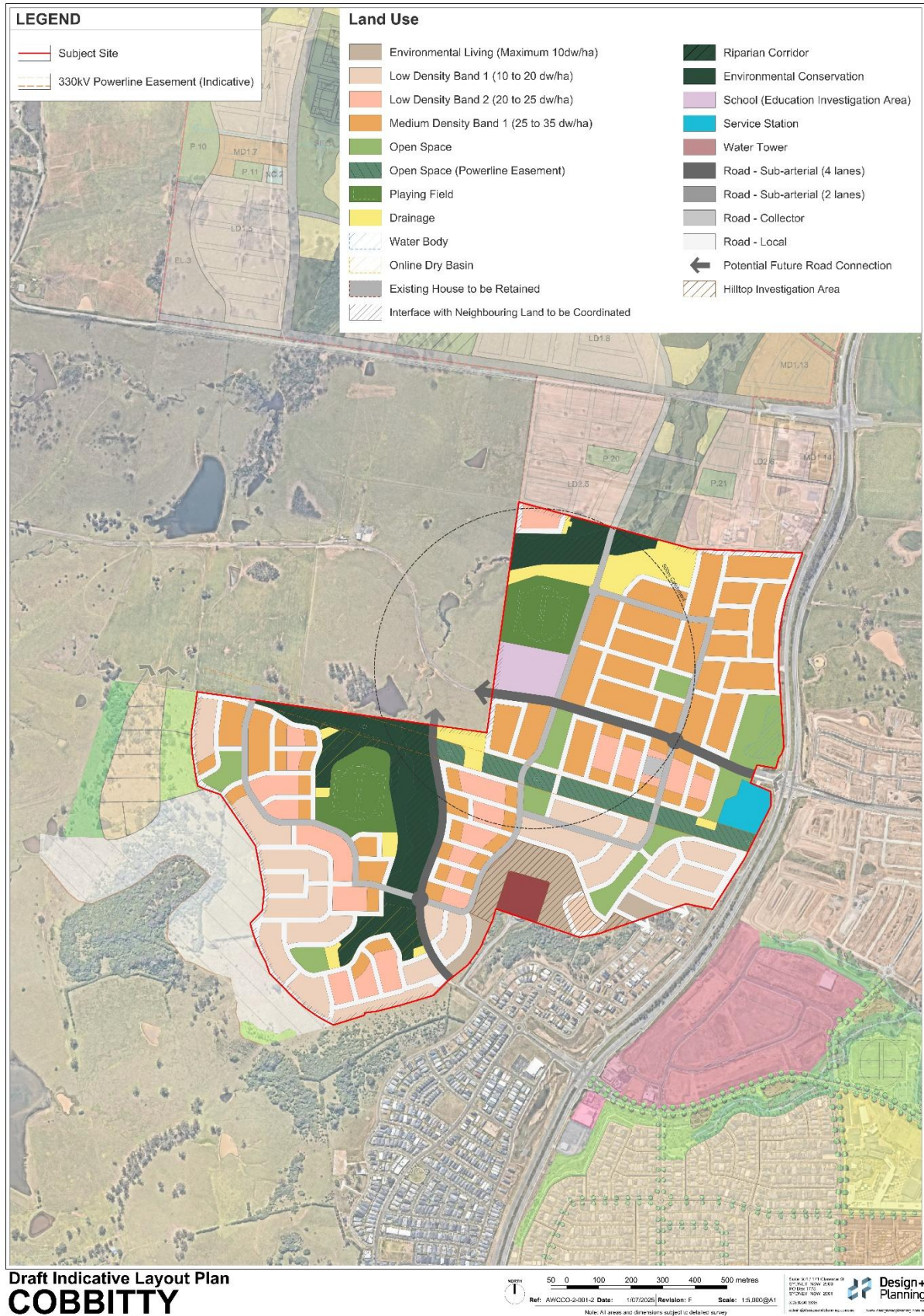


Figure 3: Draft Indicative Layout Plan (ILP)

2. Statutory framework

An array of strategic plans, legislation, policies, and guidelines apply to the planning and management of biodiversity issues within the study area. This information was reviewed and used to identify priority issues and approaches for the study area and are summarised below.

2.1 Statutory framework

Table 1 summarises the relevant legislation and policies that apply to the study area, which are required to be considered.

Table 1: Statutory framework and relevance to this study

Act	Relevance
Commonwealth	
<i>Environment Protection & Biodiversity Conservation Act 1999</i> (EPBC Act)	On 28 February 2012, the Commonwealth Minister for the Environment announced the program of development related activities within the Growth Centres that had been approved under the Growth Centres Strategic Assessment. (This was the second stage of the approval of the Strategic Assessment of the Growth Centres under the Commonwealth EPBC Act). Specifically, <i>“All actions associated with the development of the Western Sydney Growth Centres as described in the Sydney Region Growth Centres Strategic Assessment Program Report (Nov 2010) have been assessed at the strategic level and approved regarding their impact on the following matters of national environmental significance (MNES):</i> <i>World Heritage Properties</i> <i>National Heritage Places,</i> <i>Wetlands of International Importance,</i> <i>Listed threatened species, populations, and communities, and</i> <i>Listed migratory species.”</i> 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. Therefore, provided development activity proceeds in accordance with the Growth Centres requirements (such as the Biodiversity Certification Order, the Western Parkland City SEPP and Development Control Plans (DCPs), Growth Centres Development Code etc), then there is no requirement to assess the impact of development activities on MNES and hence no requirement for referral of activities to the Commonwealth. The requirement for assessment and approval of threatened species and endangered ecological communities and the other MNES issues listed above under the EPBC Act has now been “turned off” by the approval of the Strategic Assessment.
State	
<i>Biosecurity Act 2015</i> (Biosecurity Act)	The <i>Noxious Weed Act 1993</i> was repealed and replaced with the Biosecurity Act. Under the Biosecurity Act 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 <i>Greater Sydney Regional Strategic Weed Management Plan 2017-2022</i>. 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

Act	Relevance
	action in certain circumstances where it can be demonstrated the weed poses a threat to the environment, human health, agriculture etc.
<i>Fisheries Management Act 1994 (FM Act)</i>	The <i>Fisheries Management Act 1994</i> (FM Act) governs the management of fish and their habitat in NSW. The FM Act applies to fish and marine vegetation and requires a separate assessment from the NSW <i>Biodiversity Conservation Act 2016</i> (BC Act), which only relates to terrestrial animals and plants. The objectives of the FM Act are to conserve fish stocks and key fish habitats, conserve threatened species, populations and ecological communities of fish and marine vegetation and to promote ecologically sustainable development. The FM Act also regulates activities involving dredging and/or reclamation of aquatic habitats, obstruction of fish passage, harming marine vegetation and use of explosives within a waterway. Any activity that will block fish passage, involve dredging or reclamation of channel bed or banks or involve use of explosives in the waterway within key fish habitat, will require a permit under Part 7 of this Act.
<i>Water Management Act 2000 (WM Act)</i>	The <i>Water Management Act 2000</i> 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. The relevant objectives of this act are to: <i>Apply the principles of ecologically sustainable development</i> <i>Protection, enhance and restore water sources, their associated ecosystems, ecological processes and biological diversity and their water quality</i> <i>Recognise and foster the significant social and economic benefits to the State that result from the sustainable and efficient use of water, including benefits to:</i> <i>the environment, and</i> <i>urban communities, agriculture, fisheries, industry and recreation, and</i> <i>culture and heritage, and</i> <i>the Aboriginal people in relation to their spiritual, social, customary and economic use of land and water.</i> The NSW Department of Climate Change, Energy, the Environmental and Water (DCCEEW) – Water Group administers licencing and approvals for controlled activities on 'waterfront land', which is defined as the land 40 m from the highest bank of a river, lake or estuary published on the Department's website (Water Management (General) Regulation 2018 hydroline spatial data 1.0), known as the 'hydroline'. Apart from the exceptions stated in Schedule 4, Part 2 of the Water Management (General) Regulation 2018, controlled activities are: - 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. It is an offence to carry out a controlled activity on waterfront land except in accordance with an approval. Waterfront land exists within 40 m of the top of bank of each validated watercourse within the study area, and relevant riparian buffers apply in accordance with the <i>Guidelines for Controlled Activities on waterfront land—Riparian corridors</i> (DPE 2022), the 'DCCEEW guidelines'.
<i>State Environmental Planning Policy (Biodiversity and Conservation) 2021 (Biodiversity and Conservation SEPP)</i>	The development site is located within the Hawkesbury-Nepean catchment in accordance with Chapter 6 of Biodiversity and Conservation SEPP. Therefore, general development controls under Division 2 (clauses 6.6 – 6.10) apply: - Water quality and quantity – the effect on the quality of water entering a natural waterbody will be as close as possible to neutral or beneficial, and, the impact on water flow in a natural waterbody will be minimised. - Aquatic ecology – the development is to have minimal impacts, whether direct, indirect or cumulative, to adjacent and downstream waterbodies and wetlands.

Act	Relevance
	• Flooding – the development, if flooded, is not to release pollutants or obstruct natural flows to nearby wetlands and riverine ecosystems. • Recreation and public access – foreshore access is not to cause an adverse impact on natural waterbodies, watercourses, wetlands or riparian vegetation. • Total catchment management – the consenting authority must consult with downstream Councils before granting development consent.

Strategic Plan	Biodiversity / Sustainability Objectives
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2.2 Relevant guidelines

2.2.1 Guidelines for Controlled Activities on Waterfront Land – Riparian Corridors

The NSW DCCEEW – Water Group *Guidelines for Controlled Activities on waterfront land—Riparian corridors* (DCCEEW guidelines) published in May 2022 outlines the need for a Vegetated Riparian Zone (VRZ) adjacent to the channel to provide a transition zone between the terrestrial environment and watercourse (DPE 2022). This vegetated zone helps maintain and improve the ecological functions of a watercourse whilst providing habitat for terrestrial flora and fauna. The VRZ plus the channel (bed and banks of the watercourse to the highest bank) constitute the ‘riparian corridor’ (RC) (Figure 4). To be consistent with the DCCEEW guidelines, VRZ widths should be based on watercourse order as classified under the Strahler system of ordering watercourses and using Hydroline Spatial Data which is published on the department’s website (Table 2).

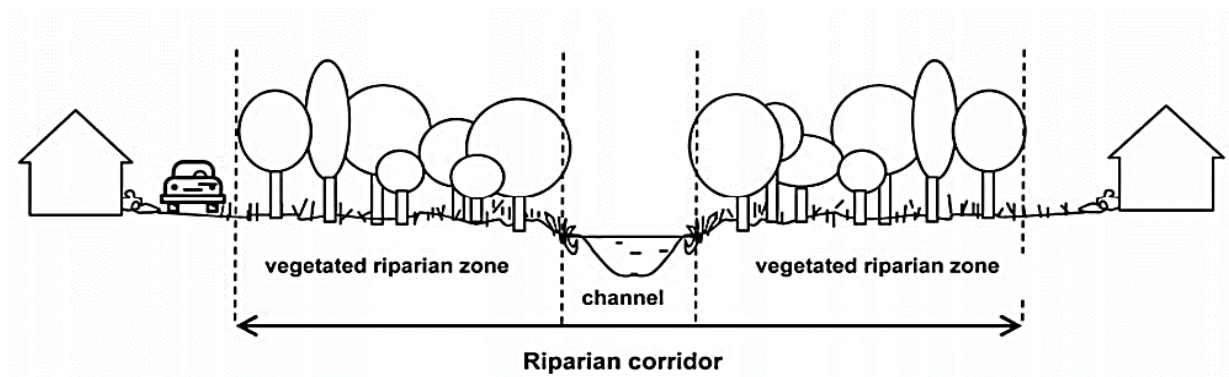


Figure 4: Vegetated riparian corridor widths relative to Strahler stream order (DPE 2022)

Table 2: Recommended riparian corridor widths relative to Strahler stream order (DPE 2022)

Watercourse Type	VRZ Width (Each Side of Watercourse)	Total Riparian Corridor Width
1 st order	10 m	20 m + channel width
2 nd order	20 m	40 m + channel width
3 rd order	30 m	60 m + channel width
4 th order and greater (includes estuaries, wetlands and any parts of rivers influenced by tidal waters)	40 m	80 m + channel width

Certain works are permissible within the riparian zone if specific design criteria are met (Table 3). Non-riparian uses in the outer 50% of the VRZ are permitted as long as compensation (1:1 offset) is achieved within the site using the 'averaging rule' (Figure 5 and key below).

