Aspect Industrial Estate State Significant Development Application - Riparian Assessment

Mirvac Projects

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Project Manager	Rebecca Ben-Haim
Prepared by	Claire Wheeler
Reviewed by	Ian Dixon
Approved by	David Bonjer
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Template 2.8.1

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Abbreviations

Abbreviation	Description
CBD	Central Business District
CEMP	Construction Environmental Management Plan
DPIE	Department of Planning, Industry and Environment
ELA	Eco Logical Australia
ENM	Excavated Natural Material
EPA	Environmental Protection Authority
EP&A Act	*Environmental Planning and Assessment Act 1979*
FM Act	*Fisheries Management Act 1994*
Hawkesbury Nepean SREP	*Sydney Regional Environmental Plan No. 20 – Hawkesbury Nepean River*
NRAR	Natural Resources Access Regulator
Penrith LEP	*Penrith Local Environmental Plan 2010*
POEO Act	*Protection of the Environment Operations Act 1997*
RC	Riparian corridor
SEARs	Secretary's Environmental Assessment Requirements
SEPP WSEA	*State Environmental Planning Policy (Western Sydney Employment Area) 2009*
SSDA	State Significant Development Application
ToB	Top of Bank
VENM	Virgin Excavated Natural Material
VMP	Vegetation Management Plan
VRZ	Vegetated Riparian Zone
WM Act	*Water Management Act 2000*
WSUD	Water Sensitive Urban Design

Executive Summary

This Riparian Assessment is required to support a State Significant Development Application (SSDA) and Development Application for a Concept Masterplan and Stage 1 development of the Aspect Industrial Estate, located at Lots 54 to 58, DP 259135, Kemps Creek. This report determines potential impacts on the riparian and aquatic ecology within the site due to the proposed development and makes recommendations to mitigate those impacts.

Two mapped hydrolines are located within the development area. Site surveys identified that the 1st order hydroline did not meet the definition of a 'river' under the *Water Management Act 2000* (WM Act). A portion of the 2nd order hydroline in the north west of the development area did meet the definition of a 'river' under the WM Act, however it was in a degraded condition with steep and bare banks, a lack of native riparian vegetation and proliferation of exotic pasture grasses in the vicinity of the waterway.

As part of the development of the Aspect Industrial Estate, the 2nd order hydroline is to be removed and a vegetated channel is to be constructed on the northern boundary of the development site. This channel will be vegetated with a full complex of native riparian vegetation in the ground, shrub and canopy layers, as per the Vegetation Management Plan prepared by ELA (2020). This will ensure that a waterway that has aquatic instream habitat, dense native riparian vegetation and a range of geomorphic features such as pools and riffles will be created within the development area, which is a marked improvement on the condition of the current 2nd order watercourse within the development area.

The existing 2nd order watercourse to be removed is approximately 180 m long and has a riparian area of 0.75 ha. The new channel will be approximately 800 m long and have a total riparian area of 3.33 ha, comprised of a 4.75 m wide channel that is approximately 0.41 ha, an inner Vegetated Riparian Zone of approximately 1.58 ha and an outer Vegetated Riparian Zone of approximately 1.34 ha.

The vegetated channel will also incorporate instream woody debris to create instream aquatic habitat, have a range of different surfaces along the bed and banks of the channel to create different geomorphic features such as pools and riffles during high flow events and be maintained under a Vegetation Management Plan for a period of five years to ensure that the vegetation is not dominated by exotic species. The proposed construction of the vegetated channel meets the objectives of the WM Act, in that the watercourse (including geomorphic variability) is to be restored and aquatic habitat is to be created.

1. Introduction

1.1 Location

Aspect Industrial Estate (the site) is legally described as Lots 54 – 58 in DP 259135, with an area of approximately 56.3 hectares (ha). The site is located east of Mamre Road, Kemps Creek within the Penrith Local Government Area (LGA). Within the State Significant Development Application (SSDA) boundary, there are two mapped tributaries of South Creek that extend for approximately 1,298 m, from Lot 54 DP 259135 in the south to Lot 58 DP 259135 in the north (Figure 1).

1.2 State Significant Development and Development Application Project Description

The site has approximately 950 m of direct frontage to Mamre Road with a proposed intersection providing vehicular access via Mamre Road to the M4 Motorway and Great Western Highway to the north and Elizabeth Drive to the south.

The site is located approximately 4 km north-west of the future Western Sydney Nancy-Bird Walton Airport, 13 km south-east of the Penrith CBD and 40 km west of the Sydney CBD.

The Department of Planning, Industry and Environment (DPIE) rezoned Mamre Road Precinct, including the site, in June 2020 under the *State Environmental Planning Policy (Western Sydney Employment Area) 2009* (WSEA SEPP). The rezoning of this precinct responds to the demand for industrial land in Western Sydney. The site is primarily zoned IN1 General Industrial with a small sliver of land zoned E2 Environmental Conservation.

