# 475 Badgerys Creek Road, Bradfield NSW – Riparian Assessment

## Ingham Property Group Pty Ltd

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## ACKNOWLEDGEMENTS

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Template 2.8.1

# Contents



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## Abbreviations

| Abbreviation | Description |
|---|---|
| DPE | Department of Planning and Environment – Water |
| DPI | Department of Primary Industries – Fisheries |
| ELA | Eco Logical Australia Pty Ltd |
| FM Act | *Fisheries Management Act 1994* |
| KFH | Key Fish Habitat |
| RC | Riparian Corridor (channel plus VRZ on each side) |
| VRZ | Vegetated Riparian Zone |
| WM Act | *Water Management Act 2000* |

# 1. Introduction

## 1.1 Purpose of report

Eco Logical Australia (ELA) was engaged by Ingham Property Pty Ltd (IPG) to review the proposed treatment of riparian corridors in the Master Plan for 475 Badgerys Creek Road, Bradfield NSW 2555 (subject land). The subject land forms part of the Aerotropolis Core Precinct within the Western Sydney Aerotropolis and is predominately zoned ENT (Enterprise) under the *State Environmental Planning Policy (Precincts – Western Parkland City) 2021* (Western Parkland City SEPP). The location of the Master Plan is shown in Figure 1.

The study validates watercourses on site, reviews relevant riparian and aquatic guidelines and provide an assessment of consistency between the proposed Master Plan and the planning framework, including the *Water Management Act 2000* (WM Act), Western Sydney Aerotropolis Precinct Plan (DPE 2023) and the Western Sydney Aerotropolis Phase 2 Development Control Plan (DCP).

## 1.2 Subject land

The subject land is 182 ha in size and is legally defined as Lots 99 and 100 in DP 1287207.

The majority of the subject land is under the ownership of IPG, with a small portion of land earmarked for the North Bradfield Zone Substation owned by Endeavour Energy. The subject land is largely defined by grass land and is largely clear of vegetation as it is currently used for agricultural purposes. There is an internal road network within the subject land which had previously connected the now demolished sheds and ancillary structures dispersed across the subject land. The subject land is suitable for development and free of contamination which has been confirmed by environmental testing and site investigations. The subject land is situated within the Western Sydney Aerotropolis, with a direct interface with the Western Sydney International Airport (WSI).

It is bound by two significant riparian corridors which define Western Sydney, with South Creek to the east and Badgerys Creek to the north-west. The immediate surroundings of the subject land are characterised by large rural landholdings used predominately for agricultural and light manufacturing purposes, all of which will be redeveloped in accordance with the Aerotropolis Precinct Plan vision. The location and surrounding context of the subject land is shown in Figure 1.

The waterways have cultural value as 'water country' described in IPG Badgerys Creek - Designing with Country (Yerrabingin 2024). Water country is the *'connective tissue, the circulatory system, the confluences and paths within and between Country'*. Landscape design of the riparian corridors acknowledges this connection and is described in the Landscape Plan prepared by Site Image (2024).