Table 3: Riparian corridor (RC) matrix of permissible use (DPE 2022)

Stream Order	Vegetated Riparian Zone (VRZ)	RC Offsetting for Non-RC Uses	Cycle ways and Paths	Detention Basins		Stormwater Outlet Structures and Essential Services	Stream Realignment	Road Crossings		
				Only within 50% outer VRZ	Online			Any	Culvert	Bridge
1 st	10 m	•	•	•	•	•	•	•		
2 nd	20 m	•	•	•	•	•		•		
3 rd	30 m	•	•	•		•			•	•
4 th +	40 m	•	•	•		•			•	•

Key to riparian corridor matrix

Stream order: The watercourse order as classified under the Strahler system based on Hydroline Spatial Data published on the Department's website¹ when zoomed in at a scale of 2 km or less. A stream may separate and then converge—this is called a 'braided stream'. A braided stream retains the same stream order throughout the braid, as though it were a single stream. For the riparian guidelines, stream order is fixed and is not to be altered if an upstream hydroline is not considered waterfront land.

Vegetated riparian zone (VRZ): The required width of the VRZ measured from the top of the high bank on each side of the watercourse.

Riparian corridor (RC) off-setting for non RC uses: Non-riparian uses, such as bushfire Asset Protection Zones, roads and urban development are allowed within the outer 50% of the VRZ, so long as offsets are provided in accordance with the averaging rule as seen in Figure 5.

Cycleways and paths: Cycleways or paths no wider than four metres total disturbance footprint can be built in the outer 50% of the VRZ.

Detention basins: Detention basins can be built in the outer 50% of the VRZ or online where indicated. Offline detention basins do not need to be offset so long as there is an equivalent VRZ for the corresponding watercourse and they are built in compliance with the department's Guidelines for watercourse crossings and Guidelines for in-stream works. If a proposed basin will not have an equivalent VRZ for the corresponding watercourse, it may still be built in the outer 50% of the VRZ but must be offset. Online basins must:

- be dry and vegetated
- be for temporary flood detention only with no permanent water holding
- have an equivalent VRZ for the corresponding watercourse order
- not be used for water quality treatment purposes.

Stormwater outlet structures and essential services: Stormwater outlets or essential services are allowed in the RC. Works for essential services on a fourth order or greater stream are to be undertaken by directional drilling or tied to existing crossings.

Stream realignment: Indicates that a watercourse may be realigned.

Road crossings: Indicates permitted road crossing methods. Also refer to DPI Fisheries policy and guidelines for fish friendly waterway crossings (Fairfull 2013).

¹ <https://www.industry.nsw.gov.au/water/licensing-trade/hydroline-spatial-data>

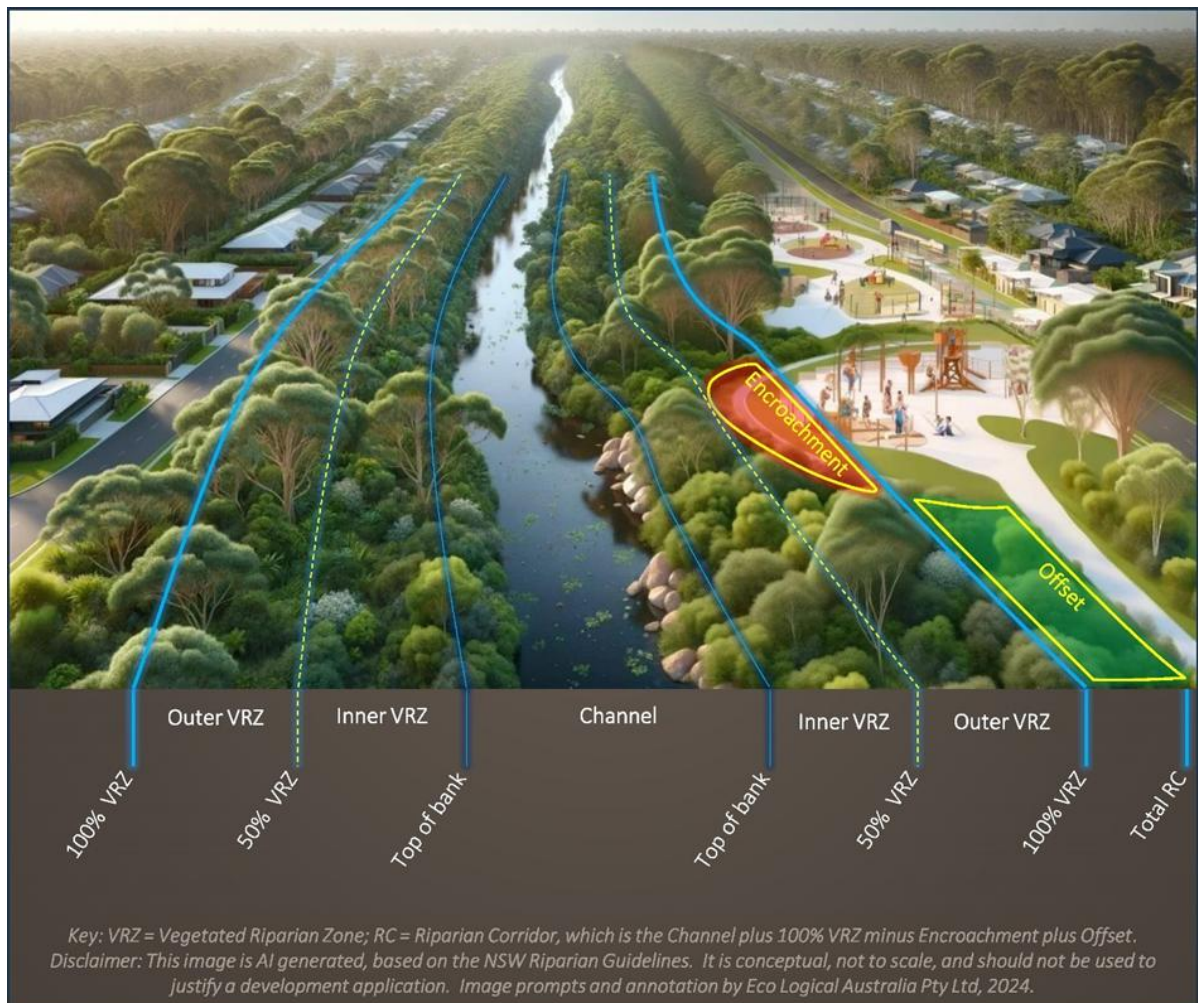


Figure 5: Riparian 'averaging rule' for offsetting encroachment into the outer 50% of the VRZ (adapted from DPE 2022)

2.2.2 Policy and Guidelines for Fish Habitat Conservation and Management

The NSW DPI Policy and guidelines for fish habitat conservation and management (Fairfull, 2013) (Fisheries guidelines) is a supplementary document that outlines the requirements and obligations under the FM Act and the *Fisheries Management (General) Regulation 2010* and were developed to maintain and enhance fish habitat and assist in the protection of threatened species. The Fisheries guidelines provides a definition of key fish habitat and provides guidance for assigning a classification of waterways for fish passage, which informs the types of infrastructure suitable for the creek line (Table 4) and sensitivity of the key fish habitat present (Table 5), which determines the potential disturbance and offsetting required for development. Specific policy and guidelines applicable to particular waterway classifications and key fish habitat sensitivity types are highlighted in Table 6.

Table 4: Classification of waterways for fish passage and crossing type (Fairfull 2013)

Classification	Characteristics of waterway class and preferred crossing type
CLASS 1 Major key fish habitat	- Marine or estuarine waterway or permanently flowing or flooded freshwater waterway (e.g., river or major creek), habitat of a threatened or protected fish species or 'critical habitat'. - Bridge, arch structure, or tunnel. - Bridges are preferred to arch structures.
CLASS 2 Moderate key fish habitat	- Non-permanently flowing (intermittent) stream, creek, or waterway (generally named) with clearly defined bed and banks with semi-permanent to permanent waters in pool or in connected wetland areas. Freshwater aquatic vegetation is present. TYPE 1 and 2 habitats present. - Bridge, arch structure, culvert ^[1] or ford. - Bridges are preferred to arch structures, box culverts and fords (in that order).
CLASS 3 Minimal key fish habitat	- Named or unnamed waterway with intermittent flow and sporadic refuge, breeding or feeding areas for aquatic fauna (e.g., fish, yabbies). Semi-permanent pools form within the waterway or adjacent wetlands after a rain event. Otherwise, any minor waterway that interconnects with wetlands or other CLASS 1-3 fish habitats. - Culvert ^[2] or ford. - Box culverts are preferred to fords and pipe culverts (in that order).
CLASS 4 Unlikely key fish habitat	- Waterway (generally unnamed) with intermittent flow following rain events only, little or no defined drainage channel, little or no flow or freestanding water or pools post rain events (e.g., dry gullies or shallow floodplain depressions with no aquatic flora present). - Culvert ^[3], causeway or ford. - Culverts and fords are preferred to causeways (in that order).

Key to crossing type

[1] High priority given to the 'High Flow Design' procedures presented for the design of these culverts—refer to the "Design Considerations" section of Fairfull and Witheridge 2003.

[2] Minimum culvert design using the 'Low Flow Design' procedures; however, 'High Flow Design' and 'Medium Flow Design' should be given priority where affordable—refer to the "Design Considerations" section of Fairfull and Witheridge (2003).

[3] Fish friendly waterway crossing designs possibly unwarranted. Fish passage requirements should be confirmed with NSW DPI.

As noted in Fairfull and Witheridge 2003, there are additional factors that must be taken into consideration by those involved in waterway crossing design and construction, including public safety, social and budgetary constraints. Each crossing is therefore assessed by NSW DPI on a case-by-case basis.

Table 5: Key fish habitat types (Fairfull 2013)

Key fish habitat and associated sensitivity classification scheme (for assessing potential impacts of certain activities and developments on key fish habitat types)

TYPE 1 – Highly sensitive key fish habitat	• <i>Posidonia australis</i> (strapweed). • <i>Zostera</i>, <i>Heterozostera</i>, <i>Halophila</i> and <i>Ruppia</i> species of seagrass beds >5 m² in area. • Coastal saltmarsh >5 m² in area. • Coral communities. • Coastal lakes and lagoons that have a natural opening and closing regime (i.e., are not permanently open or artificially opened or are subject to one off unauthorised openings). • Marine Park, an aquatic reserve or intertidal protected area. • Coastal wetlands mapped under the <i>State Environmental Planning Policy (Resilience and Hazards) 2021</i>, wetlands recognised under international agreements (e.g., Ramsar, JAMBA, CAMBA, ROKAMBA wetlands), wetlands listed in the Directory of Important Wetlands of Australia. • Freshwater habitats that contain in-stream gravel beds, rocks greater than 500 mm in two dimensions, snags greater than 300 mm in diameter or 3 m in length, or native aquatic plants. • Any known or expected protected or threatened species habitat or area of declared 'critical habitat' under the FM Act. • Mound springs.
TYPE 2 – Moderately sensitive key fish habitat	• <i>Zostera</i>, <i>Heterozostera</i>, <i>Halophila</i> and <i>Ruppia</i> species of seagrass beds <5 m² in area. • Mangroves. • Coastal saltmarsh <5 m² in area. • Marine macroalgae such as <i>Ecklonia</i> and <i>Sargassum</i> species. • Estuarine and marine rocky reefs. • Coastal lakes and lagoons that are permanently open or subject to artificial opening via agreed management arrangements (e.g., managed in line with an entrance management program). • Aquatic habitat within 100 m of a marine park, an aquatic reserve or intertidal protected area. • Stable intertidal sand/mud flats, coastal and estuarine sandy beaches with large populations of in-fauna. • Freshwater habitats and brackish wetlands, lakes, and lagoons other than those defined in TYPE 1. • Weir pools and dams up to full supply level where the weir or dam is across a natural waterway.
TYPE 3 – Minimally sensitive key fish habitat may include:	• Unstable or unvegetated sand or mud substrate, coastal and estuarine sandy beaches with minimal or no in-fauna. • Coastal and freshwater habitats not included in TYPES 1 or 2. • Ephemeral aquatic habitat not supporting native aquatic or wetland vegetation.