Consistent with the above, this report has been prepared to support a Development Application under Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for the purpose of:

- A Concept Masterplan for the site comprising 11 industrial buildings, internal road network layout, building locations, gross floor area (GFA), car parking, concept landscaping, building heights, setbacks and built form parameters (Figure 2).
- Stage 1 development of the site including (Figure 3):
    - The demolition, removal of existing rural structures and remediation works
    - Heritage salvage works (if applicable)
    - Clearing of existing vegetation on the subject site and associated dam dewatering and decommissioning
    - Realignment of existing creek and E2 Environmental Conservation zone
    - Onsite bulk earthworks including any required ground dewatering
    - The importation, placement and compaction of spoil material, consisting of:
        - ▪ Virgin Excavated Natural material (VENM) within the meaning of the *Protection of the Environment Operations Act 1997* (POEO Act); and/or
        - Excavated Natural material (ENM) within the meaning of the NSW Environmental Protection Authority's (EPA) Resource Recovery Exemption under Part 9, Clauses 91 and 92 of the *POEO (Waste) Regulation 2014 – The Excavated Natural Material Order 2014*; and/or

    - Materials covered by a specific NSW EPA Resource Recovery Order and Exemption which are suitable for their proposed use.
  - Boundary retaining walls
  - Catchment level stormwater infrastructure, trunk services connections, utility infrastructure, roads and access infrastructure (signalised intersection with Mamre Road) associated with Stage 1
  - Construction, fit out and 24 hours a day/ 7 days per week use of warehouse and distribution centre within Stage 1
  - Detailed on lot earthworks, stormwater, services and utility infrastructure associated with the construction of warehouse and distribution centre within Stage 1
  - Boundary stormwater management, fencing and landscaping; and
  - Staged subdivision of Stage 1.

The Secretary's Environmental Assessment Requirements (SEARs) have been issued in respect of the proposal. This report addresses the relevant SEARs considerations.

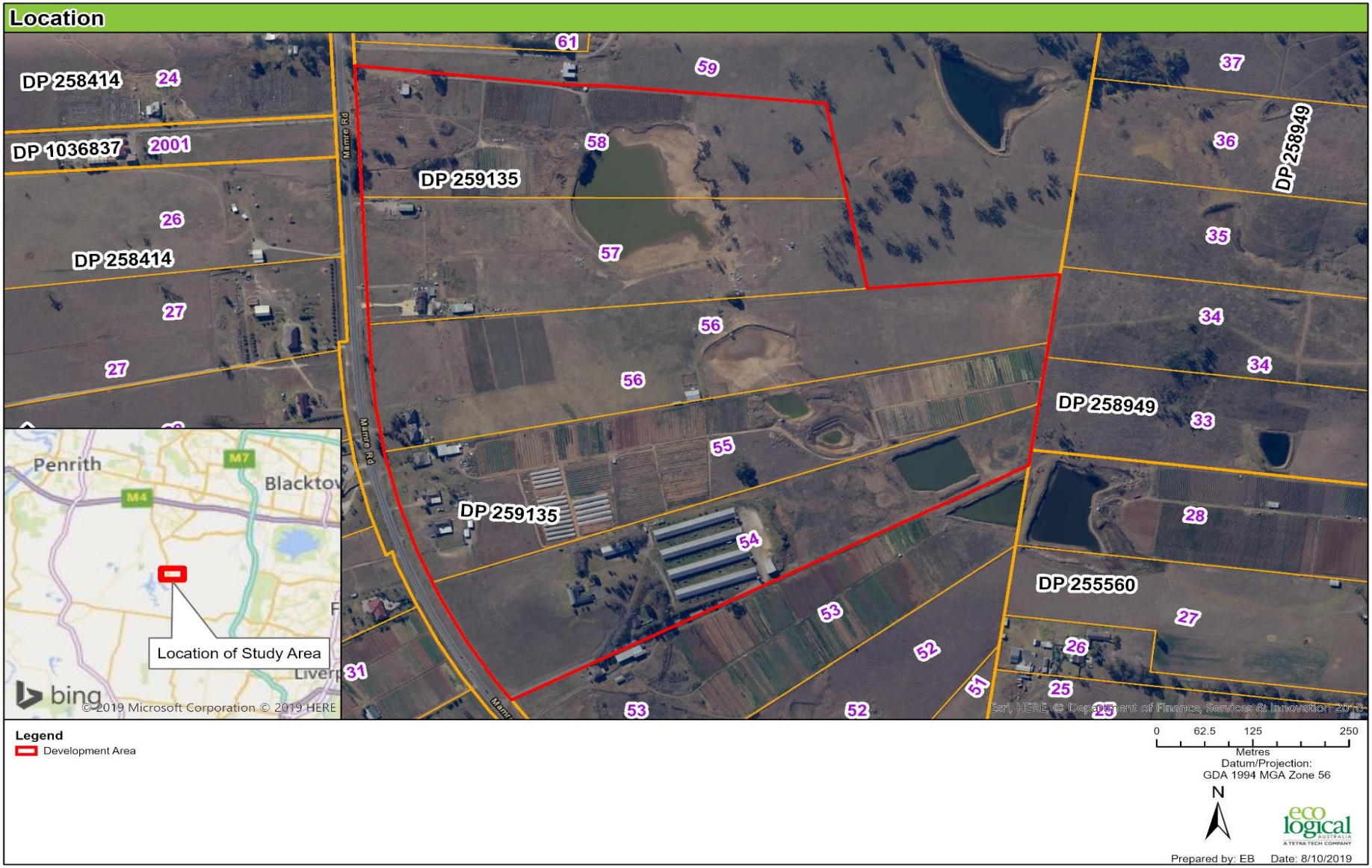

Figure 1: Development area

Figure 2: Aspect Industrial Estate Masterplan

Figure 3: Aspect Industrial Estate Works Staging Plan

2. Legislative Context

The specific riparian and aquatic regulatory requirements and policies were reviewed to determine their application to the Aspect Industrial Estate. These included:

- *Fisheries Management Act 1994*
- Fisheries spatial portal, threatened species profiles and Primefacts (Riches et al, 2016)
- *Water Management Act 2000*
- *Water Management (General) Regulation 2018*
- *State Environmental Planning Policy (Western Sydney Employment Area) 2009*
- Policy and guidelines for fish habitat conservation and management (Fairfull, 2013)
- Aspect Industrial Estate Riparian Corridor Concept Plan (AT&L, 4/9/2020, Issue P3).

2.1 Fisheries Management Act 1994

The *Fisheries Management Act 1994* (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.

In accordance with Part 4, Division 1.7, Section 4.41 (b) of the EP&A Act, applications for separate permits under Sections 201, 205 or 219 of the FM Act are not required for SSD, but the offset policy relating to loss of key fish habitat still applies under the FM Act. In order to inform a comparative and acceptable assessment of impacts to aquatic habitat, the regulatory framework of the FM Act and associated guidelines have been adopted for this assessment.

A search of the Commonwealth Protected Matters Search tool, OEH BioNet database search, Fisheries Threatened Species distribution maps (Riches et al, 2016) and Primefact publications in September 2019 identified three species of fish and one insect with potential to be found within the study area (Table 1). As there are no records within the South Creek catchment and a lack of suitable habitat on site, it is unlikely that these species would be found within the proposed development area.

Table 1: Likelihood of occurrence table for aquatic species

Scientific Name	Common Name	FM Act	EPBC Act	Habitat Associations	Records within 5 km and catchment	Likelihood of occurrence
Archaeophya adamsi	Adams Emerald Dragonfly	E		Adam's Emerald Dragonfly 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. Adult dragonflies generally fly away from the water to mature before returning to breed. Males fly actively at breeding sites and often guard a territory. Females probably lay their eggs into the water.	0	No, no suitable habitat within development area.
Maccullochella peelii	Murray Cod		V	The Murray Cod occurs naturally in waterways of Murray-Darling Basin in warm water habitats from clear, rocky streams to slow flowing turbid rivers and billabongs. They prefer habitats with submerged woody debris that provide protected spawning areas.	0	No, no suitable habitat and no records within 5 km of site.
Macquaria australasica	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 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.	0	No, no suitable habitat and no records within 5 km of site.
Prototroctes maraena	Australian Grayling	E	V	Historically, this species inhabited coastal streams from the Grose River southwards through NSW, VIC and TAS. On the mainland, this species has been recorded from rivers flowing east and south of the main dividing range. 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 migrate between freshwater streams and the ocean and as such it is generally accepted to be a diadromous species (migratory between fresh and saltwaters).	0	No, no suitable habitat and no records within 5 km of site.

Note: E = Endangered, V= Vulnerable.

2.2 Water Management Act 2000 and Water Management (General) Regulation 2018

The main objective of the *Water Management Act 2000* (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 is administered by Natural Resources Access Regulator (NRAR) and 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 WM Act defines a river as:

a. *any watercourse, whether perennial or intermittent and whether comprising a natural channel or a natural channel artificially improved, and*
b. *any tributary, branch or other watercourse into or from which a watercourse referred to in paragraph (a) flows, and*
c. *anything declared by the regulations to be a river.*

For the purposes of paragraph (c) of the definition of 'river' in the Dictionary to the Act, the following are declared to be a river as per the *Water Management (General) Regulation 2018* (WM Regulation):

a. *any watercourse, whether perennial or intermittent, comprising an artificial channel that has changed the course of the watercourse,*
   any tributary, branch or other watercourse into or from which a watercourse referred to in paragraph (a) flows.

Under the WM Act framework, activities and works proposed on waterfront land are regulated. These activities include:

- the construction of buildings or carrying out of works
- the removal of material or vegetation from land by excavation or any other means
- the deposition of material on land by landfill or otherwise
- any activity that affects the quantity or flow of water in a water source.

In accordance with Part 4, Division 1.7, Section 4.41 (g) of the EP&A Act, a water use approval under Section 89, a water management work approval under Section 90 or an activity approval (other than an aquifer interference approval) under Section 91 of the WM Act is not required for SSD.

However, in order to inform a comparative and acceptable assessment of riparian impacts, the regulatory framework of the WM Act and associated guidelines have been adopted for this assessment.

NRAR's *Guidelines for Controlled Activities on waterfront land—Riparian corridors* (NRAR, 2018) 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 4). NRAR recommends a VRZ width based on watercourse order as classified under the Strahler System of ordering watercourses and using Hydroline Spatial Data which is published on the department's website (Table 2).