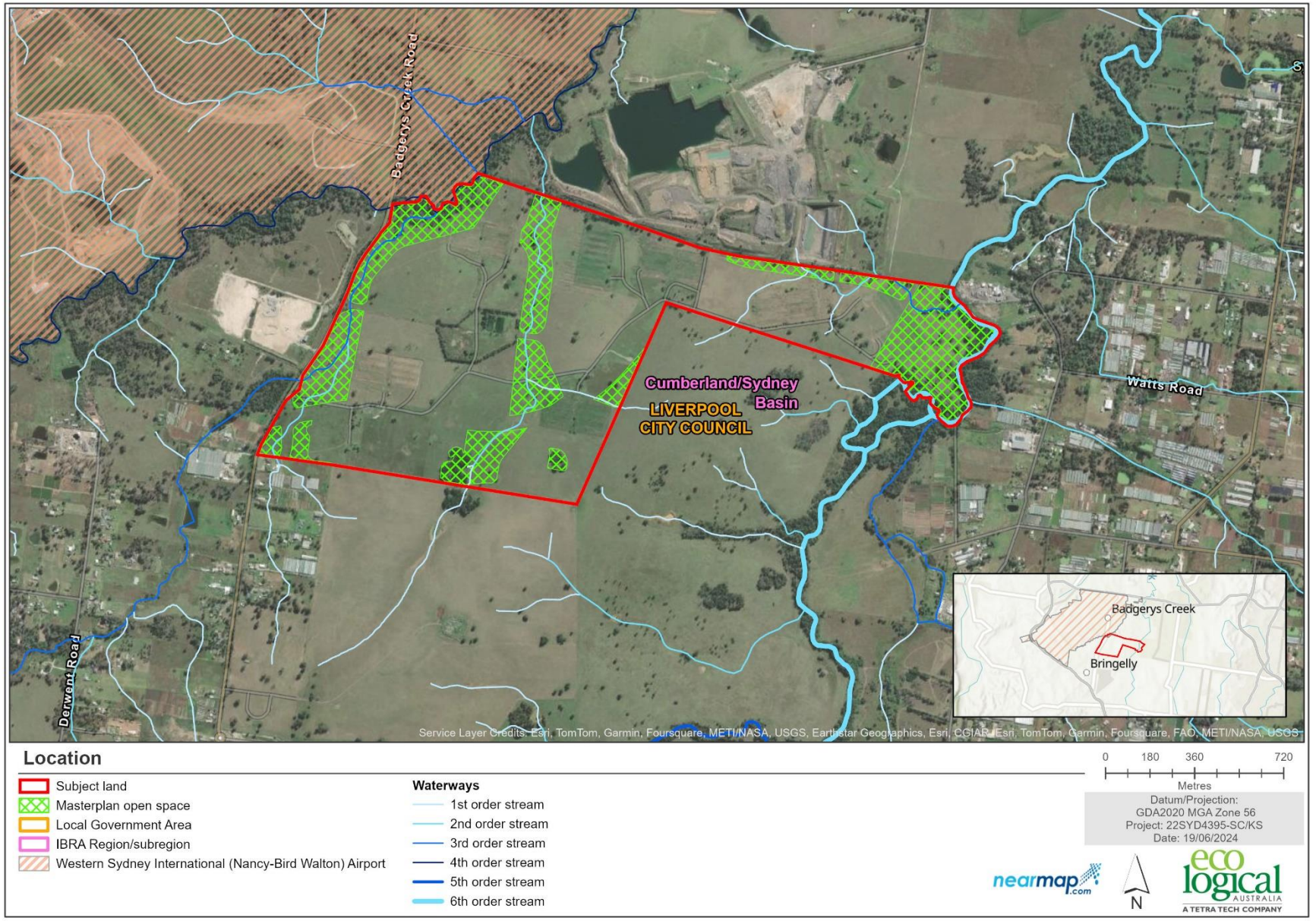


**Figure 1: Location of the subject land**

# 2. Legislative and Strategic Planning Framework

## 2.1 State Legislation

**Table 1: State legislative framework**

| Legislation | Overview |
|---|---|
| Water Management Act | 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 Department of Planning and Environment published Controlled activities – Guidelines for Riparian Corridors on Waterfront Land (2022). These guidelines assist proponents in designing development to be consistent with the intent of the legislation. |
| Fisheries Management Act | 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. |

## 2.2 Planning Instruments

**Table 2: Planning instruments**

| Plan | Objectives |
|---|---|
| Western Parkland City SEPP - Aerotropolis Precinct Plan | The Aerotropolis Precinct Plan is in force under the provisions of 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:<br>***4.5.2 Riparian corridors***<br>*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.*<br>***Objectives***<br>*BGO1 Protect, restore and maintain vegetated riparian zones adjacent to creeks and other water bodies in accordance with the Water Management Act and related Guidelines.*<br>*BG02 Manage impacts of development on waterways to achieve and maintain established waterway health targets.*<br>*BG03 Enable people to have safe contact with water in the landscape for recreation and access to urban cooling.* |
| Western Sydney Aerotropolis Development Control Plan (DCP) Phase 2 | **Riparian corridors**<br>Section 2.3.1 of the Aerotropolis DCP contains objectives and performance outcomes for waterway health and riparian corridors. These objectives are:<br>• **O1:** Protect and restore native and riparian vegetation to improve the connectivity, ecological condition, and function of ecosystems.<br>• **O2:** Ensure that development does not adversely affect aquatic fauna. |

| Plan | Objectives |
|---|---|
| | • **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.<br>• **O4:** Reinstate more natural conditions in highly modified waterways and riparian land while not increasing flood risk.<br><br>Objectives under Section 2.3.1 are addressed in Section 5.4 of this report.<br><br>**Recognise Country**<br><br>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. Overall, the proposed Master Plan layout protects the major Wianamatta/South Creek corridor in the east of the subject land and provides access through pedestrian and cycle paths.<br><br>The western and central riparian corridors are largely protected and within accessible open space. Some areas will be affected by the development for the purposes of road construction, which will be in accordance with DPI Fisheries guidelines. The central riparian corridor, which is currently largely unvegetated, will be rehabilitated and restored under a Vegetation Management Plan (VMP) (ELA 2023b). The eastern and western waterways will also be subject to the VMP, to ensure ongoing waterway and riparian vegetation health that supports the principals of recognising Country. This is achieved by improving the quality and extent of riparian vegetation, which will improve the health and function of the waterway long-term particularly for Wianamatta/South Creek. |

# 3. Field Assessment

## 3.1 Method

Survey of watercourses was conducted by Ian Dixon and Erin Hodgkin on 13 June 2023, using a drone to fly each reach from various angles. The aim of the field work was to validate watercourses against the definition of a 'river' used in the WM Act and the DPE riparian guidelines, and to ground-truth top of bank mapping for areas not included by an external surveyor. Watercourses were assigned a reach number based on their Strahler stream order using the *Water Management (General) Regulation 2018 hydroline spatial data 1.0.*

## 3.2 Results

Top of bank mapping by ELA and an external surveyor is shown in Appendix A, with reference to the following three riparian systems:

- Riparian Corridor #1 – describes the western edge of the subject land, along Badgerys Creek
- Riparian Corridor #2 – the central watercourse
- Riparian Corridor #3 – South Creek and associated tributaries.

Several 1st and 2nd order streams identified on the DPI Strahler Stream Order mapping did not meet the definition of a 'river' under the WM Act. Representative photographs of watercourse validation are displayed as interactive elements in Appendix A (view on Adobe Reader, not compatible with web browsers).

# 4. Proposed Master Plan

The treatment of riparian corridors under the Master Plan is shown in Figure 2 and Figure 3. Corridors will be restored to Cumberland Red Gum Riverflat Forest (CRGRF), which is the native vegetation community that would have existed prior to the subject land being used for agriculture. Restoration will be completed in accordance with a Vegetation Management Plan (VMP) (ELA 2024b).

Stormwater basins are generally located outside the vegetated riparian zones. Recreational infrastructure (pathways) are located in the outer 50% of the vegetated riparian zones, other than some minor incursions and creek crossings (Figure 2 and 3). Road crossings will be required for essential access and infrastructure.

A key challenge in designing the treatment of riparian corridors under the VMP was to balance the competing objectives of the Western Parkland City SEPP, Aerotropolis Precinct Plan and Aerotropolis DCP. The most significant conflict was between the restoration of riparian corridors for ecological, aesthetic and cultural objectives, whilst avoiding or minimising attracting wildlife which could affect airport operations. The Master Plan will create habitat that could be utilised by birds, and may attract wildlife to the subject land. This issue is addressed in the Wildlife Risk Assessment and Management Plan, prepared by ELA (2024).