Table 6: Policy and guidelines for riparian and freshwater aquatic vegetation (Fairfull 2013)

Policy	
1)	NSW DPI will generally not approve or support works that may harm freshwater aquatic vegetation (TYPE 1 and 2 habitats – see Table 5), unless adequate mitigation, rehabilitation and/or demonstrated compensation measures are in place (see section 3.3 of Fairfull 2013).
2)	NSW DPI will generally require riparian buffer zones to be established and maintained for developments or activities in or adjacent to TYPE 1 or 2 habitats or CLASS 1-3 waterways. Riparian buffer zones shall be measured from the top of the bank/drainage depression along CLASS 1 to 3 waterways (see Table 4). Please note that this policy does not apply to developments involving maintenance to existing, or construction of new roads or bridges crossing a waterway, but may apply to developments involving roads that are adjacent to, but not crossing a waterway (e.g. new subdivisions, rezoning proposals involving new access roads, new road developments along a new alignment).
3)	NSW DPI will require the design of riparian buffer zones to incorporate the maintenance of lateral connectivity between aquatic and riparian habitat. Installation of infrastructure, terraces, retaining walls, cycle ways, pathways and grass verges within the riparian buffer zone shall be avoided or minimised.
4)	NSW DPI will generally support proposals that aim to remove willows or other exotic trees or other weeds from the watercourse, followed by rehabilitation with native species. Willows and other exotic trees should only be removed from the stream where stream stability is not unduly compromised.
Guidelines	
a)	NSW DPI will assess the width of the riparian buffer zone based on the habitat TYPE and waterway CLASS (see Table 4 and Table 5), the possible extent of the disturbance and the susceptibility of the riverbank to erosion. As a guide the following are recommended: • TYPE 1, CLASS 1: 100 metres • TYPE 2, CLASS 2-3: 50 metres • TYPE 3, CLASS 3-4: 10-50 metres For guidelines on designing filter strips for this purpose (including appropriate widths) please refer to Prosser and Karssies (2001). Advice on protecting aquatic macrophytes in wetlands and shallow lakes can be obtained from Bailey et al. (2002).
b)	Riparian buffer zones should be clearly delineated (e.g. fences or other markers) and well managed to avoid degradation (e.g. weed and stock access management).
c)	Developments should ensure that existing native riparian vegetation is retained to the greatest extent possible in an undamaged and unaltered condition. Revegetation of disturbed areas with local native species should also be considered as part of development controls (e.g. stabilisation of sediment, sediment filters during and post-construction) and mitigation measures. Monitoring should be undertaken to ensure successful establishment of vegetation in these areas
d)	Where establishment or rehabilitation of a riparian zone is required, the rehabilitation strategy should include native in-stream vegetation (macrophytes) and snags where appropriate.
e)	Mitigation or rehabilitation measures for developments should include weed control.
f)	Willow control guidelines can be accessed at www.weeds.org.au/WoNS/willows/

2.2.3 Wetlands Management Policy 2010

The NSW Wetlands Management Policy (DECCW 2010) aims to provide for the protection, ecologically sustainable use, and management of NSW wetlands. Wetlands include lakes, lagoons, estuaries, rivers, floodplains, swamps, bogs, billabongs, marshes, coral reefs, and seagrass beds. Wetlands within the study area occur within the riparian corridor.

3. Methods

3.1 Desktop review

A review of the following data, background literature and relevant planning instruments and strategic documents was undertaken:

- NSW *Fisheries Management Act 1994*; Fisheries NSW Policy and Guidelines for Fish Habitat Conservation and Management (2013 update) (Fairfull 2013); key fish habitat mapping
- NSW *Water Management Act 2000* and Guidelines for controlled activities on waterfront land – Riparian corridors (DPE 2022)
- Water Management (General) Regulation 2018 hydroline spatial data 1.0
- Bureau of Meteorology (BOM) Groundwater Dependent Ecosystems (GDE) Atlas
- NSW River styles database (DPE 2023).

3.2 River validation and top of bank mapping

The Strahler stream order classification was extracted from the *Water Management (General) Regulation 2018* hydroline spatial data 1.0, known as the 'hydroline'. Top of bank was estimated using aerial photographs and 0.5 m contours before being field validated on 19th and 20th of February 2020 by two aquatic ecologists, using a GPS enabled tablet. A 'river', as termed in the WM Act, is a watercourse shown on the state hydroline map and one that has a defined bed, bank and evidence of geomorphic processes (erosion and deposition). A river may generally have some aquatic habitat features, either ephemeral or permanent, and may be discontinuous along its length. A watercourse may have portions of its length that do not display evidence of a river but if there are defining features upstream of that reach, then it must be classed as a river for its full length (as measured down from the uppermost part that has defining characteristics). Under the DCCEEW riparian guidelines, should a watercourse not be defined as a river, then the downstream Strahler stream order cannot be altered. That is, the Strahler stream order is a fixed calculation from the state hydroline map, regardless of whether the river exists, or has been engineered, or is proposed to be engineered (i.e. piped or filled for development).

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 ArcGIS Pro. Creeks bordering the site were assessed where possible to determine if their riparian buffers would encroach into the study area. Due to access constraints, any reaches which did not exhibit geomorphic features of a 'river' within the study area but have a hydroline which begins outside of the study area, were subject to desktop-only assessment.

3.3 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.

4. Results

4.1 Desktop review

The study area consists of nineteen 1st order, six 2nd order, one 3rd order and one 4th order watercourse (Figure 6). Key fish habitat (KFH) exists within the study area along the unnamed 3rd order watercourse running south-to-north within the western half of the study area, as well as further downstream where this creek intersects with the northern study area boundary as a 4th order watercourse (Figure 6). The river style of the watercourse comprised of reach 3D and 4B is a laterally unconfined, continuous channel with low sinuosity and a fine-grained bed, assessed in 2020 (DPE 2023).

See Section 4.4 for groundwater dependent ecosystems (GDEs) and the Biodiversity Assessment (ELA 2026) for the likelihood of occurrence of FM Act listed threatened aquatic threatened species, communities or populations.

4.2 River validation and top of bank

The *Guidelines for Riparian Corridors on Waterfront Land* (DPE 2022) acknowledge that some hydrolines 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. As highlighted in Appendix A, field survey concluded that 11 1st order watercourses and two 2nd order watercourses do not meet the definition of a 'river' for the purposes of the WM Act, as they do not exhibit evidence of geomorphic processes such as erosion or deposition in the form of bed and banks (Figure 7). Due to access constraints, the upstream portion of reach 1W, which extends beyond the study area, was assessed via desktop methods only and requires further validation. Where a watercourse had defined bed and banks upstream, the downstream mapped watercourse was classified as a 'river', regardless of the presence or absence of bed and banks. Watercourses which met the definition of a 'river' under the WM Act are highlighted in Figure 7, along with their respective vegetated riparian zones (VRZs) as per the DCCEEW riparian guidelines (Table 2). Waterfront land exists within 40 m of the top of bank of each of these validated watercourses. Total riparian corridor area, assuming an equivalent VRZ around the central online dam, is 17.02 ha. See Appendix A for a description of each reach and watercourse validation rationale.

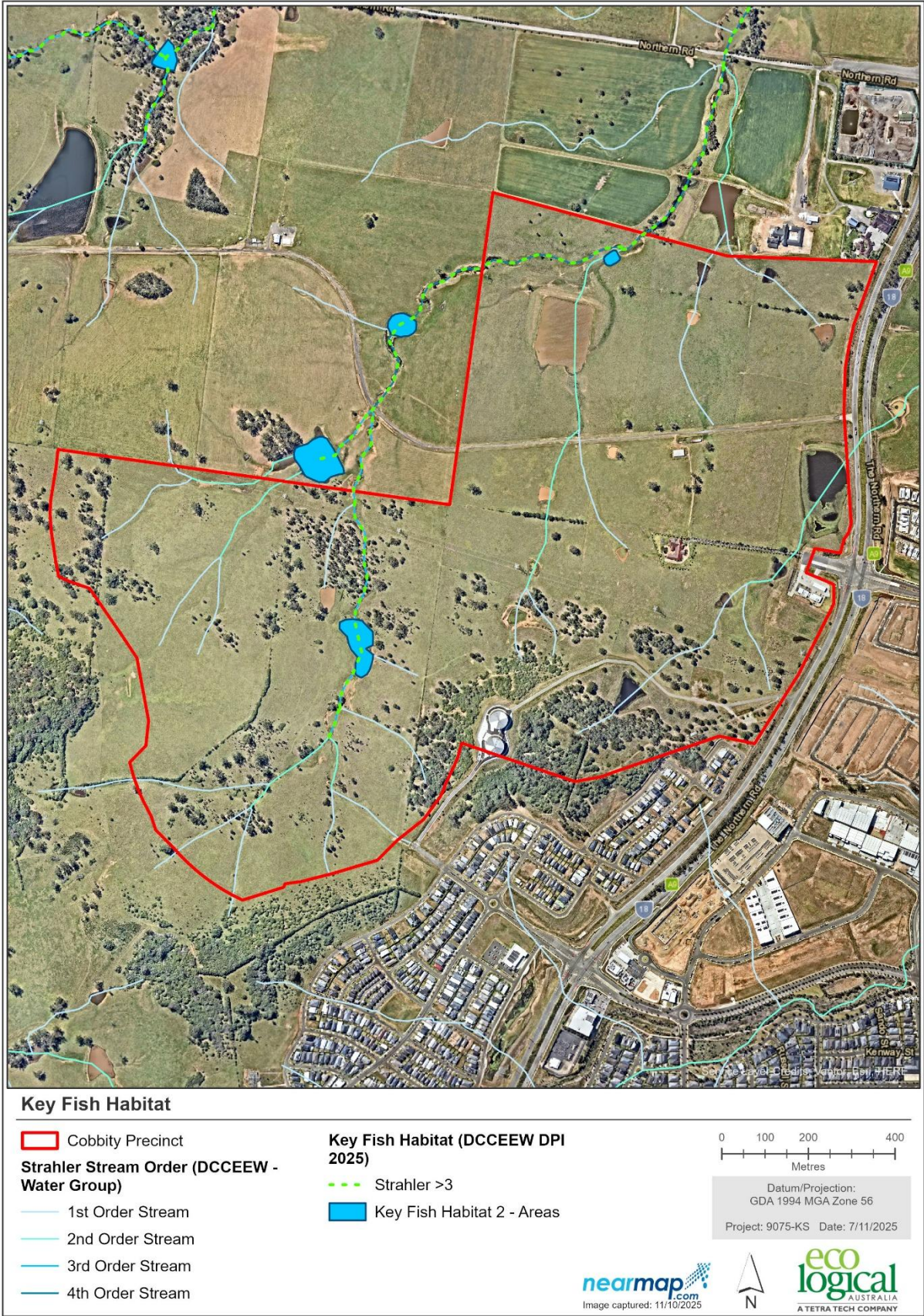


Figure 6: Key fish habitat and state hydroline mapping within the study area

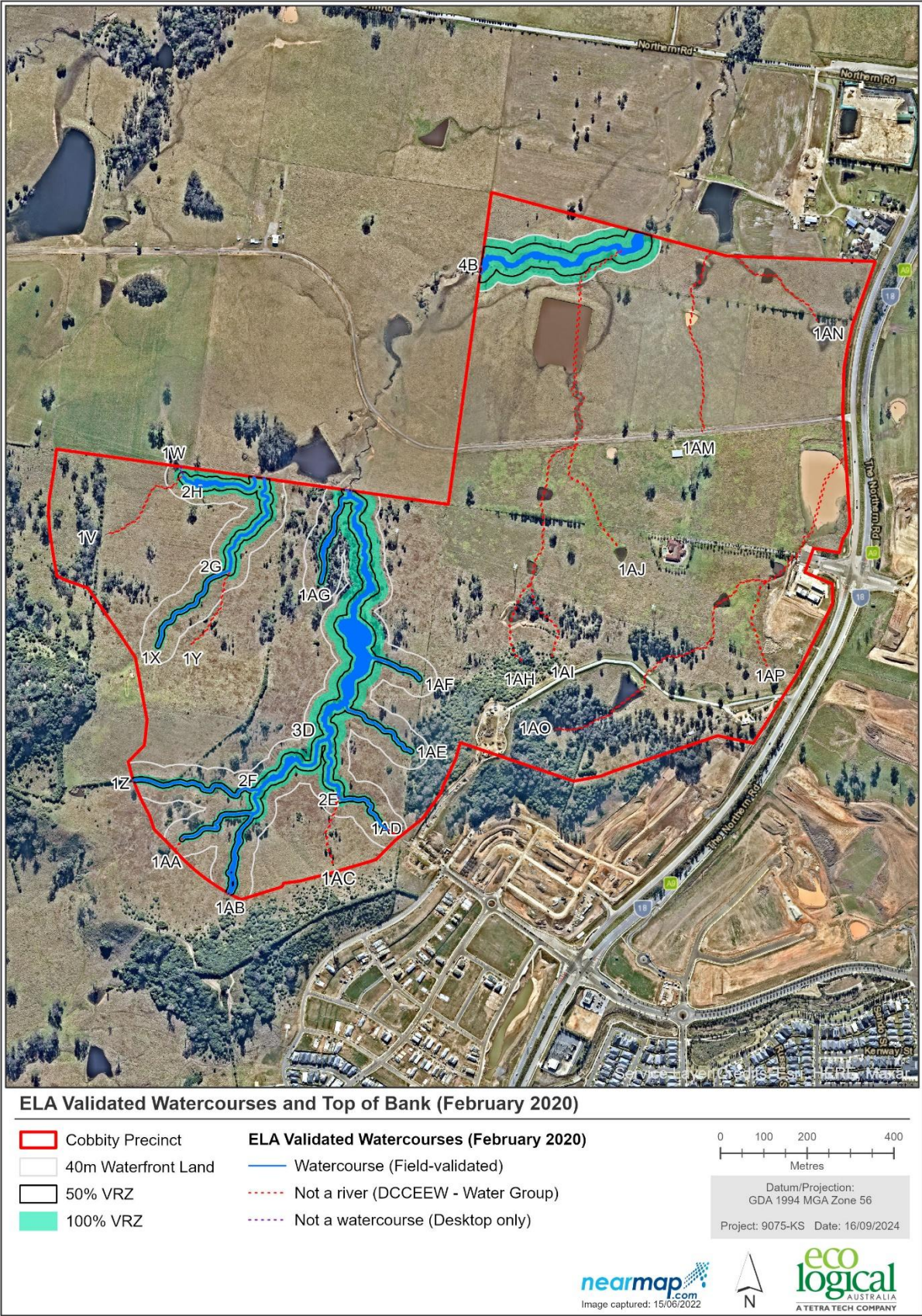


Figure 7: Watercourse validation and riparian corridors

4.3 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, 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 would be crucial to improving the condition of downstream environments.