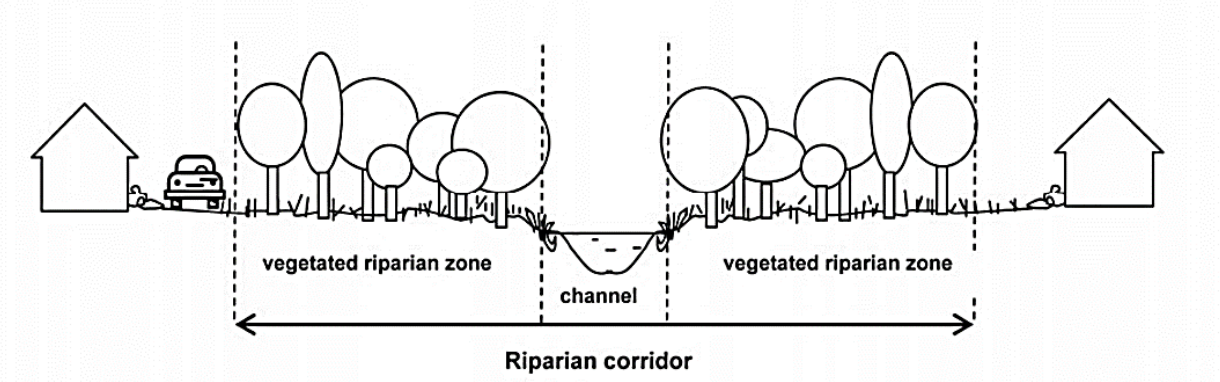

Figure 4: Vegetated Riparian Zone and watercourse channel comprising the riparian corridor (NRAR, 2018).

Table 2: 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

Non-riparian uses can be authorised by NRAR within the outer 50% of the VRZ (Column 3, Table 3) as long as compensation (1:1 offset) is achieved within the site. The outer VRZ that is impacted is to be offset elsewhere on site using the 'averaging rule' (Figure 5).

Table 3: Riparian corridor (RC) matrix of permissible use (NRAR 2018).

Stream order	Vegetated Riparian Zone (VRZ)	RC off-setting 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	10m	●	●	●	●	●	●	●		
2nd	20m	●	●	●	●	●		●		
3rd	30m	●	●	●		●			●	●
4th +	40m	●	●	●		●			●	●

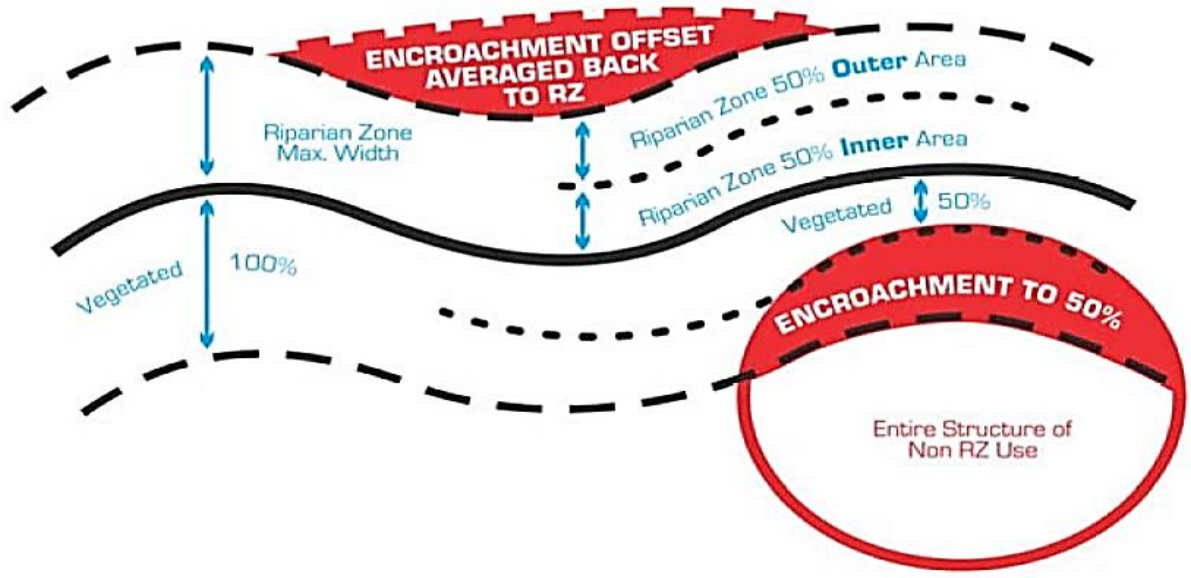

Figure 5: Riparian 'averaging rule' for offsetting encroachment into the outer 50% of the VRZ (NRAR 2018).

2.3 State Environmental Planning Policy (Western Sydney Employment Area) 2009

The *State Environmental Planning Policy (Western Sydney Employment Area) 2009* (SEPP WSEA) was amended following the adoption of the Mamre Road Precinct Plan.

Under the SEPP WSEA, a portion of the site is zoned as E2 (Figure 6). The objectives of the E2 zone are:

- *To protect, manage and restore areas of high ecological, scientific, cultural or aesthetic values.*
- *To prevent development that could destroy, damage or otherwise have an adverse effect on those values.*

The following development may be carried out within the E2 zone with consent:

> *Artificial waterbodies; Environmental facilities; Environmental protection works; Flood mitigation works; Roads.*

A number of clauses within the SEPP WSEA are applicable to the proposed development of the Aspect Industrial Estate, including Part 6 Clause 33H, 33I and 33L.

