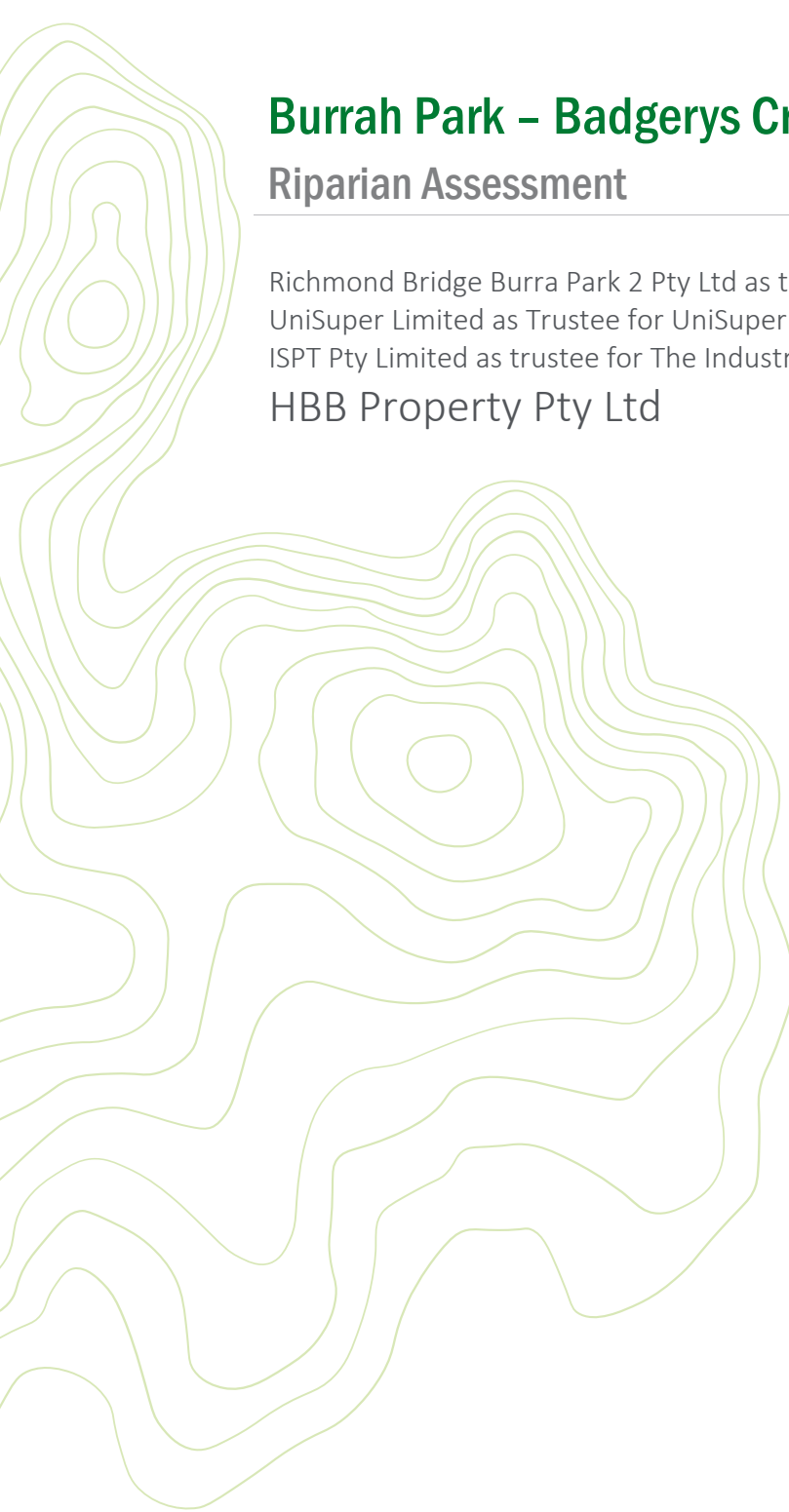




Burrah Park – Badgerys Creek

Riparian Assessment

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Abbreviations

Abbreviation	Description
CPCP	Cumberland Plain Conservation Plan
DCCEEW – Water Group	NSW Department of Climate Change, Energy, the Environment and Water
DPI – Fisheries	Department of Primary Industries – Fisheries
ELA	Eco Logical Australia Pty Ltd
EP&A Act	<i>Environmental Planning & Assessment Act 1979</i>
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
FM Act	<i>Fisheries Management Act 1994</i>
KFH	Key Fish Habitat
RC	Riparian Corridor (channel plus VRZ on each side)
Riparian Guidelines	<i>Controlled activities - Guidelines for riparian corridors on Waterfront Land</i> (DPE 2022b)
SSDA	State Significant Development Application
VRZ	Vegetated Riparian Zone
WM Act	<i>Water Management Act 2000</i>
WSI	Western Sydney International (Nancy-Bird Walton) Airport

Executive Summary

This Riparian Assessment has been prepared by Eco Logical Australia Pty Ltd (ELA) to accompany a State Significant Development Application (SSDA) for a Concept and Stage 1 SSDA for a Warehouse and Logistics Estate at 1953-2109 Elizabeth Drive, Badgerys Creek, legally described as Lot 1 in Deposited Plan (DP) 1306448 (the study area). The proposed development is known as Burrah Park. The study area is located within the Northern Gateway Precinct of the Western Sydney Aerotropolis.

The Project is to be assessed as a State Significant Development (SSD), SSD-18406916, under Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). The Secretary's Environmental Assessment Requirements (SEARs) include an assessment of impacts to wetlands and riparian corridors. The purpose of this report is to test the consistency of the Project with relevant planning frameworks.

The site is flanked by Cosgrove Creek and Oaky Creek to the north-west. These watercourses are tributaries of Wianamatta-South Creek, within the Hawkesbury-Nepean catchment. Results of watercourse validation undertaken in a previous Riparian Constraints Assessment (ELA 2022) have been adapted for use within this report, concluding three watercourses within the study area (Cosgroves Creek, Oaky Creek and a 2nd order tributary to Cosgroves Creek) met the definition of a river under the *Water Management Act 2000* (WM Act).

The proposal is generally consistent with the DCCEEW Riparian Guidelines, however two areas of encroachment into the inner 50% vegetated riparian zone (VRZ), being the proposed upstream realignment of Reach 2A into a naturalised trunk drainage path, and in the northwest of the study area due to the proposed M12 underpass. Due to the restricted area in which the underpass can be placed, this encroachment cannot be avoided. While realignment of a 2nd Order Stream is inconsistent with the Riparian Guidelines, the naturalised trunk drainage path will provide a greater area of aquatic habitat and include restoration under a VMP, leading to improved outcomes on site. One area of encroachment in the southwestern corner of the study area (Basin F) is consistent with the guidelines, because it does not encroach on the inner 50% VRZ and an equivalent area is proposed to be offset. All areas of encroachment are proposed to be offset along the riparian corridors within the study area beyond the required 1:1 offset guide. A total of 90,961 m² is available to offset the 6,667 m² encroachment area.

This report also discusses consistency with the Western Sydney Aerotropolis Precinct Plan and Western Sydney Aerotropolis Phase 2 Development Control Plan (DCP). The Project is generally consistent with the objectives and benchmark solutions set out by these plans, with justification or context provided. Responses to controls under the Biodiversity and Conservation SEPP (Division 2, s6.6 – 6.10) are also included in this assessment.

Mitigation measures have been made to ensure the ongoing health of waterways, such as implementing a Vegetation Management Plan (VMP) (ELA 2025a) to protect and restore riparian corridors, including the proposed offset areas.

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Appendix A NRAR Consultation

Appendix B Representative photographs and rationale (adapted from ELA 2022)

B1: Reach 1A-1E

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B5: Reach 4A (Cosgroves Creek)

Appendix C Riparian and Fisheries Guidelines

C1: Controlled activities – Guidelines for riparian corridors on Waterfront Land

C2: Policy and Guidelines for Fish Habitat Conservation and Management

1. Introduction

1.1. Project description

This report has been prepared to accompany a State Significant Development Application (SSDA) at 1953-2109 Elizabeth Drive, Badgerys Creek NSW (SSD-70316465) to be assessed under Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). The application seeks consent for a concept plan including future development lots and building footprints. The development also seeks consent for the Stage 1 works which will include bulk earthworks across the site, infrastructure delivery, road access/intersections, internal road construction, civil infrastructure and utilities, stormwater infrastructure works and the construction of three (3) warehouse buildings.

Specifically, development consent is sought for activities described in Table 1 below.

This report has been prepared in response to the requirements contained within the Secretary's Environmental Assessment Requirements (SEARs) dated 22 May 2024 and issued for the SSD-70316465. Specifically, this assessment validates watercourses on site, reviews relevant riparian and aquatic guidelines and provides an assessment of consistency between the proposed SSDA and the planning framework, including the *Water Management Act 2000* (WM Act), Western Sydney Aerotropolis Precinct Plan (DPE 2023b) and Western Sydney Aerotropolis Phase 2 Development Control Plan (DCP) (DPE 2022e) in response to the relevant Secretary's Environmental Assessment Requirements (SEARs) dated 22 May 2024 and issued for SSD-70316465 (Table 2).

Table 1: Project description

Element	Proposed Development
Concept Plan	Concept Masterplan for the Burrah Park comprising warehouse buildings, internal road network layout, building locations, Gross Floor Area (GFA), car parking, concept landscaping, building heights, setbacks, signage strategy, public art strategy, design excellence strategy and Connection with Country framework. The developable area is approximately 131.06 ha.
Stage 1 – Site Preparation Works	• Demolition and removal of existing structures and vegetation. • Heritage salvage works (if applicable). • Construction of roads, access infrastructure, including a signalised intersection with Elizabeth Drive. • Dam de-watering and de-commissioning. • Bulk earthworks, cut and fill, benching, battering and retaining walls. • Lead in infrastructure, utilities and servicing. • Stormwater infrastructure including construction of Sydney Water basins and Water Sensitive Urban Design (WSUD) elements.
Stage 1 – Development	• Construction and fit out of 3 warehouse buildings and ancillary office space. • Stormwater management, fencing and landscaping. • Internal road network, active transport network, public domain and open space. • Subdivision, and • Estate and on lot signage. • Total approximate GFA 85,864 sqm ○ Warehouse 1.1 – 26,855 sqm ○ Warehouse 1.2 – 31,430 sqm ○ Warehouse 3.1 – 27,561 sqm

Table 2: SSD-70316465 SEARs

Item	Description of Requirement
Suitability of the site	Demonstrate how works within the site would avoid or minimise impacts to mapped regional basins and mapped riparian areas .
Water Management	An assessment of potential surface and groundwater impacts (both quality and quantity) associated with the development, including potential impacts on watercourses, riparian areas, groundwater, and groundwater-dependent communities nearby in accordance with relevant water quality guidelines and the Department of Climate Change, Energy, the Environment and Water - Water Group (DCCEEW-Water) Groundwater Toolkit.

1.2. Site Description

The proposed development (the Project) is located at 1953-2109 Elizabeth Drive, Badgerys Creek NSW. It is legally defined as Lot 1 in Deposited Plan (DP) 1306448, within the local government area (LGA) of Penrith City Council (Figure 2). The study area totals approximately 172 ha, and is located approximately 12.5 km south-east of the Penrith Central Business District (CBD). The site is a strategic landholding located immediately north of the new Western Sydney International (Nancy-Bird Walton) Airport (WSI).

The study area is largely zoned as ENT (Enterprise) and partially as ENZ (Environment and Recreation) and SP2 (Infrastructure) under the Western Parkland City SEPP.

The study area is bordered by Oaky Creek and Cosgroves Creek to the north and north-west, which are 3rd and 4th order streams respectively, as mapped under the *Water Management (General) Regulation 2018 hydroline spatial data 1.0* (the 'hydroline') map. An additional four unnamed 1st order and two unnamed 2nd order hydrolines also occur on site. Ten existing farm dams are present on site, seven of which are online. A Dam Dewatering Plan (DDP) has been prepared for the removal of these dams (ELA 2025c).

1.3. Terms used in this report

1.3.1. Subject land

The 'subject land', presented as a solid red border and defined in Figure 2. This is a broader area beyond the impact area (below) including the western riparian corridor of Cosgroves Creek.

1.3.2. Impact Area

As defined in Figure 2, the 'impact area' refers to the area encompassed by the development plans, which includes subdivision, bulk earthworks, roads and associated services.