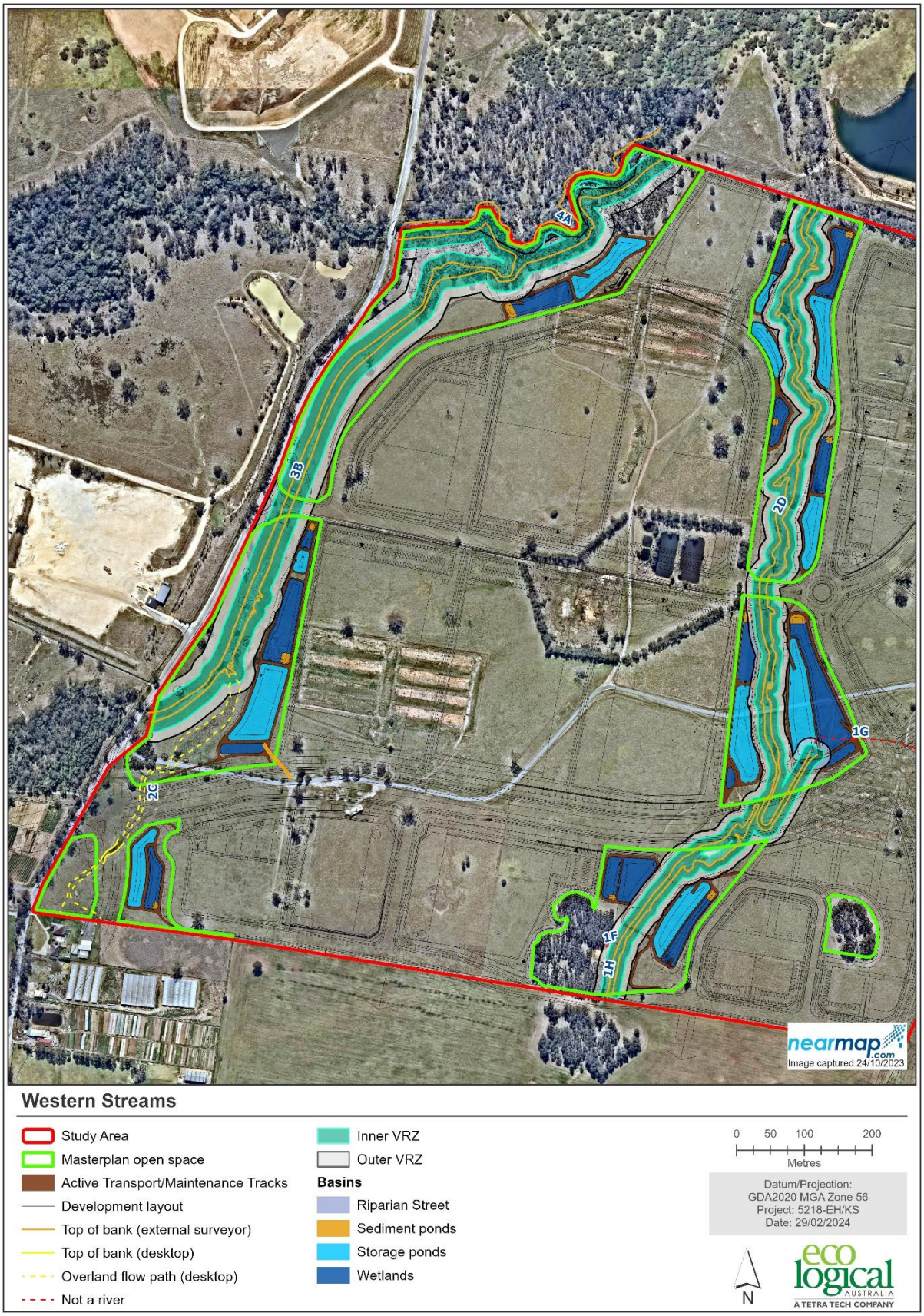


**Figure 2: Western stream validation and VRZ**

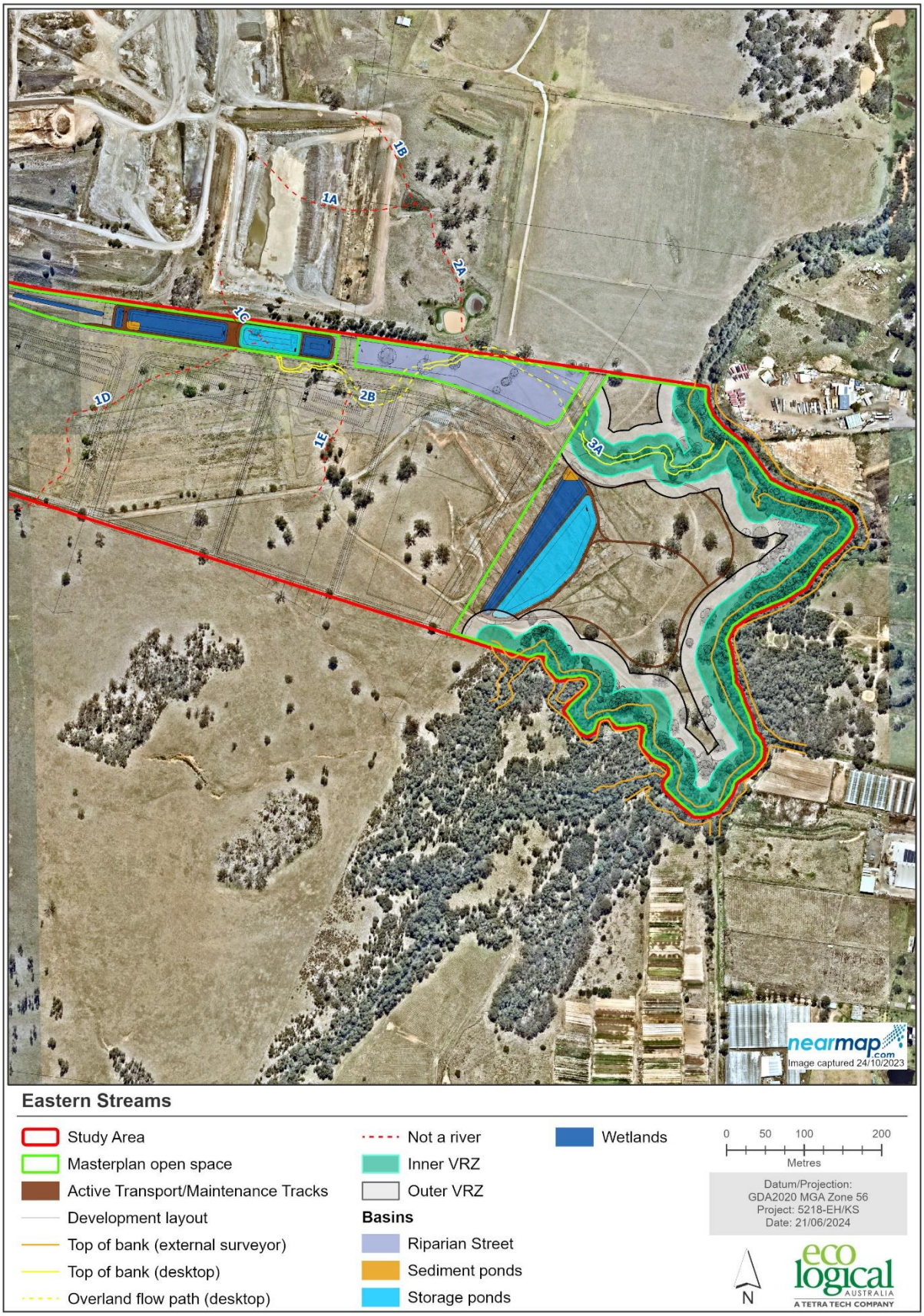


**Figure 3: Eastern stream validation and VRZ**

# 5. Consistency of Master Plan with planning framework

## 5.1 DPE Riparian Guidelines

Riparian Corridor #1 and #2 are generally consistent with the DPE Riparian Guidelines and objectives of the WM Act. Basins are located outside of the vegetated riparian zones other than some minor stormwater basin incursions of 0.29 ha into the outer 50% of the Vegetated Riparian Zone. Under the DPE guidelines, stormwater basins can be placed in the outer 50% provided the impacts are offset. The Master Plan more than adequately offsets this by providing an additional 9.3ha of open space in the riparian corridors (refer to Figure 6). There are several locations where roadways cross the VRZ on these second and third order streams to allow crossing points. The Guidelines allow for bridge or culvert crossings on any stream order and do not require an offset.

In Riparian Corridor #3, the realignment of a 2nd Order and part of a 3rd Order Strahler Stream is proposed. Re-alignment of 2nd and third order streams is not consistent with the DPE Guidelines for Riparian Corridors on waterfront land, however in this instance it has been proposed to be consistent with Figure 6 of the Precinct Plan (2023) requirement for a Riparian Street in this location. As shown in Appendix A, the condition of this watercourse is poor with no aquatic or riparian vegetation and an absence of bed and bank in some sections

## 5.2 DPI Fisheries Guidelines

Treatment of Riparian Corridor #3 (Figure 4) requires removal of a portion of Type 3, Class 4 key fish habitat. However, the area proposed to be removed is overland flow and would not sever connectivity between fish habitats. Crossing are likely to be culverts across all watercourses. Riparian Corridor #1 is Type 1, Class 3 key fish habitat, and culverts meet the Fisheries Policy and Guidelines for crossing design. The remainder of the subject land protects other key fish habitat (3rd order and above).

Key fish habitat types and classification is in accordance with *Policy and guidelines for fish habitat conservation and management* (Fairfull 2013) (see Appendix C).

**Figure 4: Drone imagery of Riparian Corridor #3**

## 5.3 Western Sydney Aerotropolis Precinct Plan

The Precinct Plan provides objectives and requirements for riparian corridors under Section 4.5.2 (DPE 2023). 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 Master Plan is consistent with the protection of three major riparian corridors within the site. Figure 5 shows a comparison of the open space in the Precinct Plan (DPE 2023) versus the Master Plan. The Master Plan provides a greater amount of open space and better connectivity through the central riparian corridor compared to the Precinct Plan.

The Master Plan proposes an Eastern Ring Road (ERR) alignment which is slightly different from the Precinct Plan, however this has little consequence in terms of aquatic habitat as the condition of the central riparian corridor is poor along its entire length and therefore there is no significant difference between the environmental impact of either alignment in terms of riparian crossing points.