For each reach, a condition of good, moderate, or poor was applied based on the:

- Stream shape and size
- Frequency of flow (ephemeral or perennial)
- Presence of aquatic habitat (pools, riffles, snags, 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. Snags were present, with good fish habitat. Watercourses in moderate condition had clearly defined bed and banks with ephemeral or intermittent water after a rain event. Aquatic vegetation may or may not be present, with less in stream features such as snags. These creeks would provide fish passage during rain events and refuge for fauna such as turtles. Poor condition watercourses had poor 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. A description of the condition of each reach is presented in Appendix A. Dams were present throughout the site and have been described in Appendix A. Overall, dams provided habitat for fish, frogs, turtles, and wader birds.

The riparian vegetation throughout the site varied in quality. Throughout the north-eastern extent of the site, the vegetation was pasture with scattered poor condition Cumberland Plain Woodland (Figure 8). In the south-western extent of the site, where most creeks met the definition of a river, riparian condition was highly modified and generally poor, with limited shrubs or canopy cover. The dominant vegetation was derived native grassland. The central creek system of 2F and 3D, had the highest quality riparian vegetation, with good quality Cumberland Plain Woodland present (Figure 8). These areas were characterised by a canopy dominated by *Eucalyptus tereticornis* (Forest Red Gum) and *Eucalyptus moluccana* (Grey Box). The open midstorey was dominated by exotic species *Lycium ferocissimum* (African Boxthorn) and *Olea europaea* subsp. *cuspidata* (African Olive), with scattered *Lantana camara* (Lantana) and *Gomphocarpus fruticosus* (Narrow-leaved Cotton Bush) in some areas. The groundcover was dominated by a large number of native grasses and forbs, including *Microlaena stipoides* (Weeping Grass), *Bothriochloa macra* (Red Grass), *Einadia hastata* (Berry Saltbush) and more. Exotic groundcover species were also present, though to a significantly lesser extent, and included *Eragrostis curvula* (African Lovegrass), *Setaria parviflora* and *Sida acuta* (Spinyhead Sida).

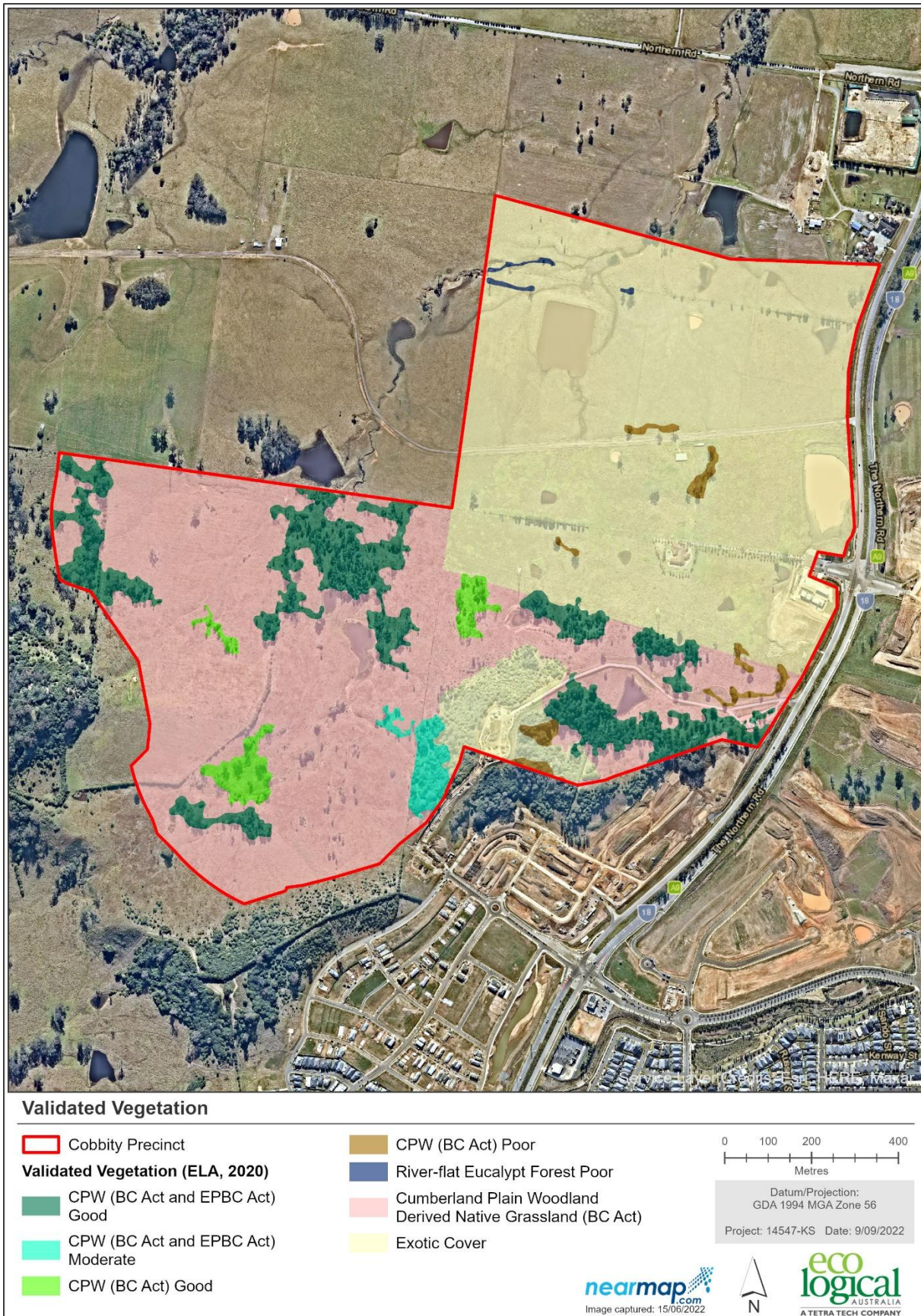
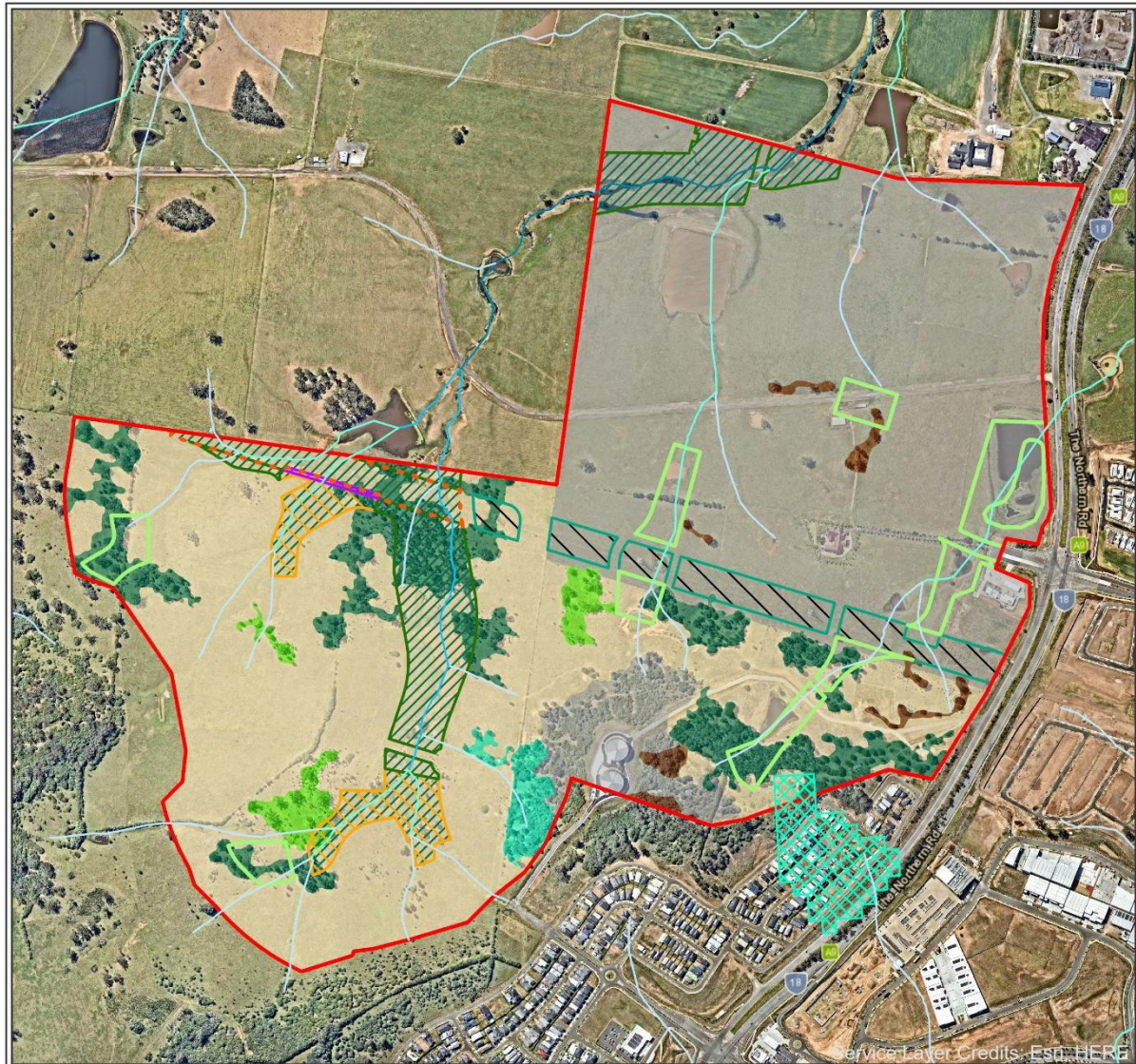


Figure 8: Validated vegetation communities and condition

4.4 Groundwater Dependant Ecosystems

One terrestrial groundwater dependent ecosystem (GDE), Cumberland Shale Hills Woodland, has a high potential of occurrence within the south-eastern corner of the study area, and no aquatic GDEs are mapped within the study area (Figure 9). Validated vegetation mapping in the Biodiversity Assessment (ELA 2026) indicates the presence of Cumberland Plain Woodland/Cumberland Plain Shale Woodlands and Cumberland Plain Woodland Derived Native Grassland in the location of the mapped terrestrial GDE (Figure 9). Definitive determination regarding the reliance on groundwater would require a hydrological survey to determine the level of the groundwater table.