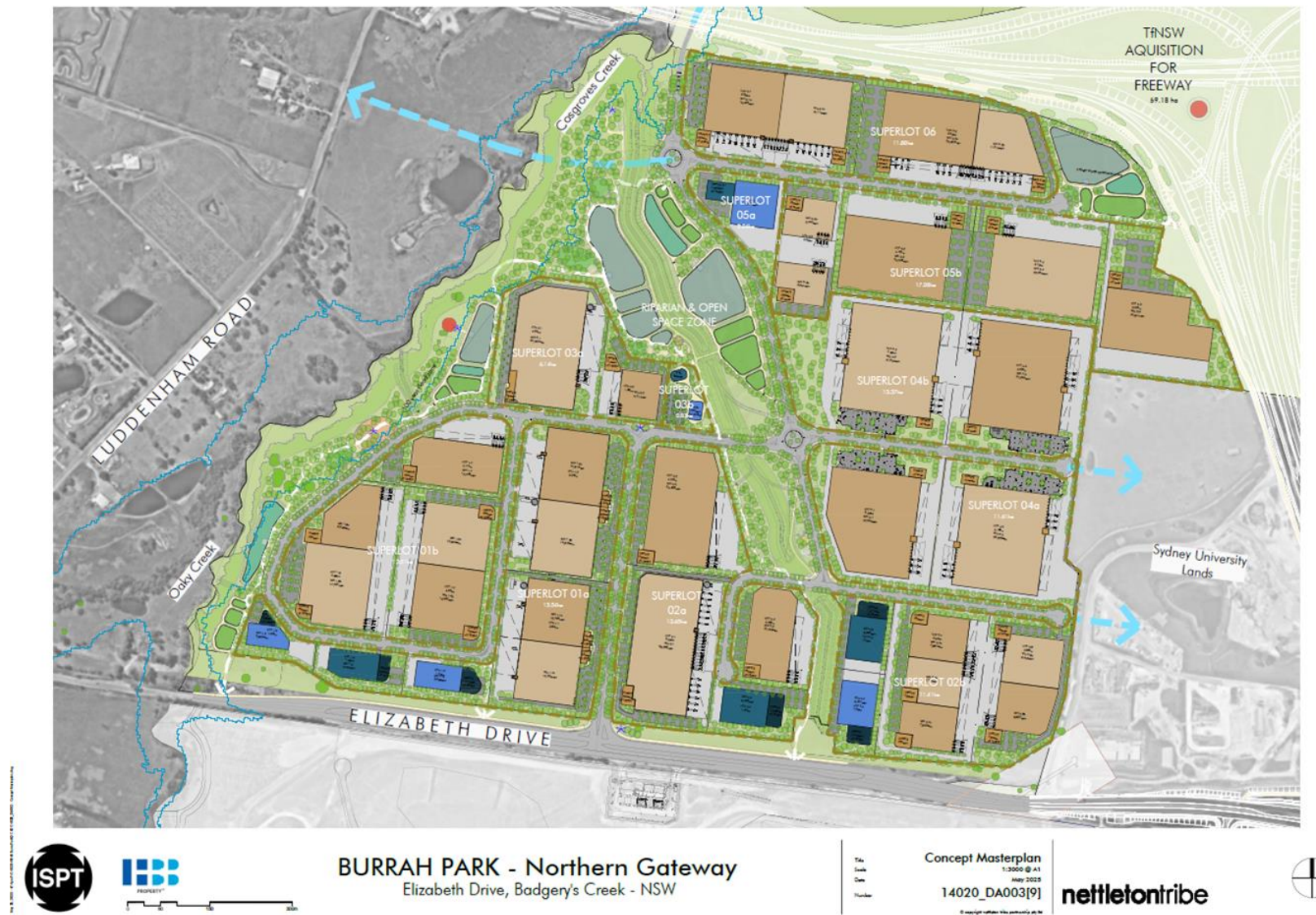


Figure 1: Concept Masterplan (Nettleton Tribe 2025)



Figure 2: Location of the study area in Badgerys Creek



Figure 3: Development layout

2. Statutory Framework

2.1. Commonwealth Legislation

Table 3: Commonwealth legislative context

Legislation	Overview
<i>Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)</i>	The EPBC Act establishes a regime for assessing and regulating the environmental impact of activities (including development) where Matters of National Environmental Significance (MNES) may be affected. Under the EPBC Act, any action which has, will have, or is likely to have a significant impact on an MNES is defined as a “controlled action”, and requires approval from the Minister. The Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW) is responsible for administering the EPBC Act. The process includes undertaking an Assessment of Significance for listed threatened species and ecological communities that represent a matter of MNES that will be affected as a result of the proposed action. The NSW Department of Climate Change, Energy, the Environment and Water (NSW DCCEEW) approved the Cumberland Plain Conservation Plan (CPCP) in August 2022 (DPE 2022d). The CPCP applies biodiversity certification and protection measures to areas of Western Sydney. Certified-urban capable land and certified-major transport corridors (Figure 4) identify land within the CPCP Area for future urban development. On 26 March 2024 the Commonwealth Environment minister granted approval for the actions described in the CPCP in accordance with Part 10 of the EPBC Act, which includes approval for urban and industrial development located on wholly certified land. The Commonwealth approval states: <i>‘Actions approved under this decision will not require separate referral, assessment or approval under the EPBC Act in order to be taken.’</i> The impact area is located on certified land under the CPCP, being either certified-urban capable or certified-major transport corridor (Figure 4). As such, no further assessment of MNES is required under the EPBC Act for the development on certified-urban capable land.

2.2. NSW State Legislation

Table 4: State legislative context

Legislation	Overview
<i>Environmental Planning & Assessment Act 1979 (EP&A Act)</i>	The EP&A Act is the principal planning legislation for NSW. It provides a framework for the overall environmental planning and assessment of development proposals. The Project is a State Significant Development to be assessed under Part 4.12 of the EP&A Act. The Planning Secretary’s Environmental Assessment Requirements (SEARs) (issued 22 May 2024) requested under Section 4.12(8) of the EP&A Act require an assessment of the developments impacts to riparian corridors and wetlands.
<i>Fisheries Management Act 1994 (FM Act)</i>	The FM Act governs the management of fish and their habitat in NSW. 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. The <i>Fisheries NSW Policy and Guidelines for Fish Habitat Conservation and Management</i> (Fairfull 2013) outlines design requirements to avoid, minimise, mitigate or offset harm to sensitive aquatic ecosystems, ensuring there is no net loss of Key Fish Habitat (KFH).
<i>Water Management Act 2000 (WM Act)</i>	The main objective of the WM Act is to manage NSW water in a sustainable and integrated manner that will benefit current generations without compromising future generations’ ability to meet their needs. The WM Act establishes an approval regime for activities within waterfront land, defined as the land 40 m from the highest bank of a river, lake, or estuary. The NSW Department of Planning and Environment – Water (DPE – Water), now the NSW Department of Climate Change, Energy, the Environment and Water (DCCEEW – Water

Legislation	Overview
	Group), published <i>Controlled activities – Guidelines for Riparian Corridors on Waterfront Land</i> (DPE 2022b), referred to hereon as the 'DCCEEW riparian guidelines'. These guidelines assist proponents in designing development to be consistent with the intent of the legislation.

2.3. Environmental Planning Instruments (EPIs)

Table 5: EPIs relevant to the SSDA

Instrument	Objectives
<i>State Environmental Planning Policy (Precincts – Western Parkland City) 2021 (Western Parkland City SEPP) – Aerotropolis Precinct Plan</i>	The study area is zoned as ENT (Enterprise) and ENZ (Environment and Recreation) under the Western Parkland City SEPP. The ENZ zoning roughly correlates with the location of mapped Strahler streams. The Aerotropolis Precinct Plan is in force under the provisions of <i>State Environmental Planning Policy (Precincts – Western Parkland City) 2021</i> (Western Parkland City SEPP), specifically Chapter 4 Western Sydney Aerotropolis. The Precinct Plan provides the place-based objectives and requirements to guide development in the Aerotropolis in a consistent and sustainable manner over time. The Precinct Plan provisions relating to riparian corridors are: 4.5.2 Riparian corridors - The protection, restoration, and maintenance of riparian corridors, including waterways and water dependent ecosystems is essential in achieving the cultural, social and biodiversity aspirations as well as tree canopy targets of the Western Parkland City. Objectives BGO1: Protect, restore, and maintain vegetated riparian zones adjacent to creeks and other water bodies in accordance with the <i>Water Management Act</i> and related Guidelines. BGO2: Manage impacts of development on waterways to achieve and maintain established waterway health targets. BGO3: Enable people to have safe contact with water in the landscape for recreation and access to urban cooling.
<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 the 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. - 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.
Western Sydney Aerotropolis Development Control Plan (DCP) Phase 2	Riparian Corridors Section 2.3.1 of the Aerotropolis DCP contains objectives and performance outcomes for waterway health and riparian corridors. These objectives are:

Instrument	Objectives
	● O1: Protect and restore native and riparian vegetation to improve the connectivity, ecological condition, and function of ecosystems. ● O2: Ensure that development does not adversely affect aquatic fauna. ● O3: Effectively manage indirect and ongoing impacts of development adjacent to waterways to ensure vegetation in the riparian area, aquatic fauna, water quality and quantity is protected and maintained. ● O4: Reinstate more natural conditions in highly modified waterways and riparian land while not increasing flood risk. Objectives under Section 2.3.1 are addressed in Section 5.5 of this report. Recognise Country The study area is situated on Dharug Country, within the Wianamatta-South Creek Catchment. Under Section 2.1.2 of the DCP, performance outcome 1 (PO1) requires consideration of the cultural values of waterways. The development should retain, connect and provide access to landscape elements including waterways and native vegetation, and respond to natural systems, including significant tributaries and waterways in the Wianamatta-South Creek catchment by avoiding significant impacts to ecological condition and the function of ecosystems in addition to the protection and restoration of native riparian vegetation. A separate report has been prepared as part of the SSDA to support Connecting to Country.