Riparian planting and restoration will be undertaken in accordance with a VMP (ELA 2024) within the central riparian corridor (#2), and along the South Creek and Badgerys Creek riparian corridors within the subject land.

Riparian Corridor #3 is consistent with the Precinct Plan, with a proposed realignment of a mapped 2nd and 3rd order stream, for the inclusion of a Riparian Street (Figure 3).

Consistency with the requirements of Section 4.5.2 is discussed in Table 3 below.

**Table 3: Precinct Plan consistency**

| Requirements | | How the Master Plan addresses |
|---|---|---|
| BG1 | Waterways and riparian corridors of Strahler Order 2 (refer to Figure 5) 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 Guidelines for Riparian Corridors on Waterfront Land published by the Department of Primary Industries (Office of Water), or other relevant guidelines adopted and in operation at the time. | Figure 5 of the Precinct Plan identifies 3 riparian corridors in the site. All three will be rehabilitated to a natural state. The riparian outcomes are consistent with the DPI (Office of Water) Guidelines as described in the section below.<br>Several 1st and 2nd order streams identified on the DPI Strahler Stream Order mapping did not meet the definition of a 'river' under the WM Act (Appendix A). |
| 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 Guidelines for Riparian Corridors on Waterfront Land published by the Department of Primary | A riparian street is provided in the northeast of the subject land (Figure 5 of the Aerotropolis Precinct Plan 2023). The design of the riparian street is in accordance with the relevant cross sections and guidelines. Two reaches in the eastern riparian corridor will be realigned as part of the riparian street treatment. The area proposed to be affected is overland flow and would not sever connectivity between fish habitats. |

| Requirements | | How the Master Plan addresses |
|---|---|---|
| | Industries (Office of Water), or other relevant guidelines adopted and in operation at the time. | |
| BG3 | Consistency with DCP indicative cross-sections to guide the design of Riparian Streets and associated riparian zones. | The riparian street and three riparian corridors are design in accordance with the DCP indicative cross sections. The riparian zones will also be managed under a VMP (ELA 2023b) and revegetated to Cumberland Red Gum Riverflat Forest. |
| BG4 | The outer 50% of the Riparian Zone, as defined by the Guidelines for Riparian Corridors on Waterfront Land may contain paths, passive recreation facilities and other amenities subject to the appropriate consideration of flood impacts and safety. | The outer 50% VRZ contains paths, maintenance tracks and basins, and will allow for passive recreation. This is permissible under the Guidelines and is offset in other areas of the riparian corridor (see Figure 6). |
| 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. | The riparian street and corridors contribute to the pervious area required under the DCP. Greater open space, and therefore more pervious area, is provided for by the Master Plan compared to the Precinct Plan (Figure 5). |

## 5.4 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, that are relevant to this riparian assessment. The Master Plan's consistency with the relevant Performance Outcomes and benchmark solutions have been described in Table 4 below.