Validated Vegetation and Groundwater Dependent Ecosystems

- Cobbitty Precinct
- Groundwater Dependent Ecosystem - Terrestrial (BOM, 2017)

Land Use

- Riparian Corridor
- Riparian Corridor (Easement)
- Riparian Corridor (Online dry basin)
- Riparian Corridor (Online dry basin/ Easement)
- Open Space
- Open Space (Easement)
- Environmental Conservation

Validated Vegetation (ELA, 2024)

- CPW (BC Act and EPBC Act) Good
- CPW (BC Act and EPBC Act) Moderate
- CPW (BC Act) Good
- CPW (BC Act) Poor
- Cumberland Plain Woodland Derived Native Grassland (BC Act)
- Exotic Cover
- River-flat Eucalypt Forest Poor

Strahler Stream Order (DCCEW - Water Group)

- 1st Order Stream
- 2nd Order Stream
- 3rd Order Stream
- 4th Order Stream

0 100 200 400
Metres

Datum/Projection:
GDA 1994 MGA Zone 56
Project: 9075-KS
Date: 11/11/2025

nearmap
Image captured: 11/10/2025



eco
logical
AUSTRALIA
A TETRA TECH COMPANY

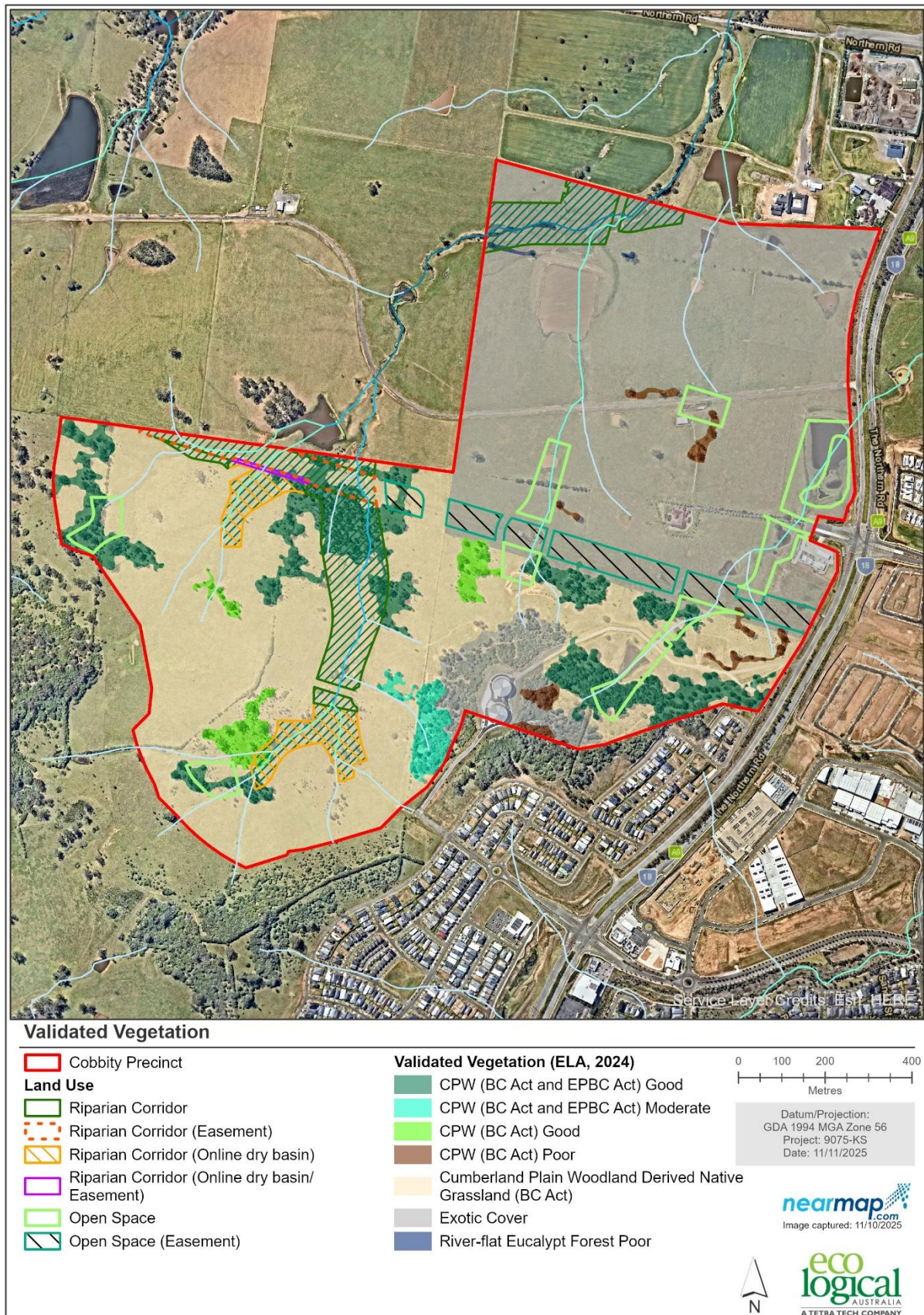


Figure 9: Groundwater dependent ecosystems within the study area

5. Riparian assessment

5.1 Indicative layout plan in relation to watercourses and riparian corridors

The site currently contains 16.49 ha of riparian corridor.

The primary creek corridor, consisting of reaches 1AG, 2E, 2F and 3D in the centre of the site has been proposed to be retained and rehabilitated, in addition to the 2nd order creeks to the west, reach 2G and 2H, and the 4th order creek along the northern boundary of the study area, reach 4B. See **Figure 11**. The ILP proposes removal and subsequent offset of seven 1st order watercourses which meet the definition of a 'river' under the WM Act, in addition to the removal of the online dam along reach 3D (Figure 12), which would restore a more natural hydrological regime along the watercourse through creation of a base-flow channel and restoration of the riparian corridor. The ILP also proposes the installation of a dry, vegetated online basin. 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 stabilisation
- Provide riparian vegetation buffers, allowing the recovery and reinstatement of more natural conditions within currently highly modified waterways
- Allow for the safe conveyance of floodwater.

Accounting for removal of the seven validated 1st order watercourses and encroachment of the ILP into the riparian corridor in certain areas, the total riparian corridor delivered in the ILP is 17.02 ha with a balance of +0.91 ha. Proposed encroachment is 4.25 ha, and proposed offsets are 5.15 ha (Figure 12). Therefore, the proposal adheres to the 'averaging rule' and 1:1 compensation required by the DCCEEW riparian guidelines, assuming removal of the online dam.

Removal of watercourses which meet the definition of a 'river' under the WM act has occurred in other precincts, usually where:

- The river is a first-order watercourse.
- The river is in a degraded or poor condition and doesn't provide any important habit linkages
- The loss of riparian zone is offset by the increase of riparian zone in the remaining watercourses at a ratio of 1:1.

Further, the proposal would improve the structure and integrity of vegetation within the proposed riparian corridor, defined in Figure 12, and support Connecting to Country objectives through the preservation of ridgelines, views, and waterways. Restoration of the riparian zone would be achieved through the Riparian Management Strategy outlined in Section 5.5, and future Vegetation Management Plans (VMPs) to be prepared at the Development Application (DA) stage. These measures would be focused on improving the riparian areas which have limited native vegetation, and protecting and improving areas of intact native vegetation which will contribute to broader landscape connectivity, in conjunction with the Landscape Masterplan (Urbis 2026). 'Nature trails' and footpaths proposed within

the riparian corridor by the Landscape Masterplan are permitted within the riparian corridor under the DCCEEW riparian guidelines, provided they do not encroach on the inner 50% VRZ and have a total disturbance footprint width of less than 4 m (Table 3).

Permissible road crossing types under the DCCEEW guidelines for watercourse crossings on waterfront land (DPE 2022) for the 3rd and 4th order watercourses in the study area include a culvert or a bridge (Table 3). Provided a culvert or a bridge is proposed over the 3rd and 4th order watercourses within the study area at the DA stage, the proposal is consistent with the DCCEEW guidelines for road crossings. See section 5.4 for permissible crossing types under the DPI Fisheries guidelines.

Where proposed works are inconsistent with the *Guidelines for Controlled Activities on Waterfront Land* (DPE 2022), 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 the WM Act described below:

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.*

The ILP allows for protected and rehabilitated riparian corridors to be established. Under the Riparian Management Strategy and future VMPs, these vegetated channels will become protected waterways within the precinct which will improve their current condition, as currently 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 revegetation and weed control would create stable beds and banks and a buffer between residential areas and the watercourse.