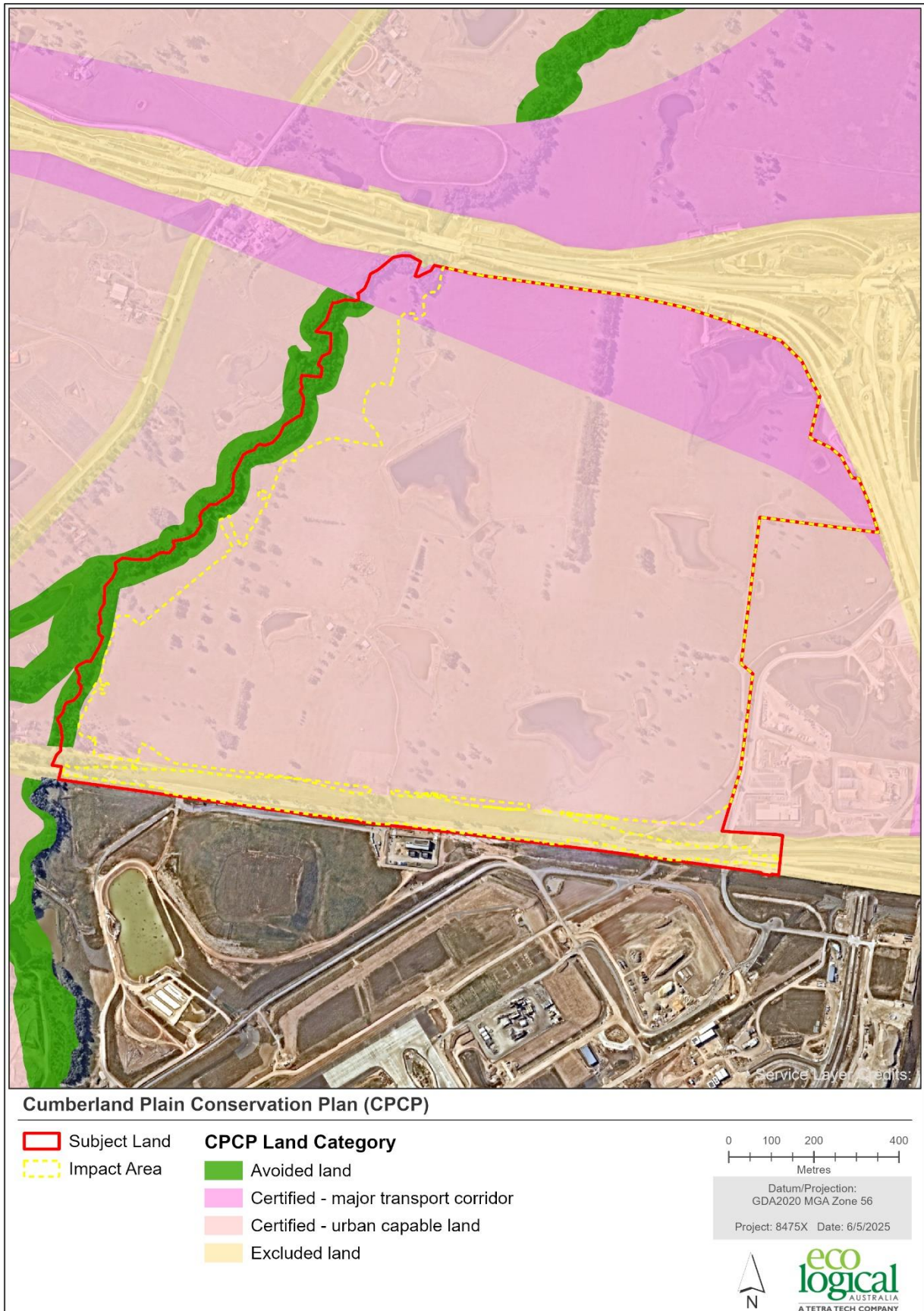


Figure 4: Cumberland Plain Conservation Plan land categories

3. Methods

3.1. Desktop assessment

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

- Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* – Protected Matters Search Tool (10 km radius)
- NSW *Fisheries Management Act 1994*; NSW DPI *Fisheries Policy and Guidelines for Fish Habitat Conservation and Management (2013 update)* (Fairfull 2013); KFH mapping; listed protected and threatened species and populations, including species profiles; ‘Primefact’ publications and expected distribution maps (Riches et al 2016).
- NSW *Water Management Act 2000* and Guidelines for controlled activities on waterfront land – Riparian corridors (DPE 2022b)
- Water Management (General) Regulation 2018 hydroline spatial data 1.0
- NSW Wetlands Management Policy 2010 (DECCW 2010)
- Online Zoological Collections of Australian Museums (OZCAM) and Atlas of Living Australia (ALA) – individual species searches to determine likelihood of occurrence of threatened species
- NSW River styles database (DPE 2023a)
- National Atlas of Groundwater Dependent Ecosystems (GDEs)
- State Environmental Planning Policy (Biodiversity and Conservation SEPP) 2021 – Chapter 6 Water Catchments
- State Environmental Planning Policy (Precincts – Western Parkland City) 2021 – Aerotropolis Precinct Plan
- Western Sydney Aerotropolis Development Control Plan (DCP) Phase 2
- Review of previous survey data (ELA 2022)

3.2. Field survey

Survey of watercourses within the study area was undertaken by ELA staff on 10th May 2018 (ELA 2022). The objective of the field work was to confirm whether the watercourses conformed to the definition of ‘river’ as stated in the WM Act and according to the DCCEEW riparian guidelines. This involved examining the beds, banks, and indications of geomorphic alterations such as erosion and deposition where the watercourses appeared on the hydroline map. Additionally, the task included delineating the top of bank (TOB) for any confirmed watercourses to ensure appropriate riparian buffers were applied.

Each hydroline within the study area, including portions of the hydroline beyond the site boundary, were observed for evidence of geomorphic features, as a river may be discontinuous along its length, but must be classed as a river for its full length (as measured down from the uppermost part that has defining characteristics). Additionally, watercourses outside of the study area may have riparian buffers which intersect the study area boundary. Where watercourses met the definition of a ‘river’ under the WM Act, top of bank was digitised using a GPS-enabled tablet, aerial imagery, and 2-metre contours. Finally, the appropriate riparian buffers were applied to TOB as per the DCCEEW riparian guidelines (DPE 2022b). Watercourses were assigned a reach number based on the Strahler system described in Schedule 2 of the *Water Management (General) Regulation 2018*.

Notes on the condition of the watercourses within the study area were taken to describe geomorphic condition, riparian vegetation, and aquatic habitat for the purposes of informing waterway classification type and KFH type under the FM Act, and identifying any threatened aquatic species, populations and communities or their habitat listed under the FM Act and EPBC Act. Particularly, notes were taken on vegetation structure, connectivity and quality, bed and bank stability, and aquatic habitat quality and diversity.

4. Results

4.1. Desktop review

The study area consists of one 4th order watercourse, Cosgroves Creek, along the western boundary of the study area, and one 3rd order tributary to Cosgroves Creek, Oaky Creek, in the south-western corner of the study area. Hydroline mapping shows an additional two unnamed 2nd order watercourses and four unnamed 1st order watercourses within the study area. Ten farm dams exist on site, seven of which are on a hydroline. These waterways flow into Cosgroves Creek, which is a tributary of Wianamatta-South Creek within the Hawkesbury-Nepean catchment (Figure 5). The confluence of Cosgroves Creek with Wianamatta-South Creek is approximately 4.5 km northeast of the study area.

Due to the situation of the study area within the Hawkesbury-Nepean catchment, as defined in Chapter 6 of the Biodiversity and Conservation SEPP, the development controls outlined in Section 5.4 apply to the proposal.

The River Style of Cosgroves Creek and Oaky Creek is a *laterally unconfined, continuous channel with low sinuosity and a fine-grained bed, in a moderate geomorphic condition* (assessed in March 2020) (DPE 2023a). All watercourses and dams within the study area constitute a 'wetland' under the NSW Wetlands Policy (DECCW 2010). A search of the National Atlas of Groundwater Dependent Ecosystems (GDEs) indicates high probability of terrestrial GDEs within the Cosgroves Creek and Oaky Creek Riparian Corridor (Figure 6). The closest high probability aquatic GDE is to the east, along Wianamatta-South Creek (Figure 7).

Cosgroves Creek and Oaky Creek are mapped as Key Fish Habitat (KFH) by DPI Fisheries (Figure 5). The Fisheries spatial portal identifies the nearest major waterway within the catchment, Wianamatta-South Creek, as having fair freshwater fish community status. The nearest expected threatened fish species modelled by DPI Fisheries is *Macquaria australasica* (Macquarie Perch), which has a recorded occurrence on Atlas of Living Australia (ALA) in Lake Burragorang (Warragamba Dam), approximately 12 to the west-south-west of the study area. Other threatened species under the FM Act with modelled potential distribution near the study area include *Prototroctes maraena* (Australian Grayling) and *Archaeophya adamsi* (Adams Emerald Dragonfly). ALA records confirm there are no records of these FM Act listed threatened species within 10 km of the study area.

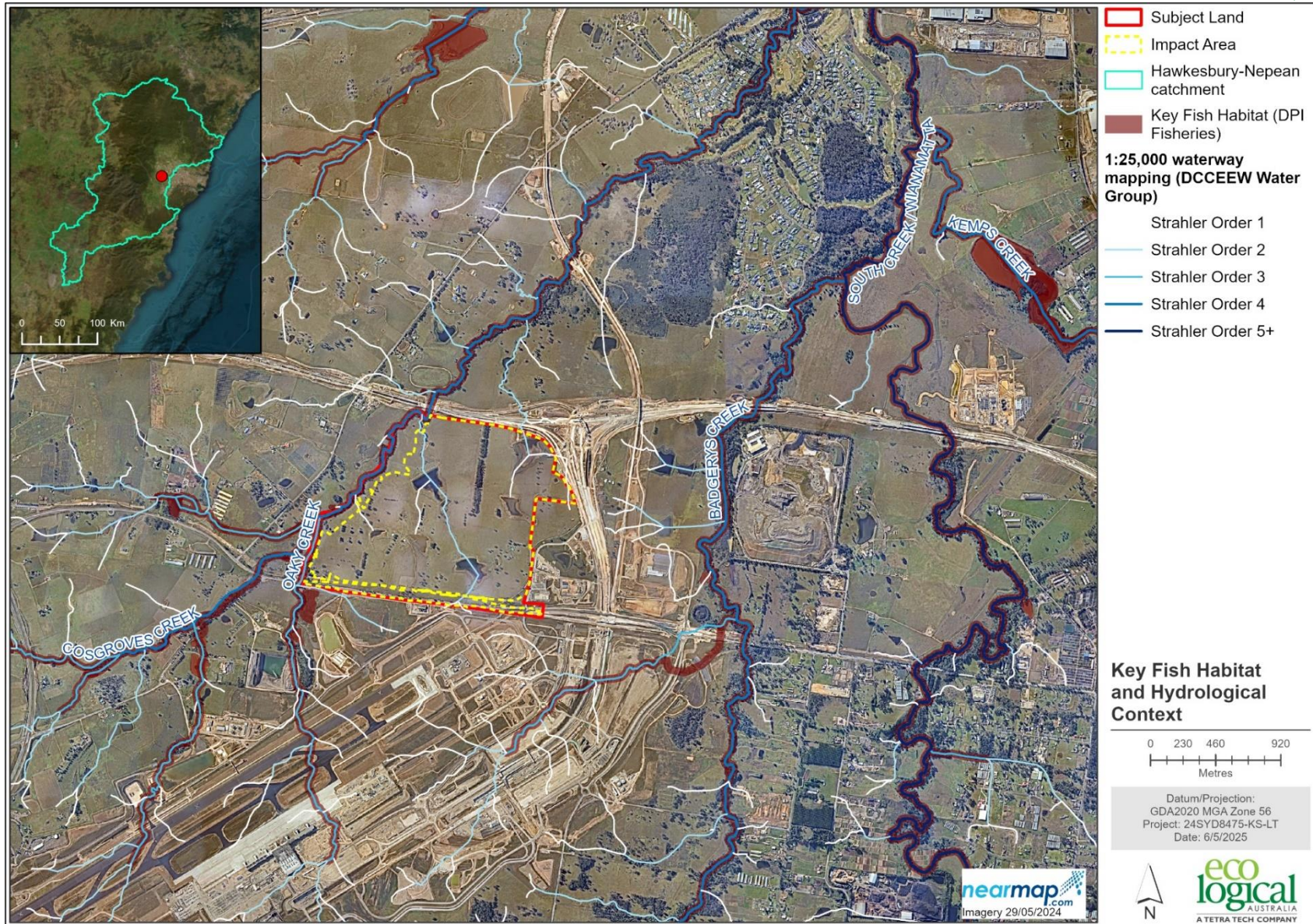


Figure 5: Key fish habitat and hydrological context of the study area

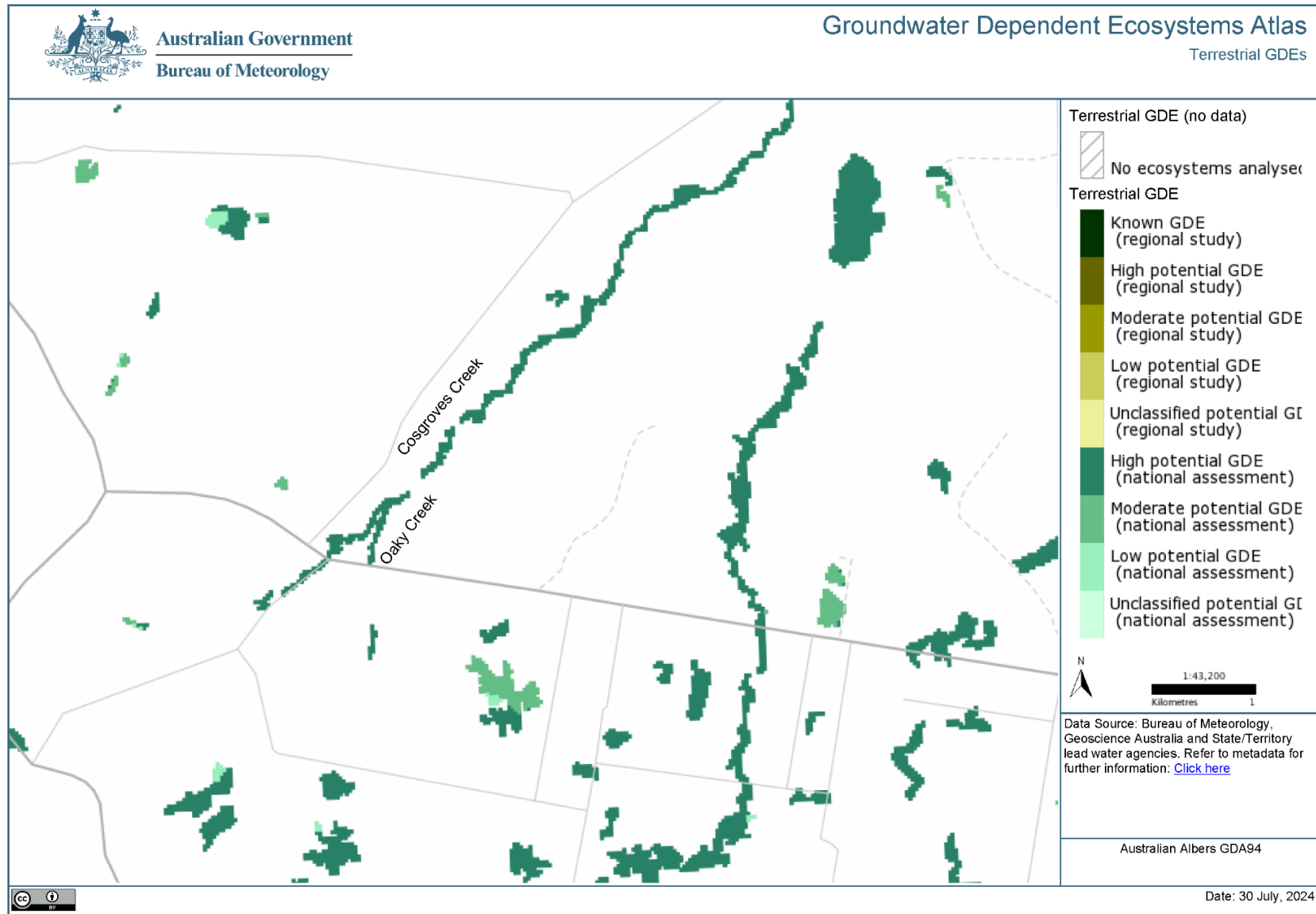


Figure 6: Probability of terrestrial groundwater dependent ecosystems near the study area