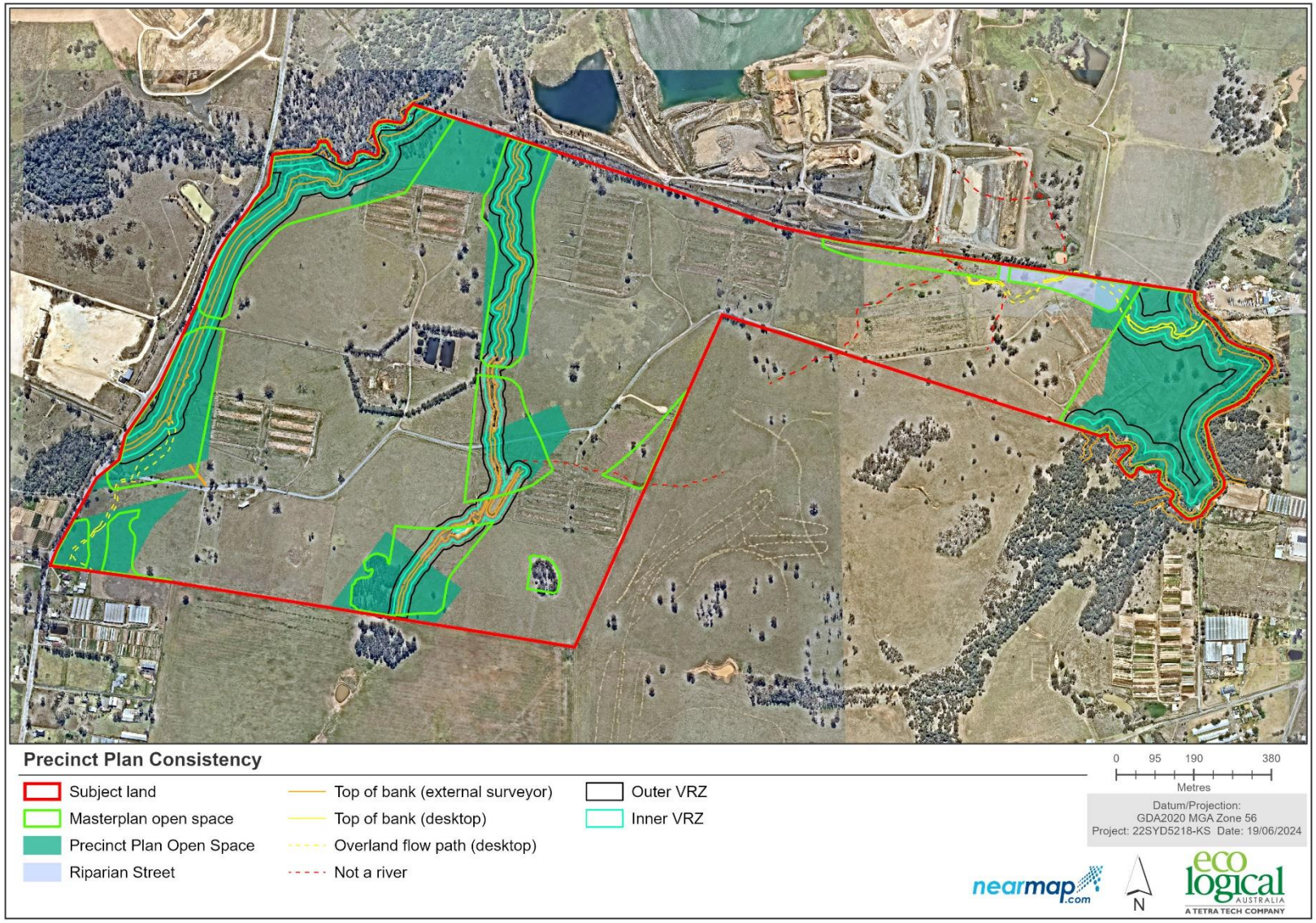


**Figure 5: Precinct Plan comparison with Master Plan**

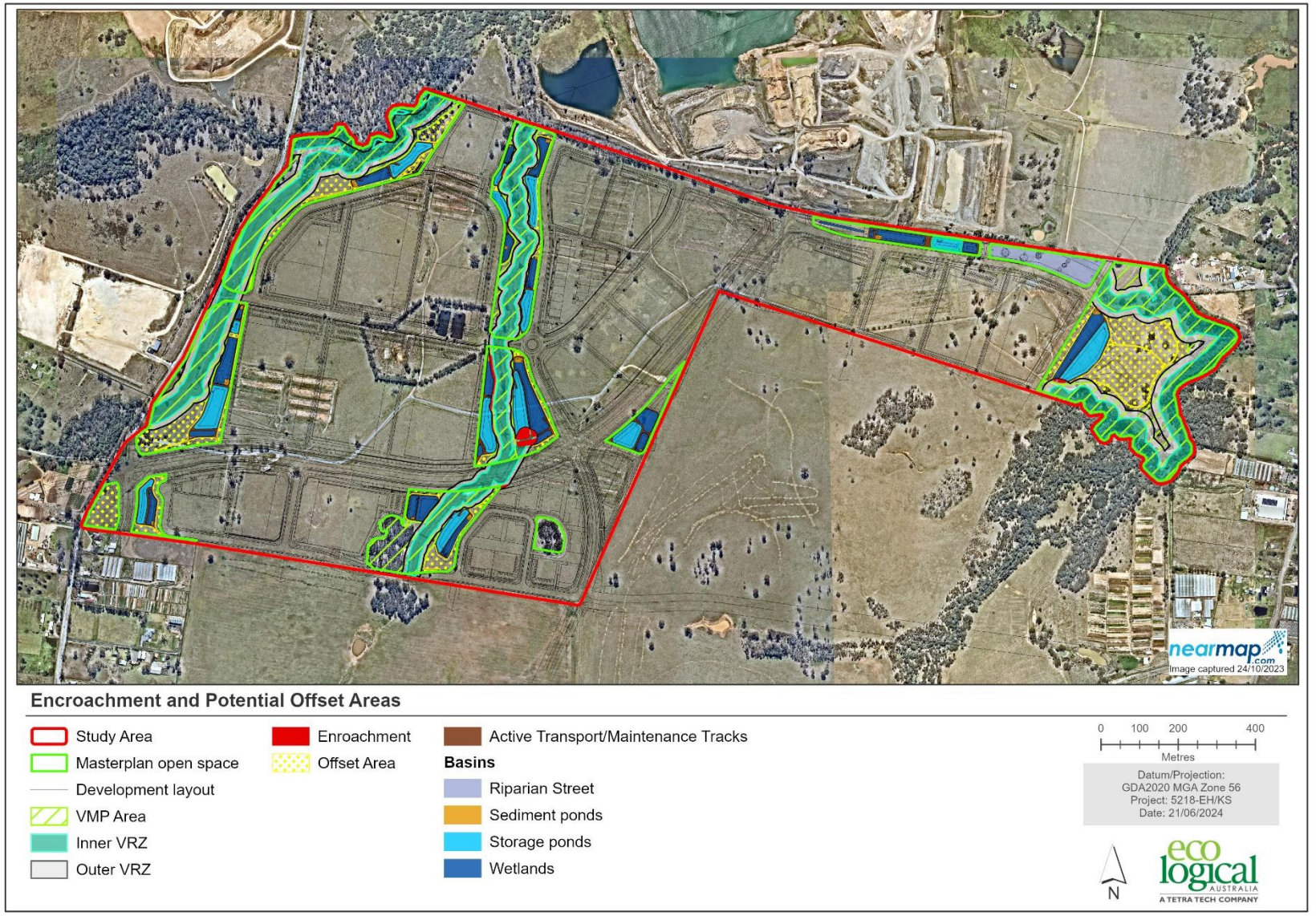


**Figure 6: Riparian offsets**

**Table 4: DCP outcomes and Master Plan consistency**

| Performance Outcome | Benchmark solution | How the Master Plan addresses |
|---|---|---|
| **PO1** Development retains and restores native vegetation and riparian corridors. | 1. Development maintains and protects waterways in accordance with the following guidelines:<br>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.<br>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.<br>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.<br>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.<br>4. Retain areas of the Proteaceae shrubs for the Eastern Pygmy Possum *Cercartetus nanus* along or adjacent to riparian areas to improve and maintain habitat connectivity.<br>5. Weeds from creeks, streams and riparian areas are removed and replaced with appropriate native planting.<br>6. Locate stormwater infrastructure including pipelines and detention basins wholly on certified-urban capable land consistent with the Plan's biodiversity 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. | 1. a and b. Catchments M11 and M12, each with a Strahler order 1 watercourse entering the subject and will be piped. Sections that are piped will have capacity up to 1% AEP. The riparian street channel in Riparian Corridor 3 (eastern corridor) picks up overland flows from a catchment > 15 ha. Refer to and the Integrated Water Cycle Management Plan (IDC, 2024) for further detail on solutions (a) and (b) relating to stormwater and drainage modelling.<br>c. Strahler stream order 2 and above will be maintained in a natural state other than two reaches in Riparian Corridor #3. In this corridor a riparian street is proposed as required by the Precinct Plan and DCP section 2.3.1 (PO4).<br>d. Rehabilitation of Strahler Order 2 and higher streams will be undertaken in accordance with a Vegetation Management Plan (VMP) (ELA 2024), which provides guidance for revegetation to Cumberland Red Gum Riverflat Forest.<br>4. Proteaceae were not recorded within the subject land.<br>5. A VMP (ELA 2024) has been prepared for the Vegetated Riparian Zone and will be implemented with the development. The VMP contains weed removal where relevant.<br>6. Stormwater infrastructure is located on certified land. Refer to the Biodiversity Assessment (ELA, 2024). . |