33H Earthworks

1. *The objectives of this clause are as follows—*
   a. *to ensure that earthworks for which development consent is required will not have a detrimental impact on environmental functions and processes, neighbouring uses, cultural or heritage items or features of the surrounding land,*
   b. *to allow earthworks of a minor nature without separate development consent.*
2. *Development consent is required for earthworks unless—*
   a. *the work is exempt development under this Policy or another applicable environmental planning instrument, or*
   b. *the work is ancillary to other development for which development consent has been given.*
3. *Before granting development consent for earthworks, the consent authority must consider the following matters—*
   a. *the likely disruption of, or detrimental effect on, existing drainage patterns and soil stability in the locality,*
   b. *the effect of the proposed development on the likely future use or redevelopment of the land,*
   c. *the quality of the fill or the soil to be excavated, or both,*
   d. *the effect of the proposed development on the existing and likely amenity of adjoining properties,*
   e. *the source of fill material and the destination of excavated material,*
   f. *the likelihood of disturbing relics,*
   g. *the proximity to and potential for adverse impacts on a waterway, drinking water catchment or environmentally sensitive area,*
   h. *appropriate measures proposed to avoid, minimise or mitigate the impacts of the development,*
   i. *the proximity to and potential for adverse impacts on a heritage item, an archaeological site, or a heritage conservation area,*
   j. *the visual impact of earthworks as viewed from the waterways.*

33I Development on flood prone land

1. *This clause applies to development requiring consent that is carried out on flood prone land.*
2. *Consent is not to be granted to the carrying out of development to which this clause applies unless the consent authority has taken into consideration whether or not—*
   a. *the development will adversely affect flood behaviour resulting in detrimental increases in the potential flood affectation of other development or properties, and*
   b. *the development will alter flow distributions and velocities to the detriment of other properties or the environment of the floodplain, and*
   c. *the development will enable safe occupation of the flood prone land, and*
   d. *the development will detrimentally affect the floodplain environment or cause avoidable erosion, siltation, salinity, destruction of riparian vegetation or a reduction in the stability of the riverbank/watercourse, and*
   e. *the development will be likely to result in unsustainable social and economic costs to the flood affected community or general community, as a consequence of flooding, and*
   f. *the development is compatible with the flow conveyance function of the floodway, and*
   g. *the development is compatible with the flood hazard, and*
   h. *in the case of development consisting of the excavation or filling of land, the development—*
      i *will detrimentally affect the existing drainage patterns and soil stability in the locality, and*
      ii *will adversely impact or alter flood behaviour.*

33L Stormwater, water quality and water sensitive design

1. *The objective of this clause is to avoid or minimise the adverse impacts of stormwater on the land on which development is to be carried out, adjoining properties, riparian land, native bushland, waterways, groundwater dependent ecosystems and groundwater systems.*
2. *Before granting development consent to development on land to which this Policy applies, the consent authority must take into consideration whether—*
   a. *water sensitive design principles are incorporated into the design of the development, and*
   b. *riparian, stormwater and flooding measures are integrated, and*
   c. *the stormwater management system includes all reasonable management actions to avoid adverse impacts on the land to which the development is to be carried out, adjoining properties, riparian land, native bushland, waterways, groundwater dependent ecosystems and groundwater systems, and*
   d. *if a potential adverse environmental impact cannot be feasibly avoided, the development minimises and mitigates the adverse impacts of stormwater runoff on adjoining properties, riparian land, native bushland, waterways, groundwater dependent ecosystems and groundwater systems, and*
   e. *the development will have an adverse impact on—*
      i *the water quality or quantity in a waterway, including the water entering the waterway, and*
      ii *the natural flow regime, including groundwater flows to a waterway, and*
      iii *the aquatic environment and riparian land (including aquatic and riparian species, communities, populations and habitats), and*
      iv *the stability of the bed, banks and shore of a waterway, and*

f. the development includes measures to retain, rehabilitate and restore riparian land.

The impacts of the proposed development relevant to these land zones and clauses of the SEPP WSEA are discussed in Section 6.7.