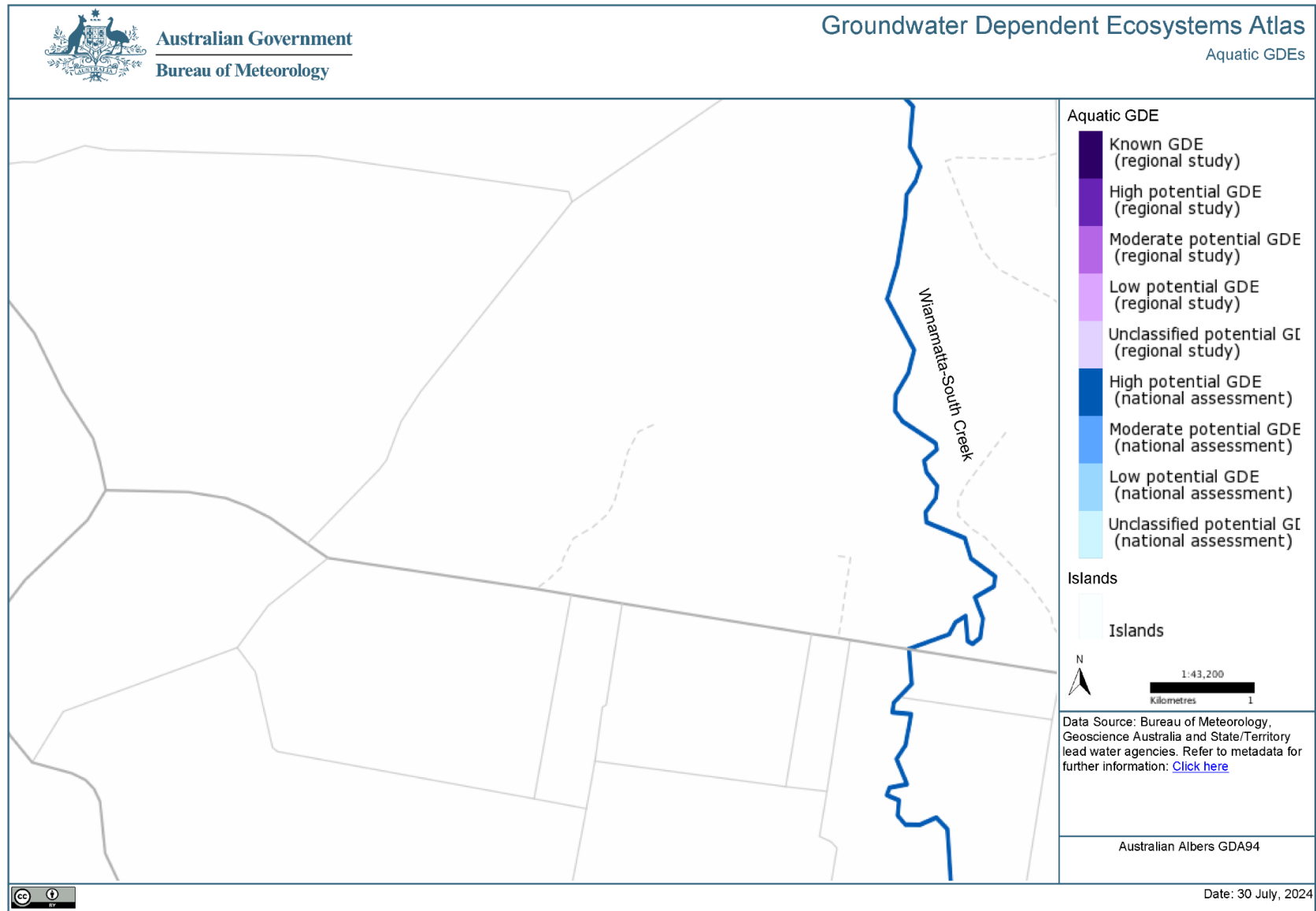


Figure 7: Probability of aquatic groundwater dependent ecosystems near the study area

4.2. Watercourse validation and top of bank (adapted from ELA 2022)

Field survey of the mapped hydrolines within and adjacent to the study area in May 2018 confirmed that each 1st order watercourse, reach 1A through 1E, did not meet the definition of a 'river' under the WM Act, as no defined bed, banks, channels, or signs of geomorphic processes were observed in these locations (Figure 8).

A portion of reach 2A, beginning downstream of its fourth online dam, had a defined channel and banks. Likewise, a portion of reach 2B north of the study area boundary exhibited similar features. Clear evidence of geomorphic processes was also observed at reach 3A and 4A, Oaky Creek and Cosgroves Creek, respectively (Appendix B).

As a result, Oaky Creek, Cosgroves Creek and the unnamed 2nd order watercourse were classed as rivers for the purposes of the WM Act (from the uppermost part that had defining characteristics along reach 2A) (Figure 8).

Subsequently, 40 m from the top of the bank of these watercourses constitutes waterfront land, and the DCCEEW riparian guidelines apply to the proposal (Figure 9). ELA consulted with NRAR (now DCCEEW – Water Group) in March 2020 with regard to the above findings. NRAR agreed in principle with the findings, however noted that NRAR advice was preliminary. The consultation is provided as Appendix A.

Representative photographs, rationale, and a description of each reach is presented in Appendix B.

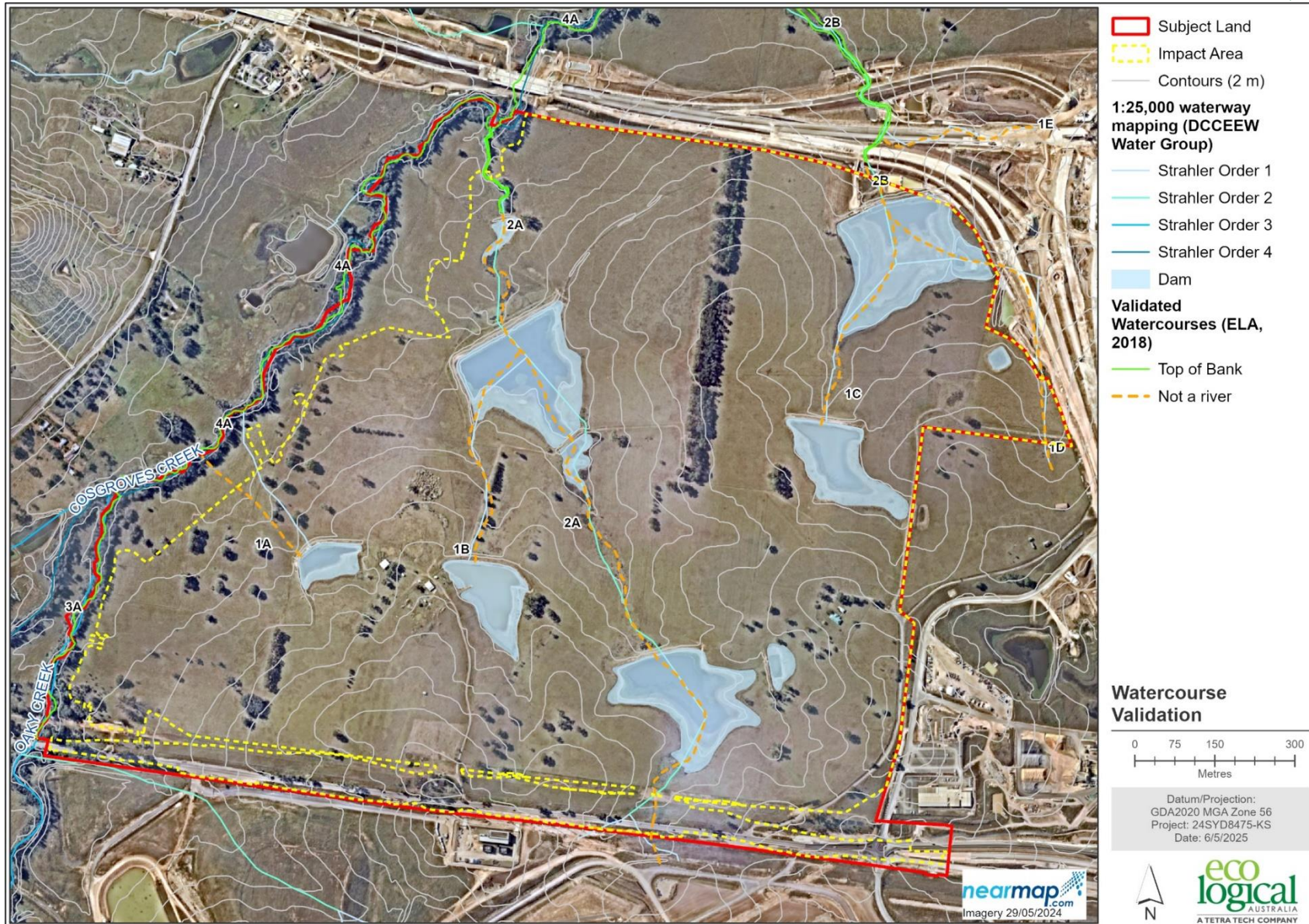


Figure 8: Watercourse validation (adapted from ELA 2022)