| **PO2** Protect key aquatic habitat where it occurs. | 1. Where aquatic habitat exists, proposed development responds to *Policy and Guidelines for Fish Habitat Conservation and Management* by the Department of Primary Industries and other relevant guidelines.<br>2. Aquatic fauna habitat is rehabilitated in streams of Strahler Order 2 and higher. | See section 5.2 above. Riparian Corridor #1 is Type 1, Class 3 key fish habitat, and culverts meet the Fisheries Policy and Guidelines for crossing design. The remainder of the subject land protects other key fish habitat (3rd order and above). |

| Performance Outcome | Benchmark solution | How the Master Plan addresses |
|---|---|---|
| | 3. Existing habitat, such as fallen debris, is retained in streams of Strahler Order 2 and higher. | |
| **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. | Road crossings will be designed and constructed in accordance with DPI Fisheries *Policy and Guidelines for Fish Friendly Waterway Crossings.* Refer to Section 5.1, Section 5.2.<br>The major roadway proposed through the centre of the study area is the Eastern Ring Road (ERR). The central waterway (Riparian Corridor #2) will flow through culverts beneath the ERR. No direct impacts to mapped DPI key fish habitat (KFH) would occur as a result of the ERR (Figure 7).<br>Some impacts in western waterways occur in KFH (Figure 7) requiring road crossings. All road crossings in the form of culverts are permissible in accordance with the *Guidelines for riparian corridors on waterfront land* on any stream order. Culverts are to be designed in a fish-friendly way to allow for continued species movement (per DPI Fisheries *Policy and Guidelines for Fish Friendly Waterway Crossings*). |
| **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.<br>**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.<br>**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).<br>**4.** Despite any other provision of this DCP, for lots in the Mixed Use zone with development that includes active ground floor uses:<br>**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 | The riparian street shown in Figure 3 has been designed in accordance with the DCP. Detail is contained in the Public Domain Landscape Strategy (Site Image 2024). Cycleways and paths are not proposed within the Riparian Street. |

| Performance Outcome | Benchmark solution | How the Master Plan addresses |
|---|---|---|
| | **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.<br>**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.<br>**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).<br>**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. | |