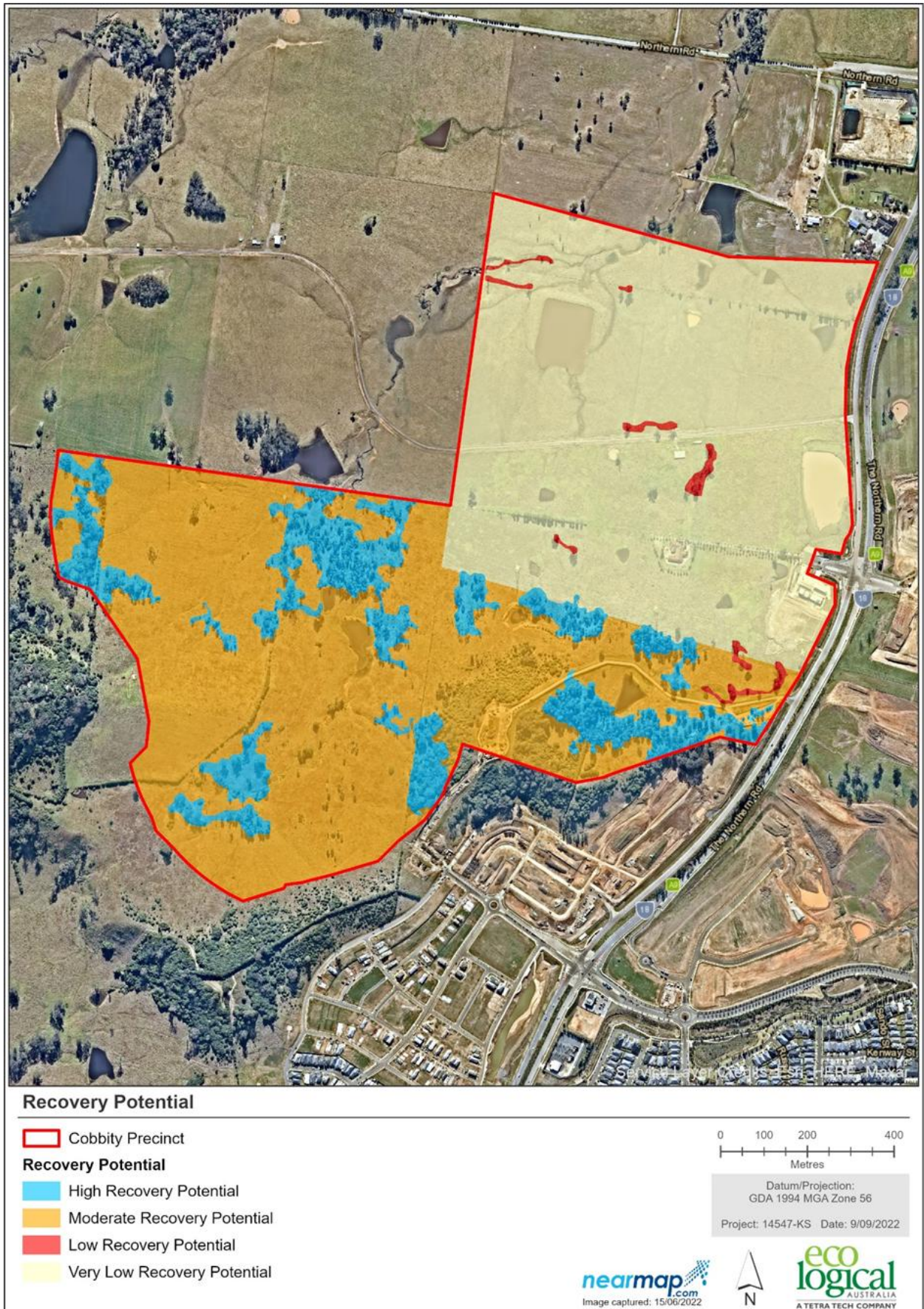


Figure 10: Recovery potential of vegetation within the study area

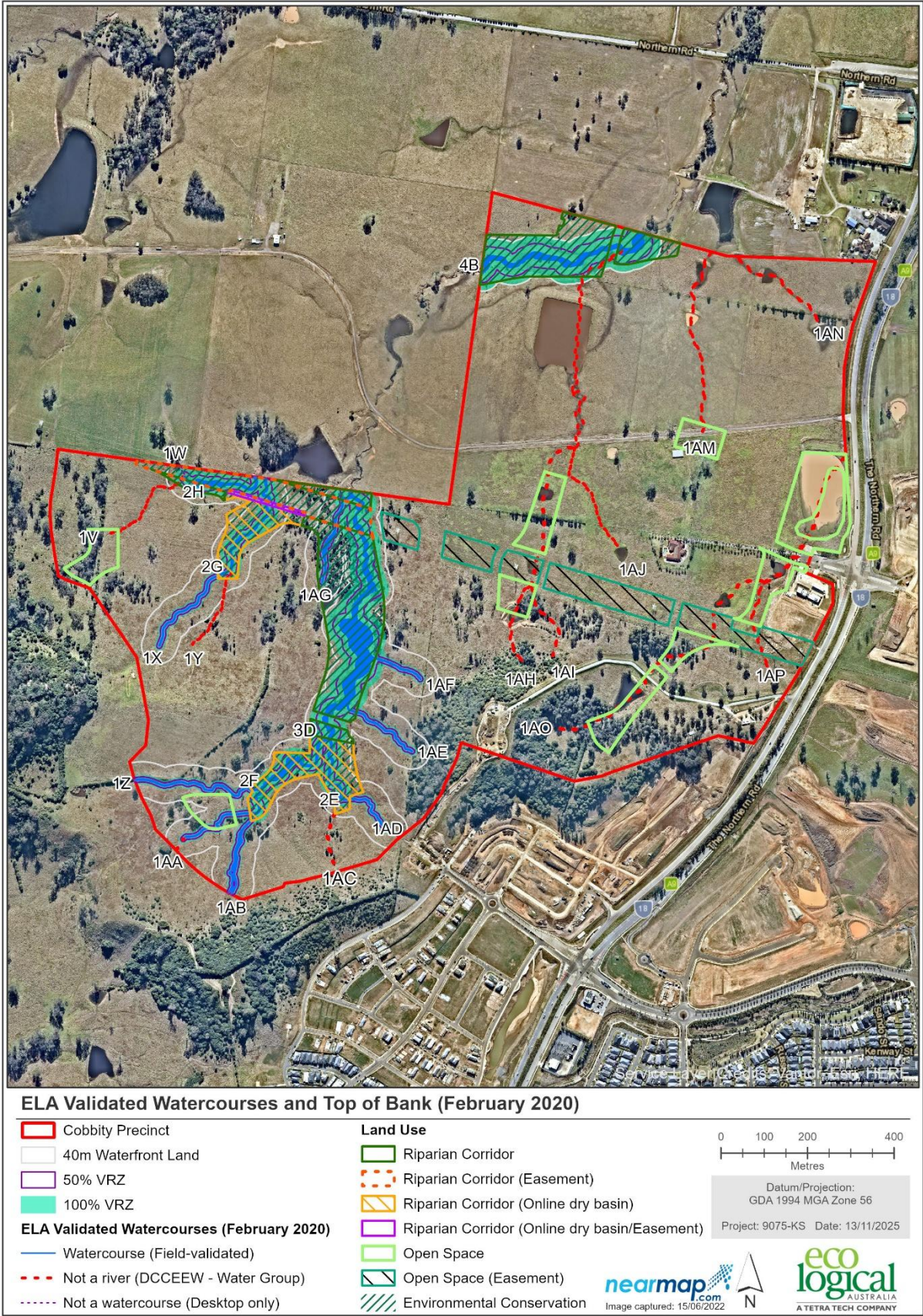


Figure 11 Riparian corridor in relation to validated watercourses

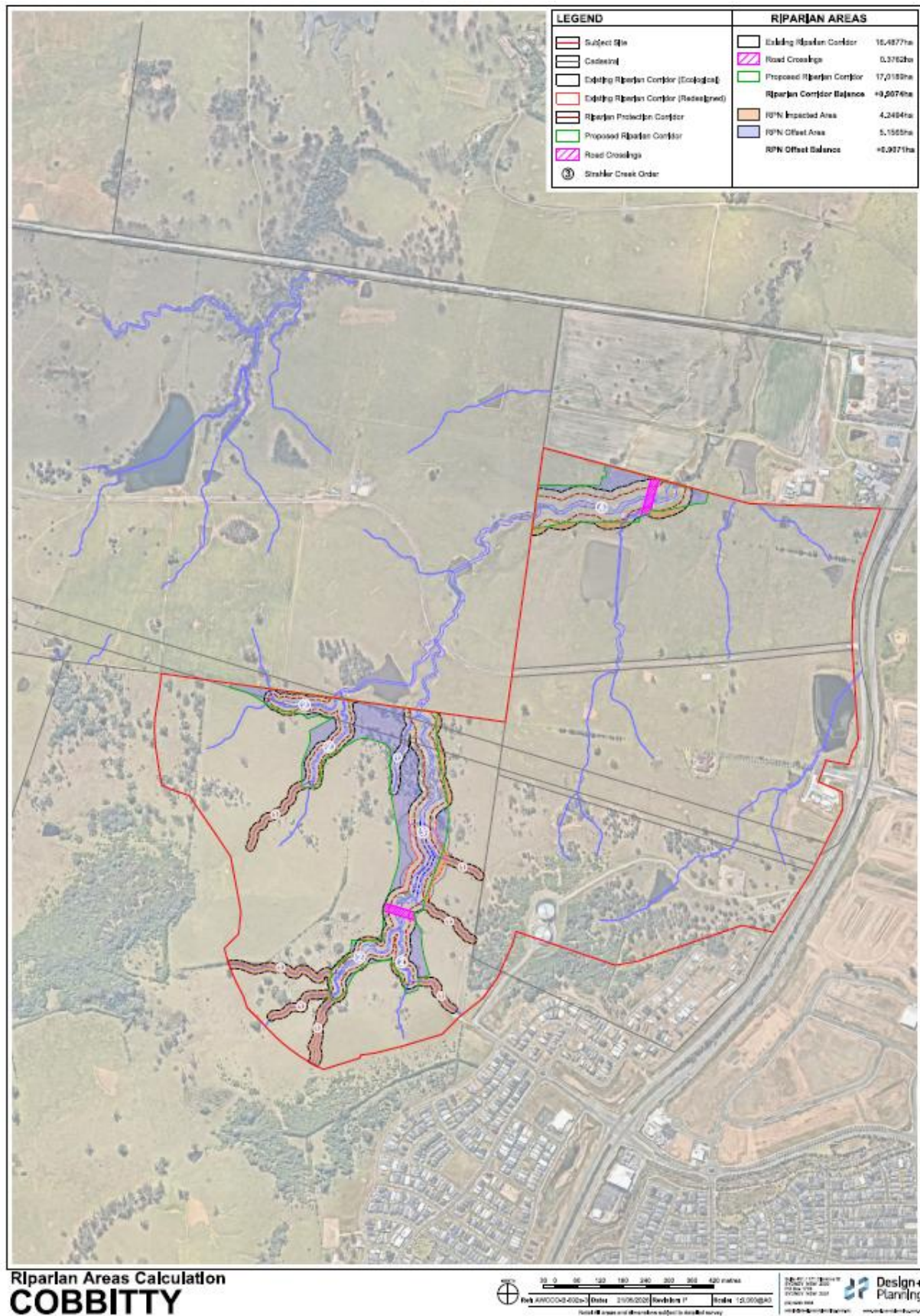


Figure 12: Encroachment of the proposed ILP into the riparian corridor and proposed areas for offset

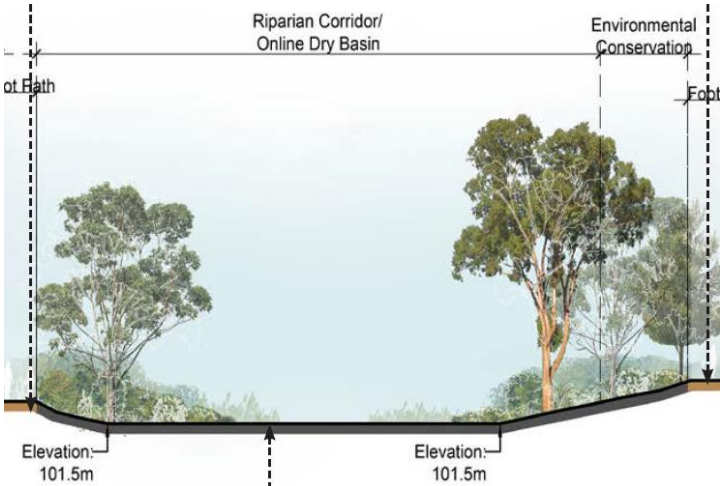
5.2 Online basin

The Water Cycle Management Report (JWP, 2026) details six detention devices, including one wet basin (situated above a permanent pond) and five dry bed basins. All basins are located offline to 3rd and 4th order watercourse. Basins B1-2 and B4 are located online to 2nd order watercourses. The two online basins are to be dry and would be revegetated to a full-structured vegetation community (Cumberland Plain Woodland or River-flat Eucalypt Forest), with species selection based on species which are tolerant of inundation.

Table 7: DCCEEW riparian guidelines requirements for online basins

Requirement	Comment
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Online detention basins must be dry and vegetated.	The proposed dry detention basins will be fully vegetated, as indicated by the Landscape Masterplan below (Urbis 2026).
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Cobbitty Creek Parklands Central Section A (Urbis 2026)

The online basins would be designed and managed as a fully-structured riparian corridor under a VMP to be developed at the DA stage. The hydraulic model prepared by JWP (2026) 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.

Online detention basins must be for temporary flood detention only, with no permanent water holding.	The proposed online basin is for flood detention only and will not hold permanent water.
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Online detention basins must have an equivalent VRZ for the corresponding watercourse order.	Although no equivalent VRZ is proposed when measured from the edge of the basin, the proposed dry online basin would contain a base-flow channel (assumed top of bank for VRZ buffering) and operate as a functional riparian corridor with fully structured vegetation. The modelled Manning’s n value for the basin when dry or less than 0.5 m depth is 0.12 (JWP 2026). Sydney Water describes riparian/stream vegetation with an n value between 0.05 – 0.1 as “Grass and/or weeds more than twice the height of flow depth; or dense, strong reed growth; or significant shrub growth within the channel; or significant inflexible vegetation within channel” (Sydney Water 2024). When combined with trees that are tolerant of periodic inundation, the basin would provide functions expected under the WM Act, and meet the requirements of a VRZ. Basin vegetation would be managed and maintained under a VMP, to be prepared at the DA stage.
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Requirement	Comment
Online detention basins must not be used for water quality treatment purposes.	Water quality management will be undertaken in separate stand-alone devices outside the outer 50% VRZ. The online basin is proposed for water retention only.

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 watercourse whilst considering the hydrological context of the broader catchment.

5.3 Groundwater Dependant Ecosystems

Field survey confirmed no BOM-mapped aquatic GDEs were present on site. The mapped terrestrial GDE is present in the south-eastern corner of the study area, based on field-validated vegetation mapping (Figure 9). In lieu of an extensive groundwater assessment, groundwater is unlikely to be a significant constraint to the development. Provided that water cycle management measures are implemented in the design, changes to spatial and temporal flows are likely to be minimal and not significantly affect the groundwater table.

5.4 Aquatic ecology

KFH exists along the central 3rd order watercourse and further downstream where it intersects the northern portion of the study area as a 4th order creek. This watercourse may be classified as Class 2 – Moderate key fish habitat and Type 2 – Moderately sensitive key fish habitat due the intermittently flowing and semi-permanent to permanent nature of the watercourse, presence of snags, clearly defined banks and sparse aquatic vegetation as described in Appendix A. As such, the preferred crossing type for the 3rd and 4th order waterway crossings under the Fisheries guidelines with respect to waterway classification is, in order of preference, bridges, arch structures, box culverts and fords. The proposed road crossings over the 3rd and 4th order watercourse would adhere to the design requirements outlined in Fairfull and Witheridge (2003) to meet fish passage policy and guidelines, ensuring the proposal does not create any barriers to fish passage. Moreover, the proposed removal of the online dam and replacement with a base-flow channel would restore fish passage within the reach. The overall consistency of the crossing design with fish passage requirements under the Fisheries guidelines would be determined at the DA or detailed design stage.

DPI Fisheries also recommend a riparian buffer zone 50 metres from the top of bank for Type 2 Class 2 waterways. Where the proposed works encroach on the VRZ required under the WM Act, 1:1 offsetting is proposed in addition to full revegetation and rehabilitation of the riparian corridor under a VMP. Therefore, the condition of the riparian corridor would be improved from its pre-development state, which includes negligible to sparse riparian vegetation (Appendix A). Overall, the proposal is generally consistent with the policies and guidelines for protecting urban riparian vegetation, as it seeks to ensure the riparian corridor functions as a 'natural' system through revegetation.

See the Biodiversity Assessment (ELA 2026) for the likelihood of occurrence of threatened aquatic species, communities or populations listed under the FM Act.

5.5 Riparian Management Strategy and recommendations

The subject site is dominated by Cumberland Plain Woodland in varying conditions with large patches of Derived Native Grassland. The subject site also contains large areas of Exotic Cover at the northern extent of the subject site. Areas of River-Flat Eucalypt Forest are comparatively minimal and limited in location along few watercourses.

While all the Cumberland Plain Woodland within the subject site meets the description of the critically endangered ecological community listed under the BC Act, most of the remnants do not meet the definition of the federally listed Cumberland Plain Shale Woodland and Shale Gravel Transition Forest. Large patches of Cumberland Plain Woodland are present along the main creek lines of the site and should be retained and rehabilitated as part of the ILP. 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.

5.5.1 Averaging rule

As discussed in Section 5.1, DCCEE'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, etc., provided that an equivalent area connected to the riparian corridor is offset on the site. The inner 50% 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. As such, the riparian rehabilitation areas may be subject to change following detailed design.

5.5.2 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 overstorey 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 10):

- 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 moderate to high recovery potential which indicates that rehabilitating the riparian corridor along the central and north-western creek lines has a high feasibility. The recommended areas of rehabilitation target the watercourses that already have moderate to good condition vegetation established for example around 2F and 3D. Vegetating along these watercourses and linking the isolated vegetation patches would allow for an improvement in wildlife corridors and overall creek condition. This would incidentally facilitate the recovery of the creek systems to a functioning natural waterway.

5.5.3 Management zones

The area of the riparian corridor proposed to be retained and managed within the ILP is approximately 17.02 ha. The rehabilitation works for the riparian corridor will be focused on weed control, assisted regeneration and revegetation. The riparian corridor consists of three management zones as identified below and in Figure 13.