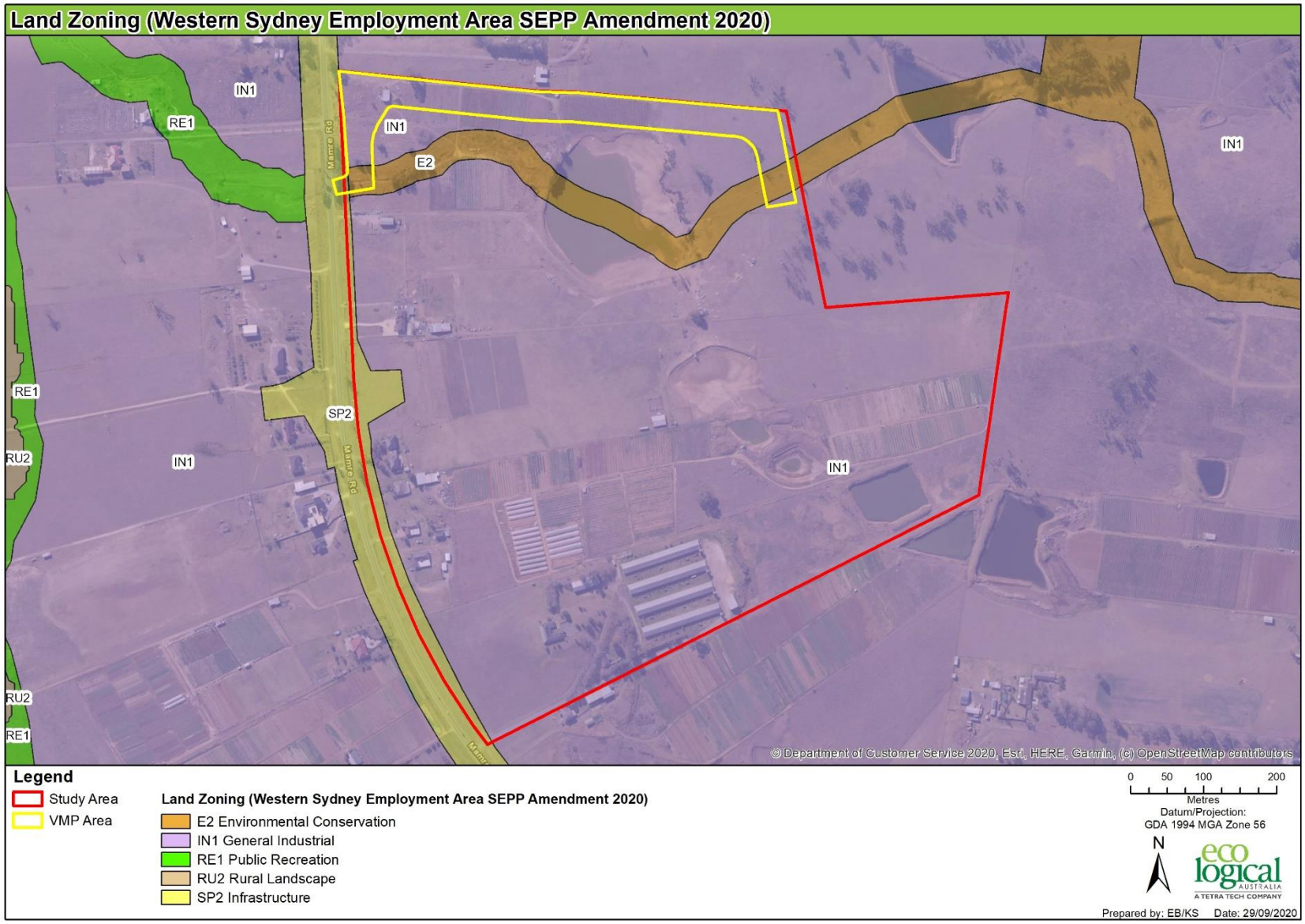

Figure 6: Land zoning under Western Sydney Employment Area SEPP

2.4 Policy and guidelines for fish habitat conservation and management

The *Policy and guidelines for fish habitat conservation and management* (Fairfull, 2013) (herein referred to as the 'Policy') is a supplementary document that outlines the requirements and obligations under the FM Act and the *Fisheries Management (General) Regulation 2010* and were developed to maintain and enhance fish habitat and assist in the protection of threatened species. The Policy provides a definition of key fish habitat and provides guidance for assigning a rating for fish habitat sensitivity (Table 4) and the type of key fish habitat (Table 5).

Table 4: Classification of waterways for fish passage (Fairfull, 2013).

Classification	Characteristics of waterway class
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'.
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 pools or in connected wetland areas. Freshwater aquatic vegetation is present. TYPE 1 and 2 habitats present.
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.
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 free standing water or pools post rain events (e.g. dry gullies or shallow floodplain depressions with no aquatic flora present).

The Policy classifies waterways into three types of key fish habitat. While the tributary of South Creek within the SSDA area is likely to be considered a Type 3 habitat using the descriptions outlined in Table 5, the guidelines do note that 1st and 2nd order streams on gaining streams are not considered to be key fish habitat unless they are known habitat for threatened aquatic species. The tributaries have not been mapped as key fish habitat by DPI Fisheries and do not support threatened aquatic species, however the main drainage line of South Creek, approximately 1.4 km downstream of the site, is mapped as key fish habitat.

Table 5: Key fish habitat types (Fairfull, 2013).

Table 1 – 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 >5m^2 in area
- Coastal saltmarsh >5m^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[2]
- 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 <5m^2 in area
- Mangroves
- Coastal saltmarsh <5m^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 plan)
- 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

3. Methods

The Strahler stream order classification was extracted from the Department of Primary Industry's GIS dataset. Site surveys were carried out on 10 December 2018 and 21 January 2019 by Aquatic Ecologist Claire Wheeler to determine if the watercourse on site met the definition of a 'river' under the WM Act and determine the current condition and extent of riparian and aquatic habitat:

1. Definition of a 'river' under the WM Act – Waterways within the SSDA boundary were assessed to determine if they met the definition of a 'river' using definitions outlined in section 2.2 of this report.

22. Riparian habitat assessment - An assessment of riparian condition and recovery potential was conducted for the waterways. This assessment considered native vegetation cover, connectivity and quality, bed and bank stability and habitat diversity.

3. Aquatic habitat assessment - An assessment of the aquatic habitat within the mapped waterways was completed, which examined the quality of aquatic habitats, including vegetation structure and regeneration, weed infestation, woody debris, fish habitat, patch size and connectivity potential.