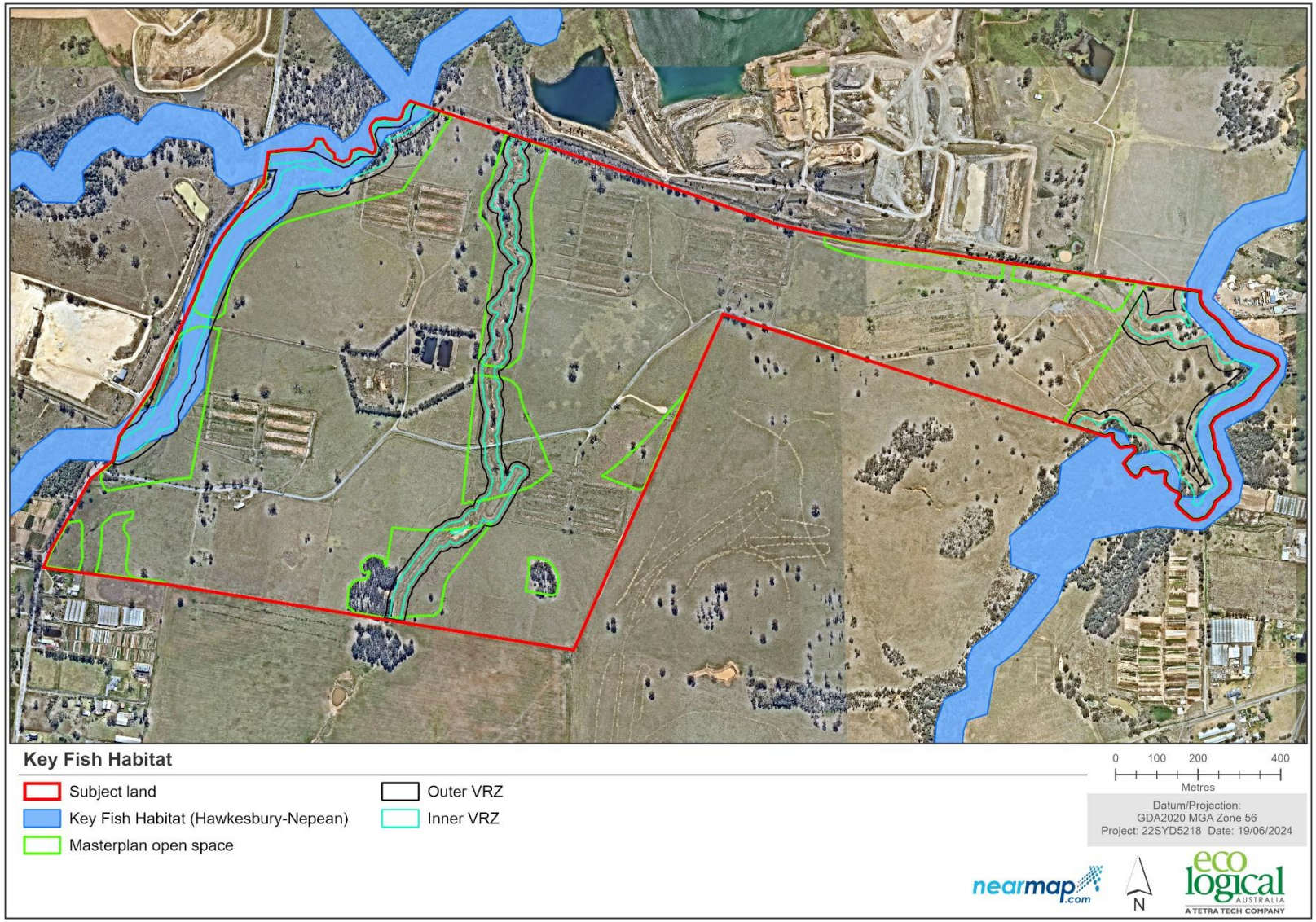


**Figure 7: DPI Fisheries mapped Key Fish Habitat (Hawkesbury-Nepean)**

# 6. Conclusion

The Master Plan site contains three corridors in generally poor condition with little aquatic habitat or riparian vegetation other than in the north east and north west of the site. The Master Plan will generally improve the condition of riparian corridors through the implementation of a Vegetation Management Plan.

The review of the Master Plan against relevant riparian guidelines and the Precinct Plan concludes that:

- Riparian Corridor #1 and #2 meet the intent of DPE Riparian Guidelines, DPI Fisheries Policy and Guidelines and the Precinct Plan. Encroachments into the outer 50% VRZ are permitted under the guidelines and have been offset. Road crossings (culverts) are required, and will be designed in accordance with DPI Fisheries *Policy and Guidelines for Fish Friendly Waterway Crossings*.
- The Master Plan provides greater connectivity, pervious area and larger open space including along Riparian Corridor #2 compared to the Precinct Plan. This corridor will be revegetated under a VMP.
- Realignment of a portion of Riparian Corridor #3 for the purpose of a Riparian Street is consistent the DCP and Precinct Plan, but is inconsistent with the DPE Riparian Corridor Guidelines. Key Fish Habitat (KFH) would not be affected, despite the realignment of a 3$^{rd}$ order stream, because fish movement is not facilitated until closer to South Creek.

# 7. References

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# Appendix A – River validation and site photographs

Note:
This PDF contains interactive elements.
To view interactive elements this PDF must be viewed on screen using a compatable PDF viewer.