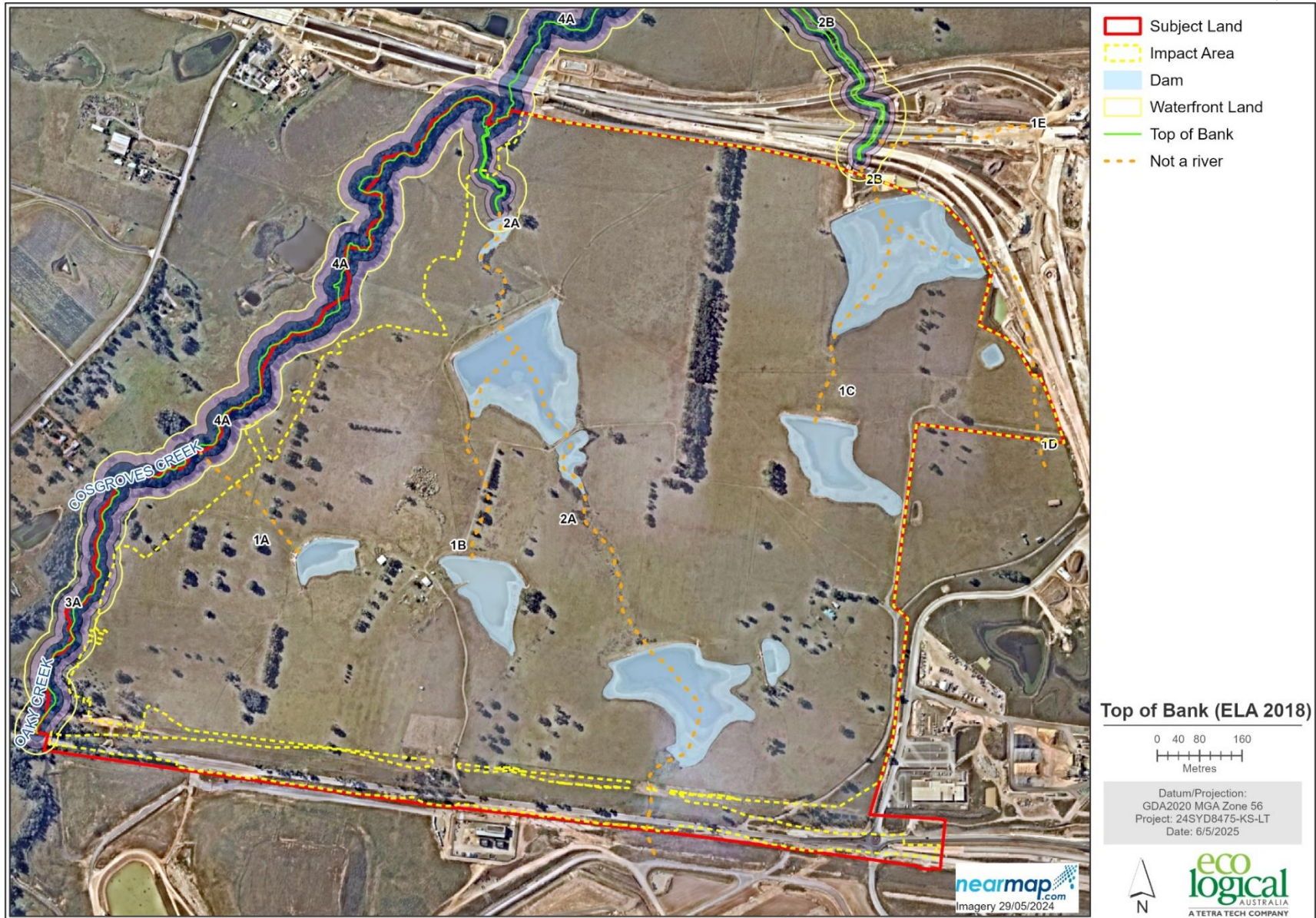


Figure 9: Top of bank and vegetated riparian zones (adapted from ELA 2022)

5. Consistency with Planning Framework

5.1. DCCEEW Riparian Guidelines

Previous field survey confirmed that reach 3A, 4A, and a portion of reach 2A and 2B met the definition of a 'river' under the WM Act (ELA 2022). Therefore, the site comprises 'waterfront land' and the DCCEEW riparian guidelines are relevant to these validated watercourses (Figure 8, Figure 9), with the exception of Reach 2B that has since been modified into culverts beneath the newly constructed M12 West and is no longer classed as waterfront land. Reach 2B has not been considered further. See Table 11 in Appendix B for the recommended riparian corridor widths relative to Strahler stream ordering.

In relation to works on validated waterfront land, the Master Plan proposes landscaping, a trunk drainage channel, a section of road, road batter, a bioretention basin and wetland (including batter), and drainage outlets (Figure 2, Figure 10). Total encroachment on the riparian corridor (RC) is 6,667 m², which requires offsetting elsewhere along the RC in accordance with the 'averaging rule' outlined in the DCCEEW riparian guidelines (Appendix C). Specifically, a portion of the road, road batter and landscaping area within the northwestern corner of the study area encroaches on the vegetated riparian zone (VRZ) of Cosgroves Creek, including the inner 50% VRZ (Figure 10). This impact is required to align a future underpass, between a pylon and revetment wall of a newly constructed bridge supporting the M12 West transport corridor. The areas which encroach on the inner 50% VRZ are inconsistent with the DCCEEW Riparian Guidelines and would usually require redesign. However, due to the restricted area in which the underpass can be placed, this encroachment cannot be avoided.

Additionally, south of this location, the total upstream portion of the RC (channel width plus VRZ either side) of reach 2A is proposed to be realigned and extended as a naturalised trunk drainage path to support the Sydney Water stormwater scheme. Realignment of a 2nd order watercourse is inconsistent with the guidelines. However, the total area of the RC removed for realignment (encroachment shown in Figure 10) is proposed to be offset along the reach 2A or Cosgroves Creek riparian corridor. A Vegetation Management Plan (VMP) (ELA 2025a) is proposed to restore and manage the trunk drainage.

The proposed bioretention basin and wetland in the southwestern corner of the study area (Basin F) constitutes another encroachment, though minor (0.032 ha), on the outer VRZ. Offline detention basins do not need to be offset if an equivalent vegetated riparian zone (VRZ) for the corresponding watercourse is included. However, as the proposed basin does not have a VRZ, it must be offset elsewhere along the riparian corridor. Portions of waterfront land identified as 'Avoided Land' under the Cumberland Plain Conservation Plan (CPCP) (DPE 2022d) which are not protected by the VRZ are to be prioritised as offset areas (Figure 10) and will be managed under a VMP (ELA 2025a).

As the study area comprises 'waterfront land', the DCCEEW *Controlled activities – guidelines for watercourse crossings on waterfront land* (DPE 2022c) also apply where potential future designs may seek to include a road crossing. These guidelines seek to minimise the impact of watercourse crossings on water flow and quality, stream ecology, and existing riparian vegetation. As highlighted in Appendix C Table 12, permissible road crossing types for Strahler Order 3 and 4 waterways include a bridge or a culvert. Bridges which fully span the channel are preferred, as they are best at maintaining channel function. However, box culverts may also be considered where they maintain the existing or natural hydraulic, hydrologic, geomorphic and ecological function of the watercourse. For 2nd order streams, any road crossing type is permitted under the guidelines.

The proposal is inconsistent with the DCCEEW riparian guidelines in two areas of encroachment into the inner 50%, being the proposed M12 underpass in the northwestern corner of the study area, and proposed realignment of the upstream portion of reach 2A and its total RC into a naturalised trunk drainage path. One area of encroachment in the southwestern corner of the study area (Basin F) is consistent with the guidelines, as it does not encroach on the inner 50% VRZ and an equivalent or greater area is proposed to be offset. Potential offset areas, which are also associated with a VMP, are available in the study area more than 10 times the encroachment area. A total of 90,961 m² of offsetting is proposed to occur under the VMP.

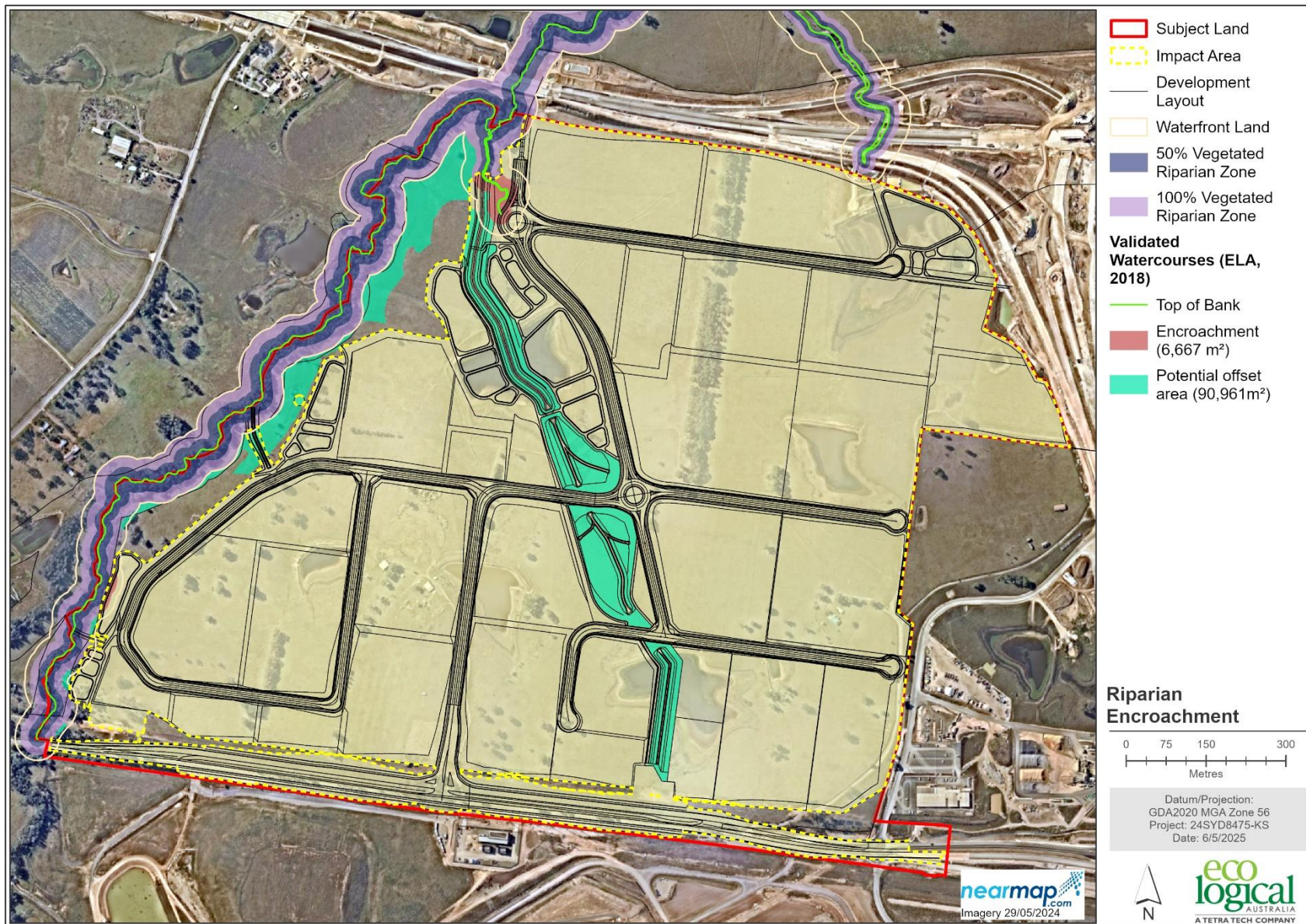


Figure 10: Riparian encroachment and offsets

5.2. DPI Fisheries Guidelines

The *DPI Policy and guidelines for fish habitat conservation and management* (Fairfull 2013, outlined in Appendix C) provide requirements for assessing impact of waterfront development to ensure the sustainable management, and 'no net loss', of Key Fish Habitat (KFH) in NSW. The guidelines are used to inform what type of infrastructure is suitable for a waterway and the potential disturbance, offsetting or environmental compensation required, dependent on the sensitivity of the KFH present and the waterway classification.

Cosgroves Creek and Oaky Creek are identified by DPI Fisheries as KFH. A detailed map of KFH types was not created in the 2018 field survey, but Cosgroves Creek and Oaky Creek met the definition of a Class 3 waterway, due to their intermittent nature, lack of instream native aquatic vegetation, and the presence of semi-permanent pools in Cosgroves Creek (See Appendix B for reach photos and descriptions). Section 3.2.4.2 of the *Policy and guidelines for riparian and freshwater aquatic vegetation* also recommends a riparian buffer zone width of 50 metres for Type 2, Class 2-3 habitats and waterways. The remainder of the waterways within the study area are not classed as KFH, unless they are found to have threatened species, populations or communities listed under the FM Act.

An assessment of the likelihood of occurrence of threatened species, populations, or communities listed under the FM Act and EPBC Act is provided in Table 6. It was concluded that none are known to occur or expected to occur within the study area, or upstream of the study area.

- Should potential design iterations wish to include a road crossing over Oaky Creek or Cosgroves Creek, in order of preferability, the DPI guidelines for Class 3 waterways permit a culvert or ford crossing type where box culverts are preferred to fords and pipe culverts (in that order), with 'Low Flow Design' procedures a minimum requirement (
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Table 13) (Fairfull 2013).

Overall impact assessment against DPI guidelines is provided in Table 7 below. The proposal is somewhat consistent with the DPI guidelines, as no impact to FM Act listed threatened species, populations or communities or creation of barriers to fish passage is expected. Areas of potential impact on KFH includes the encroachment of the M12 underpass, required road batter and landscaping area in the northwestern corner of the study area (Figure 10).