4. Existing Environmental Conditions

DPI mapping showed two unnamed watercourses within the study area (Figure 7); a 1st order watercourse in the south east of the site and a 2nd order watercourse in the north of the site. These have been labelled as 1A and 2A respectively in Figure 8. These watercourses are tributaries of South Creek, within the Hawkesbury Nepean catchment.

Within the development area there are also five farm dams, most of which had limited riparian and / or fringing vegetation surrounding them and poor aquatic habitat values. The site had been the subject of significant disturbance in the past, with a number of small irrigation channels constructed across various lots to service the market gardens within the properties.

The 1st order watercourse mapped within the south east and centre of the development area passed through five farm dams within the site and no indicative features of a waterway (such as defined bed and banks or geomorphic features such as erosion and deposition) were observed along the length of this mapped watercourse.

The mapped 2nd order watercourse that originated to the north east of the development area passed through one farm dam in a roughly east-west direction and flowed towards Mamre Road. A defined channel was observed within the north western section of the development area.

Figure 7: Watercourses mapped within development area, extracted from DPI dataset

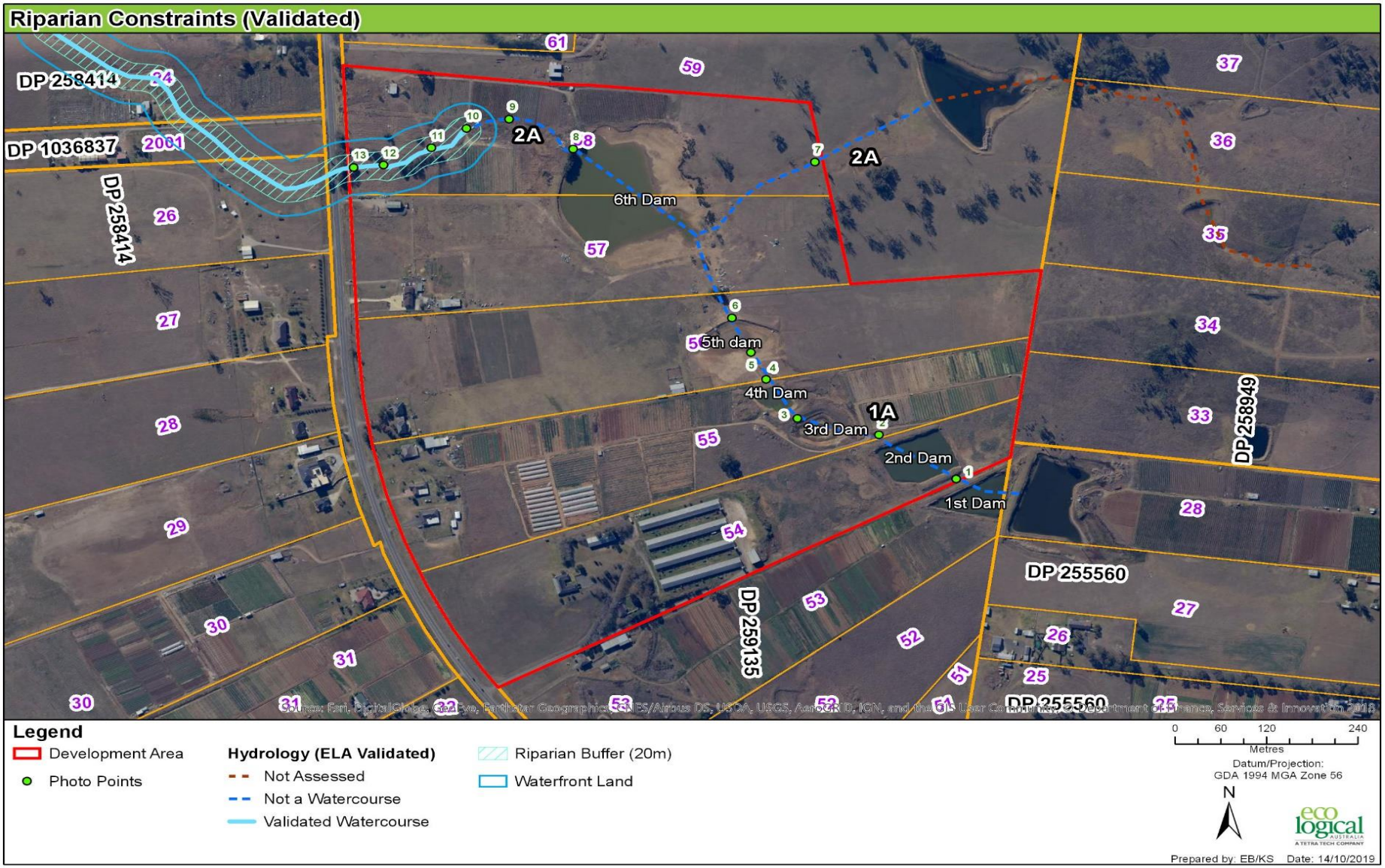

Figure 8: Validated riparian areas and photo point locations

4.1 Reach 1A

The mapped watercourse originating from the lot to the south east of the study area is an unnamed 1st order watercourse.