- Zone 1: Rehabilitation and Weed Management
- Zone 2: Revegetation
- Zone 3: Revegetation (Groundcover and Mid-Storey Species).

An assessment of the native resilience and weed densities was conducted during field surveys. The vegetation within the riparian corridor is generally in poor to moderate condition with high weed densities in the ground layers. Areas of exotic pasture will require maintenance to prevent the continued incursion of weeds into the riparian corridor. This will best be achieved by regular mowing or ongoing weed control along the interface of the riparian corridor and proposed developable areas.

The key management priorities and required management actions for revegetation 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 (either fully structured, ground cover only or wetland species based on locations shown in Figure 13).
- Monitor native vegetation and weed densities.
- Species selection will be based on Riverflat Eucalypt Forest, but with particular attention paid to the proposed period of inundation as shown in Appendix B.

The key management priorities and required management actions for rehabilitation and weed management are:

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

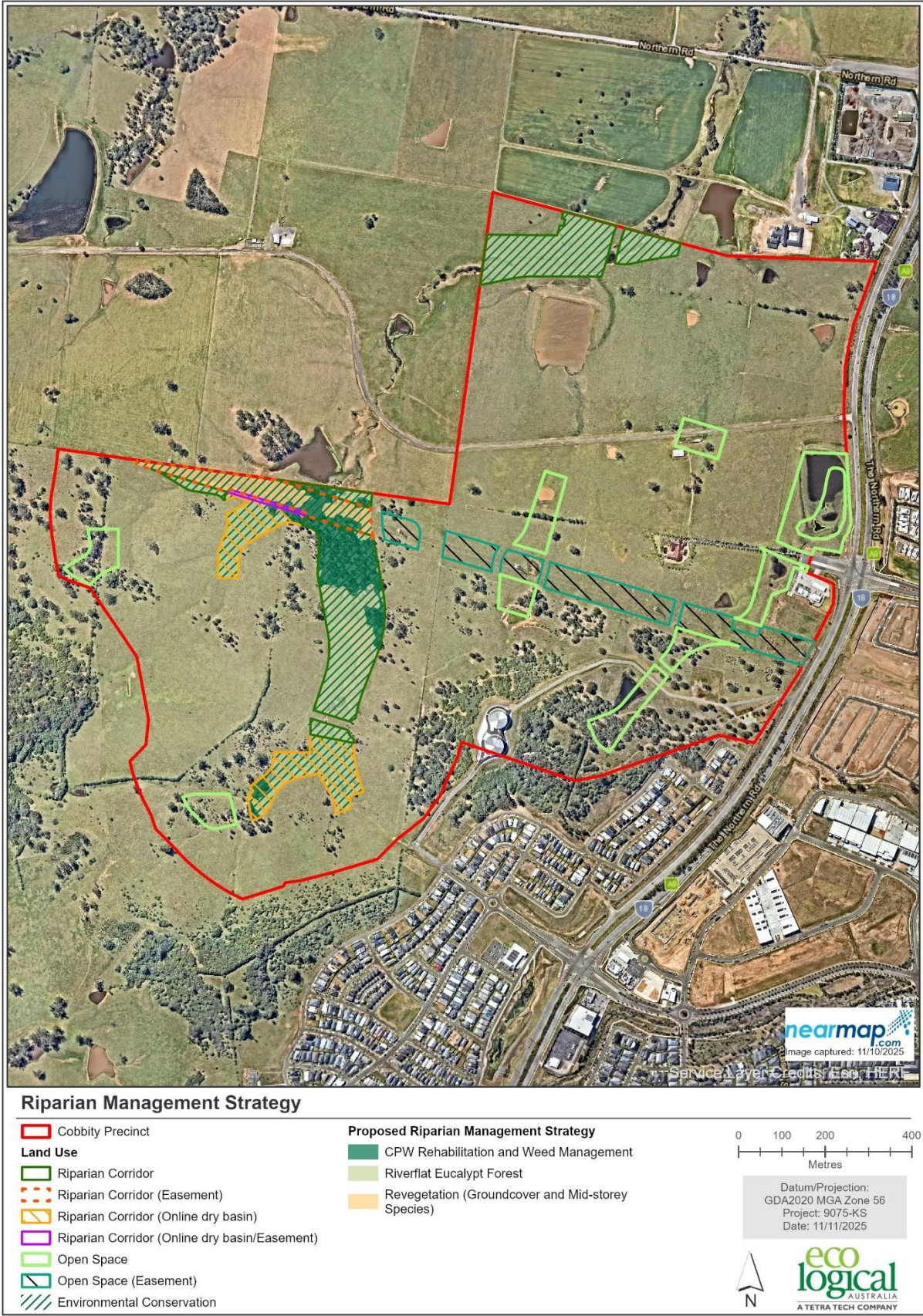


Figure 13: Indicative riparian management zones

5.5.4 SEPP and DCP provisions

Major riparian corridors should be zoned C2 Environmental Conservation as this provides clear objectives for the protection and management of the riparian corridor. The permissible uses within the Environmental Conservation zones are shown below.

Zone	Permitted without consent	Permitted with consent	Prohibited
Environmental Conservation	Nil	Drainage; 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

Where multiple land uses are proposed, for example public access for recreation, other land use zones may be appropriate such as RE1 Public Recreation, as long as the management regime for the land has a primary objective of environmental protection. However, the proponent is proposing to zone riparian corridors and adjacent accessible areas as C2 with hatching on the riparian corridors to identify where the corridor must be maintained for conservation purposes.

The riparian areas should also be subject to the Camden City Council Growth Centres Precincts DCP clauses that relate to Water Cycle Management (2.3.2) and Native Vegetation and Ecology (2.3.5). The clauses are triggered by including the riparian areas on the Western Parkland City SEPP Riparian Protection Area map. The DCP (section 2.3.5) has controls specifically for the Riparian Protection Areas which should apply to the South Creek West precinct:

- *Within land that is in a Riparian Protection Area, native vegetation is to be conserved and managed in accordance with the Guidelines for riparian corridors on waterfront land prepared by the NSW Office of Water.*

The conservation and management regime for the vegetation should be described in a Vegetation Management Plan that has been prepared to be consistent with the zone objectives, the above guidelines and Landscape plans prepared for the development.

Where public access for recreation is proposed, public ownership of riparian lands is likely to be the best solution. Discussion with local government regarding the infrastructure and vegetation management in the riparian zone is recommended.

An assessment under the Biodiversity and Conservation SEPP is provided below for controls on development generally (Table 8), which is applicable to development in the Hawkesbury-Nepean catchment.

Table 8: Impact assessment for controls on development generally under Part 6 of the Biodiversity and Conservation SEPP

Item	Impact assessment
Clause 6.6 Water quality and quantity	<i>(2) Development consent must not be granted to development on land in a regulated catchment unless the consent authority is satisfied the development ensures—</i> <i>(a) the effect on the quality of water entering a natural waterbody will be as close as possible to neutral or beneficial.</i> The proposed revegetation, rehabilitation and management of the riparian corridor under a VMP prepared at the DA stage is anticipated to have a beneficial effect on the watercourse during the operational phase of the development. Potential adverse effects on the watercourse during the construction phase would be mitigated through the implementation of a Construction Environmental Management Plan (CEMP), also prepared at the DA stage. <i>(b) the impact on water flow in a natural waterbody will be minimised.</i> The proposed works include the removal of the online dam on the 3rd order creek and construction of a base-flow channel, allowing for the reinstatement of natural flow.
Clause 6.7 Aquatic ecology	<i>(2) Development consent must not be granted to development on land in a regulated catchment unless the consent authority is satisfied of the following—</i> <i>(a) the direct, indirect or cumulative adverse impact on terrestrial, aquatic or migratory animals or vegetation will be kept to the minimum necessary for the carrying out of the development.</i> A CEMP prepared at the DA stage would include mitigation measures to ensure the proposed works would not have a direct, indirect or cumulative adverse impact on flora or fauna. See the Biodiversity Assessment for the potential impacts of construction and operation on terrestrial biodiversity (ELA 2026). The proposed rehabilitation of the riparian corridor under a VMP would have a positive impact on aquatic ecology throughout the operational phase of the development, relative to the current aquatic and riparian condition of the watercourses (Section 4.3). Revegetation of the riparian corridor would increase aquatic habitat values in KFH through improved shading and bank stability, introduction of snags, increased native leaf litter as food for macroinvertebrates, and improvement in nutrient cycling and water quality. Moreover, the removal of the online dam on the 3rd order watercourse would remove a barrier for fish passage. <i>(b) the development will not have a direct, indirect or cumulative adverse impact on aquatic reserves.</i> The proposal is located approximately 38 km west of the nearest aquatic reserve, and would not have an adverse impact on the reserve. <i>(c) if a controlled activity approval under the Water Management Act 2000 or a permit under the Fisheries Management Act 1994 is required in relation to the clearing of riparian vegetation—the approval or permit has been obtained.</i> The requirement for approval or permit will be addressed as part of future integrated development applications. <i>(d) the erosion of land abutting a natural waterbody or the sedimentation of a natural waterbody will be minimised.</i> Erosion mitigation measures during construction would be addressed in a CEMP to be prepared at the DA stage. The proposal includes retaining walls within the riparian corridor abutting the online detention basin for the prevention of erosion during high-flow events throughout the proposal's operational stage. <i>(e) the adverse impact on wetlands that are not in the coastal wetlands and littoral rainforests area will be minimised.</i> Under the NSW Wetlands Management Policy 2010, the watercourse within the study area is broadly classed as a wetland, as are all ephemeral and perennial watercourses in NSW. See responses a-d above.

Clause Flooding	6.8	<i>(2) Development consent must not be granted to development on flood liable land in a regulated catchment unless the consent authority is satisfied the development will not—</i> <i>(a) if there is a flood, result in a release of pollutants that may have an adverse impact on the water quality of a natural waterbody.</i> The Water Cycle Management Report (JWP 2026) demonstrates compliance with water quality targets set out within the Camden City Council Growth Centres Precincts DCP. <i>(b) have an adverse impact on the natural recession of floodwaters into wetlands and other riverine ecosystems.</i> The proposal site does not lie between a watercourse and any flood dependent ecosystems. There are no wetlands mapped downstream.
Clause Recreation and public access	6.9	<i>(2) Development consent must not be granted to development on land in a regulated catchment unless the consent authority is satisfied of the following—</i> <i>(a) the development will maintain or improve public access to and from natural waterbodies for recreational purposes, including fishing, swimming and boating, without adverse impact on natural waterbodies, watercourses, wetlands or riparian vegetation.</i> Public access to the watercourses would be greatly improved relative to current public accessibility. As per the Landscape Masterplan (Urbis 2026), nature trails, boardwalks and bridges are proposed within the riparian corridor.
Clause Total catchment management	6.10	<i>In deciding whether to grant development consent to development on land in a regulated catchment, the consent authority must consult with the council of each adjacent or downstream local government area on which the development is likely to have an adverse environmental impact.</i> This is the responsibility of council.

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Appendix A – Reach descriptions

A1 First order watercourses

Reach descriptions for first-order creeks are detailed in Table 9.