Table 6: Likelihood of threatened aquatic species occurring in the study area (10 km search)

Scientific name	Common name	FM Act	EPBC Act	Habitat associations	ALA records	Likelihood of occurrence
<i>Archaeophya adamsi</i>	Adams Emerald Dragonfly	E	-	Aquatic larvae have been found in narrow, shaded riffle zones with moss and abundant riparian vegetation (often closed canopy) in small to moderate sized creeks with gravel or sandy bottoms.	0	No, no suitable habitat within study area.
<i>Macquaria australasica</i>	Macquarie Perch	E	E	Habitat for this species is bottom or mid-water in slow-flowing rivers with deep holes, typically in the upper reaches of forested catchments with intact riparian	0	No, no suitable habitat within study area. Study area is far upstream from the Hawkesbury River

Scientific name	Common name	FM Act	EPBC Act	Habitat associations	ALA records	Likelihood of occurrence
				vegetation. Macquarie Perch also do well in some upper catchment lakes. In some parts of its range, the species is reduced to taking refuge in small pools which persist in midland-upland areas through the drier summer periods.		and is separated from the Nepean River by a drainage divide. The nearest ALA record is in the Warragamba Dam (Lake Burragorang), approximately 12 km to the west-south-west of the study area.
<i>Prototroctes maraena</i>	Australian Grayling	E	V	This species spends only part of its lifecycle in freshwater, mainly inhabiting clear, gravel-bottomed streams with alternating pools and riffles, and granite outcrops. Grayling migrates between freshwater streams and the ocean and as such it is generally accepted to be a diadromous species.	0	No, no suitable habitat. The nearest modelled distribution by DPI Fisheries is south of Wollongong.

Table 7: Assessment requirements – DPI Fisheries Policy and Guidelines for Fish Habitat Conservation

Assessment	Response	Comment
Has the proposal attempted to avoid impact to sensitive and valuable habitat, minimise unavoidable impact and mitigate severity of direct or indirect impact, offset with environmental compensation.	☐ Yes ☒ Potential ☐ No	Potential impacts to water quality during the construction phase of the development would be minimised through the implementation of appropriate sediment and erosion controls under a CEMP. Any potential impact on KFH would be minimised through implementation of the DCCEW <i>Controlled Activities – Guidelines for outlet structures on waterfront land</i> (DPE 2022a).
Will the proposed works directly or indirectly impact threatened species, populations or communities?	☐ Yes ☐ Potential ☒ No	No threatened species, populations or communities listed under the FM Act are expected to occur within or nearby the study area.
Will the proposed works harm protected vegetation (seagrass, macroalgae, mangroves or saltmarsh)?	☐ Yes ☒ No	N/A – the study area contains freshwater aquatic habitat.
Are the proposed works in or near critical habitat for the Grey Nurse Shark (Part 7A of FM Act)?	☐ Yes ☒ No	N/A – the study area contains freshwater aquatic habitat.
Will the proposed works impact aquaculture leases or commercial fisheries?	☐ Yes ☒ No	N/A – no aquaculture leases or commercial fisheries within the study area.
Are the works categorised as a key threatening process (as per Schedule 6 of the FM Act) for example: - Current shark meshing program in NSW waters - Hook and line fishing in areas important for survival of threatened fish species - Human-caused climate change - Instream structures and other mechanisms that alter the natural flow	☐ Yes ☒ No	The Project does not include works categories as a key threatening process (KTP). The restoration of vegetated riparian zones through implementation of a Vegetation Management Plan (VMP) (ELA 2025a) would improve aquatic and riparian condition along Cosgroves Creek and Oaky Creek. The central trunk drainage channel will also be subject to restoration under the VMP.

Assessment	Response	Comment
● Introduction of non-indigenous fish and marine vegetation to the coastal waters of NSW ● Introduction of fish to fresh waters within a river catchment outside their natural range ● Removal of large woody debris from NSW rivers and streams ● Degradation of native riparian vegetation along NSW watercourses.		
Will the works result in a 'net loss' of key fish habitat?	☐ Yes ☒ No	Works to rehabilitate the riparian corridors under a VMP would improve aquatic habitat.
Do the works require a permit or consultation under Part 7 of the FM Act? Permits relate to: Harming marine vegetation Dredging and/or reclamation of bed or bank Obstruction of fish passage Relocation of threatened species.	☐ Yes ☐ Potential ☒ No	Works may involve 'dredging and/or reclamation of bed or bank' or within KFH. However, a permit under Part 7 of the FM Act is not required for SSDA.

5.3. Western Sydney Aerotropolis Precinct Plan

The Precinct Plan provides objectives and requirements for riparian corridors under Section 4.5.2 (DPE 2023b). The objectives for riparian corridors are to:

- *Protect, restore and maintain vegetated riparian zones adjacent to creeks and other water bodies in accordance with the WM Act and related guidelines.*
- *Manage impacts of development on waterways to achieve and maintain established waterway health targets.*
- *Enable people to have safe contact with water in the landscape for recreation and access to urban cooling.*

The consistency of the Project with the requirements outlined in the Precinct Plan are summarised in Table 8 below.

Table 8: Compliance with relevant requirements of the Aerotropolis Precinct Plan

Reference	Objectives	Proposal Compliance
BG1	Waterways and riparian corridors of Strahler Order 2 (refer to Figure 5 of Precinct Plan) and higher are to be retained and rehabilitated to a natural state (unless minor realignment can be justified), in accordance with the requirements of the <i>Guidelines for Riparian Corridors on Waterfront Land</i> published by the Department of Primary Industries (Office of Water), or other relevant guidelines adopted and in operation at the time.	The upstream extent of reach 2A, a 2 nd order watercourse, is proposed to be realigned and extended as a naturalised trunk drainage path and will be managed under a VMP (ELA 2025a). All other waterways and riparian corridors of Strahler Order 2 and higher within the study area will be retained and rehabilitated. Encroachments into the VRZ will be equally or greater offset on site in line with the DDCEEW riparian guidelines. Rehabilitation of the riparian corridor will be guided by a VMP (ELA 2025a). A total of 90,961 m ² of offsetting is available to be managed under the VMP.
BG2	Riparian Streets on Figure 5 are to be adjacent to riparian corridors. The design of Riparian Streets is to be integrated with the retention or naturalisation of the adjacent watercourse and associated riparian zone in accordance with the requirements of the <i>Guidelines for Riparian Corridors on Waterfront Land</i> published by the Department of Primary Industries (Office of Water), or other relevant guidelines adopted and in operation at the time.	No riparian streets are mapped within the study area in Figure 5 of the Precinct Plan.
BG3	Consistency with DCP indicative cross-sections to guide the design of Riparian Streets and associated riparian zones.	No riparian streets exist within the study area.
BG4	The outer 50% of the Riparian Zone, as defined by the <i>Guidelines for Riparian Corridors on Waterfront Land</i> may contain paths, passive recreation facilities and other amenities subject to the appropriate consideration of flood impacts and safety.	All encroachment into the outer 50% VRZ will be offset along the riparian corridor within the study area in accordance with the 'averaging rule' outlined in the DDCEEW riparian guidelines. More than ten times the encroachment area is available in potential offset areas, which are proposed to be managed under a VMP (ELA 2025a).
BG5	Where a development application proposes the creation of a Riparian Street in association with a riparian corridor in accordance with Requirement BG2, and one or more lots for development, the area of land that comprises the riparian corridor is taken to be part of the minimum pervious area to be provided as part of the development under the DCP	No riparian streets exist within the study area.

5.4. Biodiversity and Conservation SEPP

The development site is located within the Hawkesbury-Nepean Catchment in accordance with Chapter 6 of the Biodiversity and Conservation SEPP. Therefore, general development controls under Division 2 (clauses 6.6 – 6.10) apply. An assessment against these controls is provided in Table 9 below.

Table 9: Impact assessment under Part 6.2, Division 2 of the Biodiversity and Conservation SEPP

Clause	Impact Assessment
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> During construction, an increase in sedimentation and turbidity may occur with in-stream works, particularly associated with bulk earthworks in proximity to the watercourse (e.g. trunk drainage and Basin F construction). However, these effects would be minimised through implementation of a Construction Environmental Management Plan (CEMP). In addition, the operational phase would see an increase in riparian and aquatic condition with the proposed restoration and rehabilitation of the riparian corridor with the support of a VMP (ELA 2025a). <i>(b) the impact on water flow in a natural waterbody will be minimised.</i> Design and construction of drainage outlets would be in line with the DCCEEW <i>Controlled activities – Guidelines for outlet structures on waterfront land</i> in order to provide a stable transition from the basin and drainage system to a natural flow regime (DPE 2022a).
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> Direct and indirect impacts to aquatic animals would be kept to a minimum through the implementation of a CEMP. Any impact on the VRZ would be offset along the riparian corridor and revegetated and rehabilitated with the aid of a VMP (ELA 2025a), resulting in improved riparian and aquatic habitat conditions. Potential direct or indirect impacts to terrestrial or migratory animals is assessed in the Biodiversity Assessment (ELA 2025d). <i>(b) the development will not have a direct, indirect or cumulative adverse impact on aquatic reserves.</i> The study area is approximately 41 km west-north-west of the nearest aquatic reserve, and would not have a direct, indirect or cumulative 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> A s.91 controlled activity approval (WM Act) or a s.201 dredging and reclamation permit (FM Act) is not required for state significant development under Section 4.41(1) of the EP&A Act. If approval is sought through lodgement of a development application under Part 4 of the EP&A Act, then the permit or consultation requirements would be issued via an integrated process <i>(d) the erosion of land abutting a natural waterbody or the sedimentation of a natural waterbody will be minimised.</i> Potential erosion and sedimentation associated with the removal of a portion of the 2nd order stream, reach 2A, would be minimised through the implementation of a CEMP. Post-construction, the revegetation and rehabilitation of the Cosgroves Creek and Oaky Creek riparian corridor through the implementation of a VMP would help minimise future erosion and scouring.

Clause	Impact Assessment
	<i>(e) the adverse impact on wetlands that are not in the coastal wetlands and littoral rainforests area will be minimised.</i> Under the <i>NSW Wetlands Management Policy 2010</i>, the watercourses within the study area are broadly classed as wetlands, as are all ephemeral and perennial watercourses in NSW. See responses (a) – (d) provided above.
6.8 Flooding	<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> Appropriate stormwater management systems, including basins and naturalised trunk drainage, form part of the proposed SSDA. Flood liable land is largely mapped along the western boundary of the study area, associated with riparian vegetation and proposed open space. Flood modelling and impact assessment in relation to flood liable land has been undertaken as part of a separate report for this SSDA. <i>(b) have an adverse impact on the natural recession of floodwaters into wetlands and other riverine ecosystems.</i> Flood modelling and impact assessment in relation to flood liable land has been undertaken as part of a separate report for this SSDA.
6.9 Recreation and public access	<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 watercourse would be improved through adjacent public roads and paths.
6.10 Total catchment management	<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.

5.5. Western Sydney Aerotropolis Phase 2 DCP

The Phase 2 DCP was adopted for the Aerotropolis in November 2022. Section 2.3.1 of the DCP provides objectives and controls for waterway health and riparian corridors. The proposal's consistency with the relevant performance outcomes and benchmark solutions have been described in Table 10 below.

Table 10: DCP outcomes and SSDA consistency

Performance Outcome	Benchmark Solution	How the SSDA Addresses
PO1 Development retains and restores native vegetation and riparian corridors.	1. Development maintains and protects waterways in accordance with the following guidelines: a. Strahler Order 1 watercourses with a catchment area of less than 15 hectares can be re-constructed and /or piped, providing stormwater modelling demonstrates the pipe and street network is capable of accommodating flows up to and including the 100 year AEP storm event. b. Naturalised trunk drainage paths are to be provided when the contributing catchment exceeds 15 hectares or when 1% AEP overland flows cannot be safely conveyed overland as described in Australian Rainfall and Runoff – 2019. c. Waterways of Strahler Order 2 and higher will be maintained in a natural state, including the maintenance and restoration of riparian areas and habitat, such as fallen debris. d. Where a development is associated with, or will affect, a waterway of Strahler Order 2 or higher, rehabilitation will occur to return that waterway to a natural state. 4. Retain areas of the Proteaceae shrubs for the Eastern Pygmy Possum <i>Cercartetus nanus</i> along or adjacent to riparian areas to improve and maintain habitat connectivity. 5. Weeds from creeks, streams and riparian areas are removed and replaced with appropriate native planting. 6. Locate stormwater infrastructure including pipelines and detention basins wholly on certified-urban capable land consistent with the Plan's biodiversity certification approvals. Stormwater infrastructure is not to be located within land identified as avoided or land managed as a reserve.	1a. Three of the four mapped 1st order watercourses within the study area, reach 1B, 1C and 1D, have catchment areas > 15 ha (Sydney Water 2021). All mapped 1st order watercourses are proposed to be removed. These watercourses do not meet the definition of a river under the WM Act, acting only as overland flow path during high rainfall. A trunk drainage path is to be reinstated down the central ENZ zone leading to Reach 2A. 1b. A naturalised trunk drainage path is proposed along the central ENZ zone, along reach 2A. Removal of part of Reach 2A is proposed in order to realign the watercourse to meet the naturalised trunk drainage path, which is a requirement under the Sydney Water stormwater management scheme and includes a series of offline basins to aid the appropriate management of stormwater. Overall, this extends the existing extent of the validated watercourse and restoration of the 20 m channel will be undertaken as part of the VMP (ELA 2025a). 1c. The upstream portion of the 2nd order watercourse, reach 2A, is proposed to be realigned and extended with a naturalised trunk drainage path, managed under a VMP (ELA 2025a). 3rd and 4th order watercourses within the study area, and the downstream portion of the 2nd order watercourse, will be maintained in a natural state and rehabilitated where appropriate. Maintenance and restoration of the riparian corridor will adhere to the recommendations of the VMP (ELA 2025a). All encroachments of the development on riparian corridors will be offset, except for works permissible within the outer 50% VRZ under the DCCEEW riparian guidelines (Table 12). More than ten times the encroachment area is available in potential offset area, and is proposed to be managed under the VMP (ELA 2025a). 1d. As above. 4. Proteaceae were not recorded within the study area. Proteaceae (e.g. Banksia and Hakea) are not associated with the vegetation communities present on site (ELA 2025d). All existing native vegetation along the Cosgroves Creek riparian corridor associated with Avoided Land will be protected and restored under a VMP (ELA 2025a). 5. A Weed Eradication Management Plan (WEMP) has been prepared and will be implemented as part of the Project (ELA 2025d). Appropriate native plantings along riparian corridors will be undertaken in accordance with the VMP.