## Top of Bank

- Study Area
- Channel (desktop)
- Overland flow path (desktop)
- Not a river
- Top of bank (external surveyor)
- Photo point (hover mouse over icon to view)

**Strahler Stream Order**

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

0 40 80 160
Metres

Datum/Projection:
GDA2020 MGA Zone 56

Project: 5218-EH Date: 28/06/2023

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eco logical AUSTRALIA
A TETRA TECH COMPANY


Note:
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## Top of Bank

- Study Area
- Top of bank (desktop)
- Overland flow path (desktop)
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**Strahler Stream Order**

- 1st Order
- 2nd Order
- 3rd Order
- 6th Order

0 40 80 160
Metres

Datum/Projection:
GDA2020 MGA Zone 56
Project: 5218-EH Date: 28/06/2023

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# Appendix B – Landscape Master Plan


NOT FOR CONSTRUCTION
Legend
Key Plan
SITE IMAGE
Client
Ingham Property Group
Drawing Name
Landscape Masterplan
Project
Badgerys Creek IPG
Badgerys Creek, NSW 2555
PRELIMINARY
Scale 1:4000 @ A1
Job Number
SS22-5042
Drawing Number
100
Issue
A
A1

# Appendix C – Riparian and Fisheries Guidelines

## C1 Relevant Guidelines

### Guidelines for Controlled Activities on Waterfront Land – Riparian Corridors

The NSW Department of Planning and Environment – Water (DPE Water) provide *Guidelines for Controlled Activities on Waterfront Land—Riparian Corridors* (DPE Riparian Guidelines 2020). This outlines 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 8). To be consistent with the DPE 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 5).

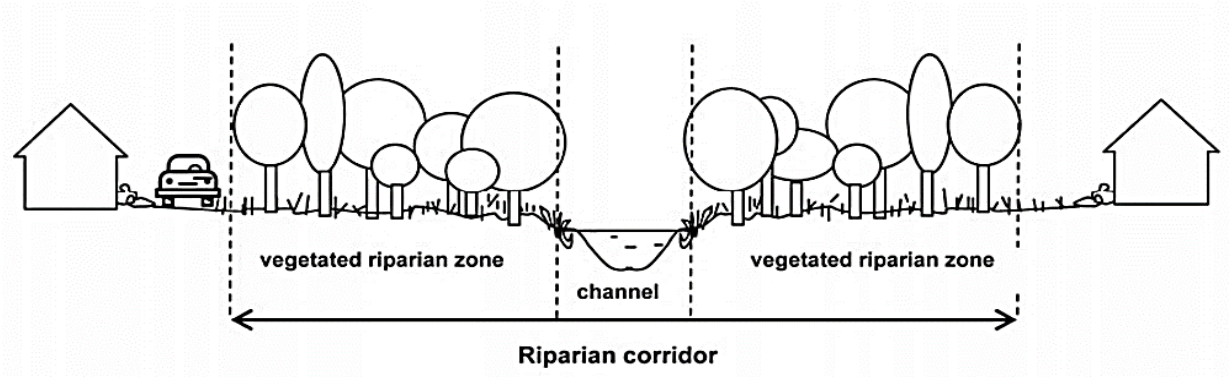


**Figure 8: VRZ and watercourse channel comprising the riparian corridor (DPE 2020)**

**Table 5: Recommended riparian corridor widths relative to Strahler Order (NRAR 2018)**

| Watercourse type | VRZ width (each side of watercourse) | Total riparian corridor width |
|---|---|---|
| 1st order | 10 m | 20 m + channel width |
| 2nd order | 20 m | 40 m + channel width |
| 3rd order | 30 m | 60 m + channel width |
| 4th 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 6 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 9).

**Table 6: Riparian corridor (RC) matrix of permissible use (DPE 2020)**

| 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 |
| 1st | 10 m | ● | ● | ● | ● | ● | ● | ● | | |
| 2nd | 20 m | ● | ● | ● | ● | ● | | ● | | |
| 3rd | 30 m | ● | ● | ● | | ● | | | ● | ● |
| 4th + | 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 website https://www.industry.nsw.gov.au/water/licensing-trade/hydroline-spatial-data*

***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 9.*

***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. 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).*

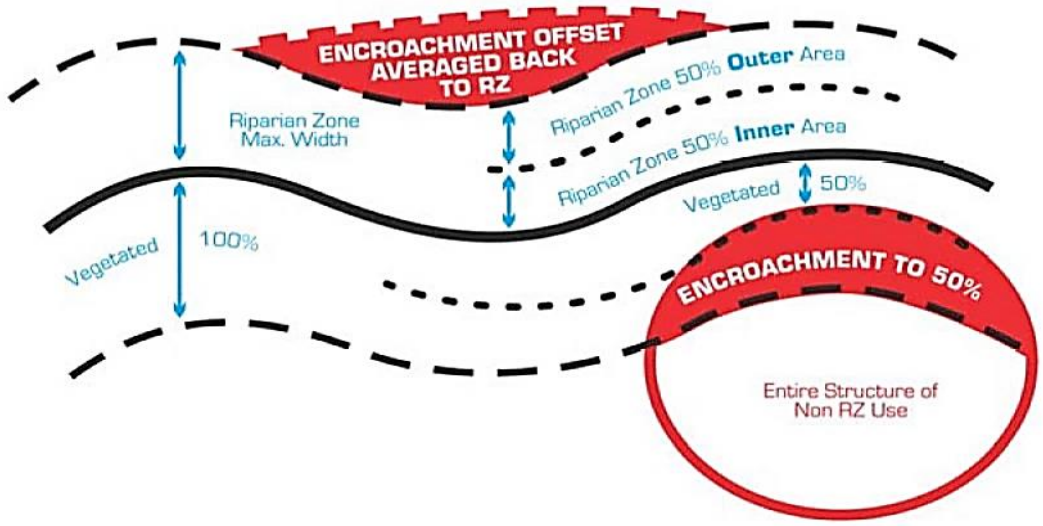


**Figure 9: Riparian 'averaging rule' for offsetting encroachment int the outer 50% VRZ (DPE 2020)**

### 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 7) and sensitivity of the key fish habitat present, which determines the potential disturbance and offsetting or environmental compensation required for development (Table 8).

**Table 7: Classification of waterways for fish passage and crossing type (Fairfull 2013)**

| Classification | Characteristics of waterway class and preferred crossing type |
|---|---|
| CLASS 1<br>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<br>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<br>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<br>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 8: 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: |
| Posidonia australis (strapweed) |
| *Zostera, Heterozostera, Halophila* and *Ruppia* species of seagrass beds >5 $m^2$ in area |
| Coastal saltmarsh >5 $m^2$ 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 |
| 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 $m^2$ in area |
| Mangroves |
| Coastal saltmarsh <5 $m^2$ 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 |

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