Table 9: First order reach descriptions

Reach	Proposed WM Act Status (pending DCCEEW – Water Group approval)	Description	Condition	Photo facing upstream	Photo facing downstream
1AA	River	The channel was defined upstream, 1 m with 0.5 high banks that were grassed and gently sloped. The riparian vegetation was mainly absent, except for pasture grasses and scattered African Olive shrubs. Moving downstream, the channel dispersed into overland flow, before becoming defined again at the start of the small patch of native vegetation predominately juvenile <i>E. tereticornis</i> . The bed was bare, with a clay silt benthic substrate. Small turbid pools were present at the low points. Flood debris was evident at the base of riparian vegetation. No aquatic vegetation was observed.	Poor	 Upstream section  Channel through vegetated riparian zone	 Upstream section – sparse riparian vegetation  Flood debris on up sides of tree trunks

1AB	River	The channel began upstream with a small head cut and defined exposed channel for 40 m before becoming overland flow with no defined bed or banks. There was no aquatic vegetation present, and the bed was a coarse clay. The riparian vegetation was African Olive shrubs, and a pasture grasses.	Poor	 Head cut upstream	 Channel meandering through olives
				 Overland flow only	 Overland flow only
1AC	Not a 'river'	No defined bed or banks. Overland flow at a low point only.	Poor		

1AD	River	Channel 0.5 – 1 m upstream, beginning with a narrow-incised channel before widening downstream with gently sloped grassed banks. The channel was dry with no aquatic vegetation present. There was a small head cut present at the confluence with 1AC. Riparian vegetation was pasture grasses only, no shrubs or trees were present.	Poor		
1AE	River	Channel varied between 0.5 – 1.5 m wide. Upstream, the channel was shallow with gently sloped banks. Water was present, in long narrow pools. No aquatic vegetation was observed. The channel was vegetated with grass and sedges. Upstream of the confluence with the dam, the channel was deeply eroded with a 1.5 m vertical head cut. One turtle was observed at the confluence. The riparian vegetation along the length of the channel was a mix of native and exotic grasses. <i>Bursaria spinosa</i> and Cotton Bush were present in the wider riparian area.	Moderate		
1AF	River	Channel approximately 0.5 m wide, with gently sloping grassed banks. Ephemeral creek, with no water at the time of survey. Riparian vegetation was pasture grass only, no trees or shrubs. Scattered <i>Eucalyptus moluccana</i> were observed in the broader riparian zone.	Poor		

1AG	River	Partly dry, ephemeral channel approximately 5 m wide with eroded banks and intermittent standings of water. Some aquatic vegetation including <i>Juncus</i> sp. observed along the channel and banks.	Poor		
1AH	Not a 'river'	No defined bed or banks. Overland flow at a low point only.	Poor		
1AI	Not a 'river'	No defined bed or banks. Overland flow at a low point only.	Poor		

1AJ	Not a 'river'	No defined bed or banks. Overland flow at a low point only.	Poor		
1AM	Not a 'river'	No defined bed or banks. Overland flow at a low point only.	Poor		
1AN	Not a 'river'	No defined bed or banks. Overland flow at a low point only.	Poor		

1AO	Not a 'river'	No defined bed or banks. Overland flow at a low point only.	Poor		
1AP	Not a 'river'	No defined bed or banks. Overland flow at a low point only.	Poor		
1V	Not a 'river'	No defined bed or banks. Overland flow at a low point only.	Poor		

1W	Not a 'river' (desktop only – requires field validation)	No defined bed or banks. Overland flow at a low point only. Upstream of site boundary was not validated.	Poor		
1X	River	Channel was defined approximately 100 m downstream from start of Strahler mapping. The banks were 0.5 m wide, with shallow pools of clear water present. The channel then dispersed downstream, becoming overland flow, until it was mapped to flow offsite.	Poor		
1Y	Not a 'river'	No defined bed or banks. Overland flow at low point only.	Poor		

1Z

River

At the upstream extent of the creek, there was an eroded head cut with a small tannin stained pool of water and vegetation that differed to the surrounding pasture grasses. Downstream, the channel dispersed into overland flow, and a single turtle was observed in the grass. The channel developed definition approximately halfway to the confluence with 2F. The channel was 1 m wide, with sloped grassy beds. Water was pooled in at the low points and woody debris was scattered throughout the reach. Riparian vegetation throughout was pasture grasses, patches of African Olive and scattered *Eucalyptus* sp. The creek had some shading, where vegetation was present. One Common Eastern Froglet was heard calling.

Moderate



Head cut at upstream extent



Channel disperses into overland flow



Defined channel



Pooling water in channel

A2 Second order watercourses

REACH 2E

The channel began with a headcut at the confluence of 1AC and 1AD. The channel was 1 m wide, with intermittent pools of water, which had an oily sheen on the surface. No aquatic macrophytes were observed in these pools. Scattered African Olive shrubs lined the channel and the remaining riparian vegetation consisted of pasture grass with no native tree species observed. The channel stopped after 50 m, dispersing into overland flow with no defined bed or banks to direct flow. Approximately 60 m downslope, the channel became defined with a clear eroded headcut. Downstream the channel was 2 m wide, with slumping banks vegetated with grass. Water was present, in depressions in the channel. There was no difference in the vegetation in the channel to the riparian zone. No trees or shrubs were present. No frogs, fish or wader birds were observed using the watercourse. The condition of 2E was moderate.



Upstream – pools of water with sheen



Facing downstream – channel disappears



Defined headcut that begins channel downstream



Banks slumping with pasture in channel

REACH 2F

Channel began at the confluence of 1AA and 1AB, the banks were both vertical with undercutting erosion. The channel widened into a pool approximately 7 m wide and 10 m wide, with shallow clear

water. An eastern long-necked turtle was observed in the pool. *Juncus* and *Persicaria decipiens* (Slender Knotweed) were present along the edge and shallows of the pool. Algae covered grass was present in the centre. Moving downstream, the channel narrowed to between 1.5 m and 2.5 m wide, with tannin-stained water and no aquatic macrophytes. The right bank was consistently steeper than the left, which had less gradient. Both banks were vegetated with pasture. The channel meandered through the paddock, with few shrubs or trees present, before joining 2E upstream of a dam. Woody debris was present throughout and there was potential fish habitat throughout the reach. The condition of 2F was good.



Upstream pool with aquatic macrophytes, turtle and Juncus.



Narrower channel with tannin-stained water

REACH 2G

The mapped channel began at the confluence of 1X and 1Y. There was no defined channel for the extent of the reach. No defined bed or banks were observed, or geomorphic processes. The reach has been mapped as a creek however, as there was a channel defined upstream along watercourse 1X. Riparian vegetation was pasture grasses only, no shrubs or trees were present. The condition of this watercourse was poor.

*Facing upstream**Facing downstream*

REACH 2H

2H begins at the confluence of 1V and 1W. At the confluence of the two first-order creeks, the channel was not defined. The channel began at the top of the first dam, which was dry at the time of the survey. Scattered *Juncus* lined the dam, however, there was no aquatic vegetation present in the dam. The second dam had clear water, with submerged grass. *Juncus* lined the edge of the dam. Downstream of the dams, the channel became overland flow with no defined geomorphic processes. There was a headcut at the boundary of the site, which defined the upstream extent of the dam downstream. There was limited variation along the watercourse, with no snags or boulders present. Turbid water was present in this headcut. No aquatic vegetation was observed in the surveyed reach, no frogs were heard, and no aquatic fauna was observed. The overall condition was moderate.

*Facing upstream – confluence of first-orders**Facing downstream – dry dam*



Facing upstream at second dam – clear water



Facing downstream – channel disperses into grass

REACH 2I

The mapped channel began at the confluence of 1AI and 1AH. There was no defined channel for the extent of the reach. No defined bed or banks were observed, or geomorphic processes. Riparian vegetation was pasture grasses only, no shrubs or trees were present. This watercourse was in poor condition.



Representative upstream and downstream photos of overland flow

REACH 2J

The mapped channel began at the confluence of 1AP and 1AO. There was no defined channel for the extent of the reach, only overland flow at a low point. No defined bed or banks were observed, or geomorphic processes. Riparian vegetation was pasture grasses only, no shrubs or trees were present. This watercourse was in poor condition.



Representative upstream and downstream photos of overland flow

A3 Third order watercourses

REACH 3D

The third-order creek began at the confluence of 2E and 2F, slightly upstream of the large dam. The channel was 2 m wide with gently sloping banks and no riparian trees or shrubs, before entering the dam, at a severely eroded 2 m drop off. Downstream of the dam, the channel was up to 5 m wide and well defined with long, wide pools present throughout which had turbid water and no aquatic macrophytes. Water was also present in other low-lying depressions. Sedges including *Juncus* sp. were observed in wet areas. Banks transitioned from gently sloping with grassy vegetation upstream to bare, steep and undercut downstream. The riparian corridor downstream of the dam had a native canopy with *Eucalyptus tereticornis* and *Angophora* spp. with exotic African Olive dominating the shrub layer. Ground cover was typical pasture grasses. Although no aquatic vegetation was present, there was woody debris throughout to diversify flow after rain. Pools and runs provided habitat for fish, frogs and wader birds. The overall condition was good.



Facing upstream to confluence of second-orders



Channel joins dam at large eroded feature



Downstream of dam – facing upstream large wide



Facing downstream – gently sloped grassy banks



Bare banks with undercutting



Long pool present at downstream extent of channel

A4 Fourth order watercourses

REACH 4B

The downstream extent of this fourth order was field-validated. At the upstream extent of the surveyed reach, the channel was evident as 3 m wide and over 1 m deep. Snags and the native aquatic plants *Typha orientalis* (Cumbungi) and Slender Knotweed were present. Birds including *Anas superciliosa* (Pacific Black Duck), *Egretta novaehollandiae* (White-faced Heron) and *Egretta pacifica* (White-necked Heron) were observed using the pool. *Limnodynastes tasmaniensis* (Spotted Marsh Frog) was also heard calling. The left bank was severely eroded, near vertical and bare. The right bank had less gradient and was vegetated by grass. Riparian vegetation was mostly absent, with two large *Melaleuca styphelioides* the only trees observed. The channel meandered downstream, with narrow runs widening into larger pools and low lying saturated grassy depressions. Both banks were vegetated by grass only and were eroded on the out bends. Water in the pools was mostly stagnant with a thick oily sheen. There was evidence of cattle tracking through the creek. At the downstream extent, where the creek flowed outside the study area, was a long deep pool, with clear water. The fence line was filled with debris, damming the pool upstream. Many snags were present. The banks were high, approximately 1.5 m, and bare. There was a small, vegetated area with *Melaleuca* sp. and *Angrophora* sp. surrounding the creek. The roots of some trees were evident sticking out of the eroded banks. *Limnodynastes peronii* (Striped Marsh Frog) and Spotted Marsh Frog were heard calling along the entire reach and frog eggs were observed in many of the pools. The overall condition was good.



Upstream where creek enters site – long clear pool



Facing downstream – sparse riparian vegetation



Centre of surveyed reach – run of shallow water



Runs flowing into pools with stagnant water



Downstream pool with debris along the fence line of property



A5 Dams

Table 10: Habitat observed at dams during field survey

Reach	Dam Number*	Description	Aquatic Fauna Observed	Aquatic Flora Observed	Representative Photo
1AN	1	Dam nearing capacity, fringing vegetation was good frog habitat.	<i>Crinia signifera</i> (Common Eastern Froglet), <i>Tachybaptus novaehollandiae</i> (Australasian Grebe)	<i>Ludwigia peploides</i> (Water Primrose), <i>Ottelia ovalifolia</i> (Swamp Lily), <i>Juncus</i>	
1AN	2	Dam nearing capacity, fringing vegetation, water was clear and shallow.	No fauna observed	Scattered <i>Juncus</i>	

Reach	Dam Number*	Description	Aquatic Fauna Observed	Aquatic Flora Observed	Representative Photo
1AM	1	Dam nearing capacity, eroded bank, water was clear with tannins.	2 turtles	Scattered Juncus	
1AM	2	Dam nearing capacity, eroded bank, water was clear with tannins.	2 turtles	Fringing Juncus	
1AO	1	Clear deep water, dam was full with submerged terrestrial vegetation.	4 turtles, Australasian Grebe, White-faced Heron, <i>Chenonetta jubata</i> (Australian Wood Duck)	Fringing Juncus	

Reach	Dam Number*	Description	Aquatic Fauna Observed	Aquatic Flora Observed	Representative Photo
1AO	2	Clear, shallow water. Dam was nearing capacity with submerged terrestrial vegetation.	No fauna observed	No flora observed	
1AO	3	Dam was deep with turbid water and grassy banks.	No fauna observed	Water Primrose, <i>Eleocharis</i> sp. (Bulrush), Juncus, Swamp Lily	
1AJ	1	Water was clear and dam was nearing capacity.	3 Turtles, 1 Common Eastern Froglet	Fringing Juncus	

Reach	Dam Number*	Description	Aquatic Fauna Observed	Aquatic Flora Observed	Representative Photo
1AH	1	Water was shallow and extremely turbid. A large tunnel had eroded through the dam wall and there were big rills eroding on the upstream side.	5 Turtles, Australasian Grebe, White-faced Heron, Striped Marsh Frog	Cumbungi in centre of dam, fringing Juncus.	
2I	1	Water was turbid, with grass the only fringing vegetation.	Australian Wood Duck, Australasian Grebe, 2 Turtles	Cumbungi	
2I	2	Water was less turbid than dam 1, grass only fringing vegetation.	No fauna observed	No flora observed	

Reach	Dam Number*	Description	Aquatic Fauna Observed	Aquatic Flora Observed	Representative Photo
2I	3	Very large dam, reaching capacity. Water was turbid and submerging terrestrial vegetation.	Australian Wood Ducks, Australasian Grebe, Pacific Black Duck, White-faced Heron, 3 Turtles	No flora observed	
2I	4	Dam walls were very steep, with dam almost at capacity with clear water. Grass was only fringing vegetation.	3 Turtles	No flora observed	
2H	1	Dam was almost dry, with a clay capped silty benthic substrate.	No fauna observed	No flora observed	

Reach	Dam Number*	Description	Aquatic Fauna Observed	Aquatic Flora Observed	Representative Photo
2H	2	Dam had clear, shallow water. Terrestrial grass was submerged.	No fauna observed	No flora observed	
3D	1	Very large dam, with a narrow eroding upstream extent that was dry. The wide downstream extent had turbid water with submerged terrestrial vegetation.	1 Turtle, White-faced Heron	Sparse Swamp Lily, Fringing Juncus	 

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