Performance Outcome	Benchmark Solution	How the SSDA Addresses
		6. All basins and stormwater infrastructure have been designed and located on wholly certified urban-capable land. Avoided Land will not be affected by the Project.
PO2 Protect key aquatic habitat where it occurs.	1. Where aquatic habitat exists, proposed development responds to <i>Policy and Guidelines for Fish Habitat Conservation and Management</i> by the Department of Primary Industries and other relevant guidelines. 2. Aquatic fauna habitat is rehabilitated in streams of Strahler Order 2 and higher. 3. Existing habitat, such as fallen debris, is retained in streams of Strahler Order 2 and higher.	1. The Project protects KFH (3rd order stream and greater) plus partially rehabilitates the 2nd order stream within the study area. The upstream portion of the 2nd order stream will be realigned and extended with a naturalised trunk drainage path, supported by a VMP (ELA 2025a). 2. Aquatic fauna habitat will be rehabilitated through riparian vegetation rehabilitation and management under a VMP (ELA 2025a). 3. Excluding habitat within dams which are to be dewatered, existing habitat will be retained in all Strahler Order 2+ streams, except for the upstream portion of reach 2A, which is proposed to be realigned and extended with a naturalised trunk drainage path.
PO3 Development provides increased connectedness to high quality passive open space and the blue-green grid.	1. Road crossings across a waterway of Strahler Order 2 or higher are to be designed to minimise impacts to vegetated riparian areas and species movements in accordance with NSW Department of Primary Industries' requirements to maintain fish passage.	1. No waterway crossings are proposed. Potential future design iterations which may include waterway crossings within the study area would be designed in accordance with the DPI guidelines (Fairfull 2013) and DCCEEW permissible crossing types (DPE 2022c).
PO4 Riparian streets shown on the Aerotropolis Precinct Plan are delivered as part of subdivision and civil works and riparian corridors are integrated with the public domain and active transport connections.	1. Riparian streets are to be designed generally in accordance with the indicative cross sections at Figure 2 and Figure 3 and Guidelines for Controlled Activities on Waterfront Land—Riparian Corridors Published by NSW Department of Industry in May 2018. 2. The outer 50% of the riparian zone can accommodate pedestrian and cycle paths (or shared paths) street furniture (including lights and seating), landscaped verges and water sensitive urban design elements that are normally part of the street verge. 3. On the side of the riparian corridor that is not adjacent to a public road, the outer 50% of the riparian corridor can form part of the front setback of development lots, provided the part of the setback that is within the riparian corridor is used for landscaped area and paths only (with permeable or semi-permeable surfaces).	1-7. No riparian streets are proposed for the study area as per the Precinct Plan (DPE 2023b). All non-permissible encroachment into the outer 50% of the VRZ will be offset in accordance with the DCCEEW riparian guidelines (DPE 2022b).

Performance Outcome	Benchmark Solution	How the SSDA Addresses
	4. Despite any other provision of this DCP, for lots in the Mixed Use zone with development that includes active ground floor uses: a. If fronting a riparian corridor or street, development may have a zero lot setback to the boundary fronting the riparian corridor or street; or b. If there is no street between the riparian corridor, the lot may encroach into the outer 50% of the riparian corridor. Buildings and hard surfaces on the lot must be outside the riparian corridor. 5. Within the Enterprise zone, development that includes office, retail or other active uses that create an active façade with surveillance to the riparian corridor or street may have a zero lot setback to the boundary fronting the street or riparian corridor. Where there is no street between the riparian corridor and the lot boundary, the lot may encroach into the outer 50% of the riparian corridor providing buildings and hard surfaces are set back at least to the outer boundary of the riparian corridor. 6. Vehicular access to lots that directly adjoin the riparian zone, or where there is a zero lot setback to the street is to be from the side or rear property boundary (i.e. opposite to the boundary fronting the riparian corridor). 7. Maintenance access for the stormwater drainage manager must be accommodated in the design of riparian streets. Further details on access requirements for maintenance is provided in Section 2.3.3 of the DCP.	

6. Conclusion

Field-validation of the state hydroline map undertaken by ELA in May 2018 (ELA 2022) concluded that the study area contained three watercourses which met the definition of a 'river' under the WM Act, plus an additional watercourse adjacent to the study area. These included the 4th order watercourse, Cosgroves Creek (reach 4A), its 3rd order tributary, Oaky Creek (reach 3A), and an unnamed 2nd order tributary (reach 2A). Validated reach 2B in the northwest of the subject land is a 2nd order creek. All other watercourses within the study area did not meet the definition of a 'river' for the purposes of the WM Act, as they did not exhibit geomorphic features of a river, such as a defined channel, bed and bank. Therefore, within the study area, waterfront land exists within 40 m of the top of bank of Cosgroves Creek, Oaky Creek and the 2nd order tributary, reach 2A. As such, the DCCEEW riparian guidelines apply to the proposal. The Project encroaches on 6,667 m² of the VRZ, which is to be offset along the riparian corridors of the respective field-validated watercourses, and proposed naturalised trunk drainage, in accordance with the 'averaging rule' outlined in the DCCEEW riparian guidelines.

The proposal generally meets the requirements for the protection, restoration and maintenance of riparian corridors under Section 4.5.2 of the Western Sydney Aerotropolis Precinct Plan, noting some inconsistencies justified by the required stormwater management scheme and the proposed trunk drainage connecting to Reach 2A. The Project is generally consistent with controls on development in regulated catchments under the Biodiversity and Conservation SEPP, the DCCEEW riparian guidelines, and the relevant performance outcomes and benchmark solutions in the Western Sydney Aerotropolis Phase 2 DCP with inconsistencies justified as above. Overall, a greater area of aquatic habitat is proposed under the Project and will include restoration of riparian corridors in accordance with the VMP (ELA 2025a).

Encroachment of the road and batter into the inner 50% VRZ for the M12 underpass of the study area presents an inconsistency with the planning framework, and potential impacts to KFH, however is unavoidable given structural constraints (existing pylons) and will be offset elsewhere within the VMP area. Inconsistency with the DCP includes removal of mapped 1st order streams within catchment areas >15 ha, however these were deemed 'not a river' with no defined bed or bank. The realignment of the upstream portion of the 2nd order stream, reach 2A, is a minor inconsistency that is compensated by the trunk drainage channel providing a greater area of aquatic habitat.

KFH exists within the study area along Cosgroves Creek and Oaky Creek, identified as Type 2, Class 3 waterways as per the DPI guidelines (Fairfull 2013). As a result, the DPI Fisheries Guideline recommends a riparian buffer zone of 50 m from top of bank. This assessment concluded that no threatened species, populations, or communities listed under the FM Act or EPBC Act are known or expected to occur within or upstream the study area. As a result, in order of preferability, the DPI guidelines permit a culvert or ford crossing type where box culverts are preferred to fords and pipe culverts (in that order), with 'Low Flow Design' procedures a minimum requirement (Fairfull 2013), should future design iterations propose a waterway crossing. These crossing are to also meet the DCCEEW riparian guidelines for 3rd and 4th order streams (culvert or bridge) (DPE 2022c).

7. References

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Appendix A NRAR Consultation

From: Mohammed Ismail <mohammed.ismail@dpi.nsw.gov.au>
Sent: Friday, March 6, 2020 11:10 AM
To: Bonjer, David
Cc: NRAR ServiceDesk
Subject: RE: Riparian Assessment Report_Northern Gateway Planning Proposal_v2.pdf

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Hi Bonjer

I have reviewed the report title "Riparian Assessment Report Northern Gateway Planning Proposal" Dated August 2018 by ecological Australia". I agree that the evaluation/assessment of the riparian corridor requirements are sound and acceptable in accordance with NRAR guidelines. However, I have concern on the encroachment of the riparian area presented in Figure 9 and must ask why could not be avoided.

Please note that the above advice is only a preliminary review of the submitted report and the information provided and must not be considered as an assessment of a development proposal nor can you assume NRAR support of future development proposal as a full assessment and determination can only be made following lodgement of Integrated DA under IDAS or assessment of an SSD.

The advice provided in no way restricts the discretion of NRAR in the assessment and determination of any future application for a proposed works/development on the subject site. Other issues not identified in this advice may emerge during full assessment of the complete application.

Hope the above has helped

Regards

Dr Mohammed Ismail, Msc PhD Eng UK
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From: Bonjer, David <DavidB@ecoaus.com.au>
Sent: Tuesday, 4 February 2020 1:57 PM
To: mohammed.ismail@dpi.nsw.gov.au
Subject: Riparian Assessment Report_Northern Gateway Planning Proposal_v2.pdf

Hi Mohammed

Just over a year ago ELA undertook a constraints assessment of a site known as the Northern Gateway, on Elizabeth Drive, Badgerys Creek. This work was done for Cyan Stone Pty Ltd. The site is proposed to be zoned for airport-related uses.

However in the meantime the proponents intend to submit a DA for modification of some dams on site. We understand this is because many of the dams are inefficient and not safe for stock. Prior to lodging the DA, we have discussed the requirements of the Water Management Act with the proponent. We agreed that a useful first step would be to liaise with the NRAR to confirm which mapped hydrolines meet the definition of a 'river' under the WM Act and therefore may require a CAA. The attached constraints report shows that many of the mapped hydrolines

do not have a defined bed or bank and therefore we believe would not be considered 'rivers' under the WM Act. This will enable the client to proceed with the correct approval pathway – and hopefully not overburden NRAR with unnecessary assessments.

We seek confirmation from NRAR of 'rivers' on the site. The attached report includes photos of each reach. If there is other documentation that you require (or you would like to have a site visit), please let me know.

Happy to discuss on the phone if that is quicker.

Cheers

David Bonjer
Planning and Approvals Lead
Sydney Office Manager

level 3, 101 Sussex Street
Sydney, NSW, 2000
M: 0405 910 839 T 02 9259 3714



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Appendix B Representative photographs and rationale (adapted from ELA 2022)

B1: Reach 1A-1E



Reach 1A, facing upstream (left) and downstream (right)



Reach 1B, facing upstream (left) and downstream (right)



Reach 1C, facing upstream (left) and downstream (right)



Reach 1D, facing upstream (left) and downstream (right)



Reach 1E, facing upstream (left) and downstream (right)

Figure 11: Representative photographs of reach 1A - 1E (adapted from ELA 2022)

No defined bed, banks, channels, or signs of geomorphic processes were observed along reaches 1A – 1E (Figure 8). These mapped watercourses are cleared, grassy depressions which likely act as overland flow paths during periods of high rainfall. Therefore, it was concluded that none of the 1st order watercourses surveyed met the definition of a river under the WM Act.

B2: Reach 2A



No defined channel, facing upstream (left) and downstream (right)



Beginning of channel, downstream of dam (left) and large woody debris in channel, facing downstream (right)



Facing upstream, near Cosgroves Creek (left), and downstream (right) – note floodgate at downstream extent of channel

Figure 12: Representative photographs of reach 2A (adapted from ELA 2022)

Reach 2A emerges from two pipe culvers beneath Elizabeth Drive. A short channel trenched into the paddock to allow water to flow away from the road verge, and continues as a grassy overland flow path draining into four online dams. Due to its artificial origin and lack of aquatic or riparian value, this

part of reach 2A did not constitute a 'river' for the purposes of the WM Act. Downstream of the fourth dam however, channelisation was observed, with a channel width of approximately 2 - 3 m lined with *Juncus acutus*, *Melaleuca styphelioides* and *Casuarina cunninghamiana* (She-oak). Closer to the confluence with Cosgroves Creek, abundant woody debris were observed in the channel and banks were relatively steeper and undercut in some sections. Therefore, downstream of the fourth online dam, reach 2A meets the definition of a river under the WM Act (Figure 8). Additionally, a floodgate in a state of disrepair was in place near the Cosgroves Creek confluence, and a marked difference in density and species of riparian vegetation was noted downstream of this floodgate.

B3: Reach 2B



No defined channel, facing upstream (left) and downstream (right)



Defined channel lined with *Juncus acutus*, facing upstream (left) and downstream (right)

Figure 13: Representative photographs of reach 3A (adapted from ELA 2022)

The other mapped 2nd order watercourse in the northeastern corner of the study area, reach 2B, begins at the confluence of reach 1C and 1D within a large online dam and flows northward outside of the study area boundary (Figure 8). Immediately downstream of the dam, no evidence of geomorphic processes was observed until approximately 80 m downstream from the dam, north of the study area boundary, where a dry, ~6 – 8 m wide channel was observed. The banks were lined with both native *Juncus* sp. and invasive *Juncus acutus* and were moderately eroded on the outer bends. The channel substrate was composed predominantly of silt, with evidence of heavy trampling by livestock.

Downstream beyond the study area, reach 2B flows into two online dams before its confluence with Cosgroves Creek, where the banks are steep, eroded, and lined with *C. cunninghamiana* (She-oak). Therefore, from the point ~80 m downstream of the dam, it was concluded that reach 2B meets the definition of a river under the WM Act.

B4: – Reach 3A (Oak Creek)



Dry, defined channel and banks, facing upstream (left) and downstream (right)

Figure 14: Representative photographs of reach 3A, Oak Creek (adapted from ELA 2022)

Reach 3A, Oak Creek, exhibited clear evidence of geomorphic processes with a defined channel and banks. The channel was dry and had a width of approximately 2- 4 m, originating from a twin box culvert underneath Elizabeth Drive in the southwestern corner of the study area boundary. The substrate was predominantly silt with some gravel. Both banks were steep and undercut, and the channel was lined with native species, including *Melaleuca linariifolia*, *M. styphelioides*, and *C. cunninghamiana*, with sections of dense exotic shrubs and groundcover including *Lantana camara*, *Tradescantia fluminensis* (Trad) and *Rubus fruticosus* (Blackberry). There was no habitat for fish, frogs or wading birds at the time of the survey. DPI Fisheries map this reach as key fish habitat (KFH). Due to clear geomorphic evidence, reach 3A meets the definition of a river under the WM Act.

B5: Reach 4A (Cosgroves Creek)



Dry, defined channel and banks, facing upstream (left) and downstream (right)



Shallow stagnant pool (left) and fence crossing creek (right)

Figure 15: Representative photographs of reach 4A, Cosgroves Creek (adapted from ELA 2022)

Cosgrove Creek, reach 4A, meanders along the western study area boundary with an average channel width of 6 - 8 m wide. The channel bed consisted of fine sediment, with some gravel and dense instream woody debris. Some long (up to 30 m) stagnant pools were present within the channel, which contained numerous invasive *Cyprinus carpio* (Carp) and *Gambusia holbrooki* (Mosquitofish). No native fish or frog species were observed, however two *Pseudechis porphyriacus* (Red-bellied Black Snake) were using the pools. DPI Fisheries map this reach as KFH. No aquatic vegetation was observed except for a small patch (2 m x 1 m) of *Typha orientalis* (Cumbungi) in the largest pool. Downstream of the confluence with reach 2A, the channel was dry. It could be inferred that large trees fallen within the channel would naturally dam the water in times of flow.

The banks along the entire reach were steep, up to 2 m, with severe undercutting on the inner bends. Upstream, the banks were lined with a mix of native trees (*Melaleuca* spp. and *C. cunninghamiana*) and exotic species, including *Bidens pilosa* (Cobblers Peg), *L. camara*, *Lycium ferocissimum* (African Boxthorn), *T. fluminensis* and *R. fruticosus*. Moving downstream, north of the confluence with reach 1A, the banks were lined with predominately native trees of varying age classes, and there were fewer exotics species present.

Due to clear evidence of geomorphic processes, Cosgroves Creek meets the definition of a river under the WM Act.

Appendix C Riparian and Fisheries Guidelines

C1: Controlled activities – Guidelines for riparian corridors on Waterfront Land

The NSW Department of Planning and Environment – Water (DPE – Water) (now DCCEEW – Water Group) provide *Controlled activities - Guidelines for riparian corridors on Waterfront Land* (DPE 2022b) which outline the need for a Vegetated Riparian Zone (VRZ) adjacent to the channel to provide a transition zone between the terrestrial environment and watercourse. 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' (Figure X). To be consistent with the DCCEEW riparian 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 11).

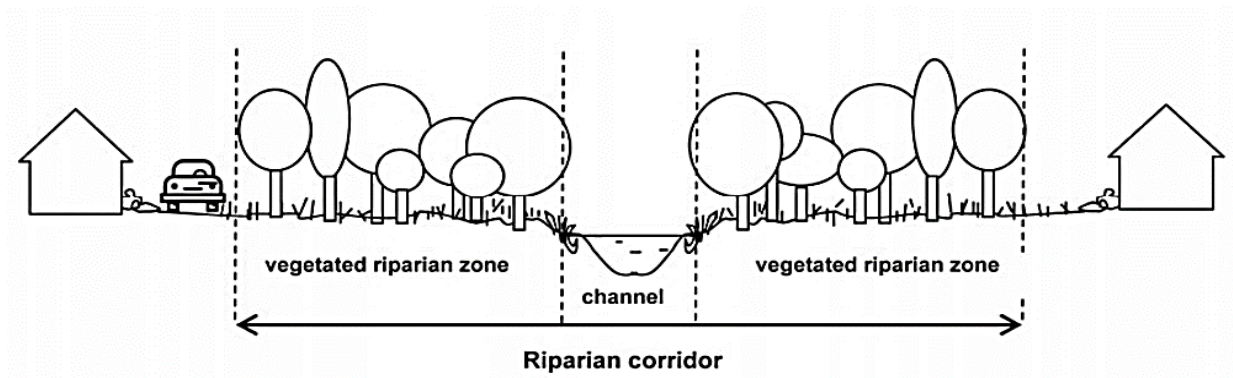


Figure 16: VRZ and watercourse channel comprising the riparian corridor (DPE 2022b)

Table 11: Recommended riparian corridor widths relative to Strahler Order (DPE 2022b)

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 12 and key below). 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 17).

Table 12: Riparian corridor (RC) matrix of permissible use (DPE 2022b)

Stream order	VRZ	RC offsetting for non RC uses	Cycleways 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	•	•	•		•			•	•

C1.1. 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 17.

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, discussed below).

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

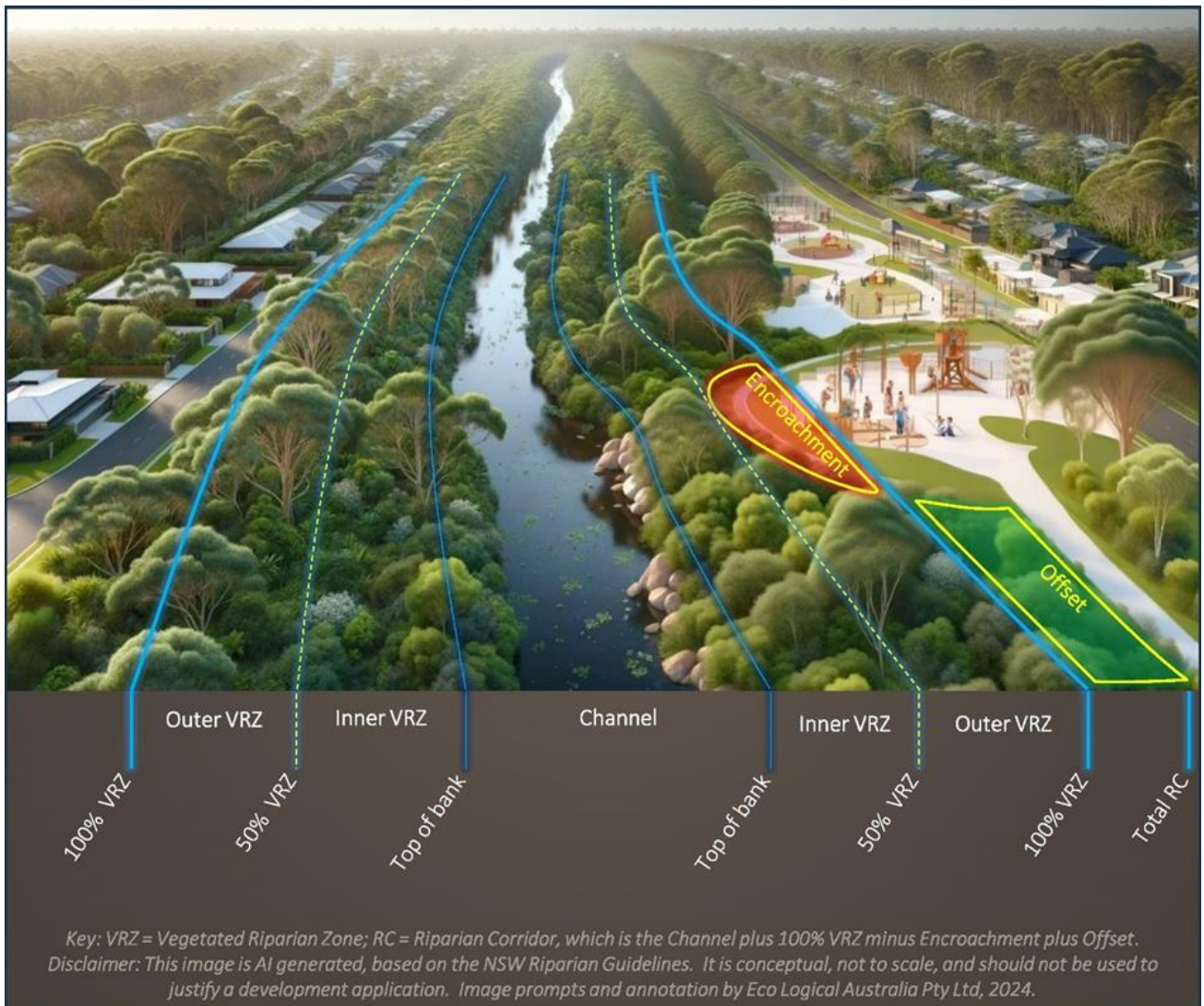


Figure 17: Riparian 'averaging rule' for offsetting encroachment in the outer 50% VRZ (adapted from DPE 2022b)

C2: Policy and Guidelines for Fish Habitat Conservation and Management

The DPI Fisheries *Policy and guidelines for fish habitat conservation and management* (Fairfull 2013) is a supplementary document that outlines the requirements and obligations under the FM Act and the *Fisheries Management (General) Regulation 2019* and were developed to maintain and enhance fish habitat and assist in the protection of threatened species. The Policy 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 13) and sensitivity of the key fish habitat present, which determines the potential disturbance and offsetting or environmental compensation required for development (Table 14). Recommended riparian buffers adjacent to fish habitat are based on sensitivity type and class (Table 15).

Table 13: 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'. Permitted crossings are 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. Permitted crossings are 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. Permitted crossings are 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). Permitted crossings are 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 14: 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 m ² in area
Coastal saltmarsh > 5 m ² in area
Coral communities

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

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

SEPP 14* coastal wetlands, 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 metres 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:

Zostera, *Heterozostera*, *Halophila* and *Ruppia* species of seagrass beds < 5 m² in area

Mangroves

Coastal saltmarsh < 5 m² in area

Marine macroalgae such as *Ecklonia* and *Sargassum* 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

*SEPP 14 coastal wetlands are now named Resilience and Hazards SEPP coastal wetlands

Table 15: Recommended riparian buffers adjacent to fish habitat (Fairfull 2013)

Classification	Recommended width of the riparian buffer zone
TYPE 1, CLASS 1	100 metres
TYPE 2, CLASS 2-3	50-100 metres
TYPE 3, CLASS 3-4	10-50 metres