Upstream of the development area, a farm dam was observed on Lot 53. The batter on the downstream side of this dam was vegetated with herbaceous weeds and had no spillway visible from Lot 54. Adjacent to the downstream side of this dam was a short drainage trench that was orientated in an east-west direction and densely covered in *Typha orientalis* (Broadleaf Cumbungi). This was not a drainage channel that was connected to the 2nd dam within Lot 54.

Figure 9 shows that there was no defined channel evident upstream or downstream of Photo Point 1. An informal access road existed between the 1st and 2nd dams. The 2nd dam occupied an area of approximately 5,680 m^2 and was surrounded by a thin buffer of herbaceous weed species, including *Verbena bonariensis* (Purple Top), *Onopordum acanthium* (Scotch Thistle), *Avena sativa* (Oats) and a small amount of *Juncus* sp. There was a small amount of *T. orientalis* on the south eastern corner of this 2nd dam. A small overflow pond was located adjacent to the north western corner of the dam and was covered in dense *T. orientalis.* The 2nd dam had poor aquatic habitat, with no overhanging vegetation and no macrophytes apart from the *T. orientalis* in the south eastern corner.

Figure 9: Photo point 1: Top left: upstream, top right: upstream at dam wall on Lot 53, bottom left: downstream on the upstream wall on Lot 54, bottom right: downstream from top of dam wall on Lot 54

Between the 2nd and 3rd dams, an unvegetated dirt road was orientated in an east-west direction and a small drainage culvert had been installed underneath this road to convey overland flow beneath rather than over the road (Figure 10). The 3rd dam occupied an area of approximately 516 m^2 and similarly to the 2nd dam, was surrounded by a thin layer of herbaceous weed species and no native canopy or shrub species. A shallow drainage channel had been constructed in an east-west orientation to convey runoff from within the market garden, located to the east of the 3rd dam (Figure 10). This drainage channel was not connected to the 2nd or 3rd dams and appeared to be for the purposes of controlling overland flow or irrigation through and around the market garden area only.

No overhanging vegetation was surrounding the 3rd dam and there was a small amount of *T. orientalis* on the south east corner of the dam. There were no other native macrophyte species within or surrounding the dam and aquatic habitat within and surrounding the dam was poor.

Figure 10: Photo point 2: Top left: looking upstream at downstream wall of the 2nd dam; top right: looking downstream towards 3rd dam in Lot 55, no defined channel; bottom left: dug out drainage channel to convey uphill runoff; bottom right: drainage culvert under unformed road.

Figure 11: Photo point 2: Top left: looking downstream north-west at 3rd dam;, top right: drainage channel dug to convey water from market garden; bottom: east along downstream wall of 3rd dam.

The 4th dam, located on Lot 55, covered an area of approximately 1,360 m^2. There was no defined channel between the 3rd and 4th dams. The 4th dam had no defined spillway or wall on the downstream side and in periods of high rainfall it is likely that the boundary between this dam and the 5th dam could disappear. Dam walls had been constructed on the eastern and southern sides of the dam (Figure 12). The wall on the eastern side of the dam had a cut-out section to allow water to enter the dam. A thin buffer of herbaceous exotic species surrounded the dam, as well as some pasture grasses on the downstream end of the dam that were growing within the water. No riparian canopy or shrub species were observed surrounding the dam and aquatic habitat in this area was limited, with no overhanging vegetation and no visible in-stream woody debris.

Between the 4th and 5th dams, a flat overland flow path was observed. There was no defined channel within this area and no bed and banks visible, however there was vegetation present that indicated the area is often waterlogged or covered in standing water (Figure 12), likely as a result of there being no dam wall on the downstream side of the 4th dam. This vegetation included species such as the native *Persicaria decipiens* (Slender Knotweed) and *Juncus usitatus* (Juncus) and the exotic species *Cyperus eragrostis* (Umbrella Sedge).

Figure 12: Photo point 3: Top left: looking north west (downstream) towards 4th dam; top right: looking east across 4th dam; bottom: looking south across 4th dam

Covering an area of approximately 2,236 m^2, the 5th dam was fringed on the upstream side by a mix of native and exotic vegetation and contained a small amount of emergent macrophytes as shown in Figure 13. Additionally, on the upstream side of the 5th dam, there was evidence of rill erosion where the clay soil around the dam was unvegetated and evidence of stock access to the dam was observed (Figure 13). The 5th dam had a defined dam wall on the northern side, with no spillway or cut-out overflow area on the downstream side. No defined channel existed below the 5th dam.

Figure 13: Photo point 5: top left: looking downstream toward dam 5; top right: looking downstream across dam 5; bottom left: looking west at rill erosion upstream of dam 5; bottom right: cattle disturbance along upstream side of dam 5, looking west.

There was an area adjacent to a small stand of *Casuarina glauca* (Swamp Oak) downstream of the 5th dam where there was pooled water on the day of the site visit on 10th December 2018 (Figure 14). There was no defined channel upstream or downstream of this area of pooled water, however it was surrounded by a few *J. usitatus* and *C. eragrostis* plants as well as pasture grasses.

Figure 14: Photo point 6: Top left: upstream from below dam 5; top right: downstream from below dam 5: bottom left: ponded water between dam 5 and 6.

There was no defined channel between the 5th and 6th dams. Immediately upstream of the 6th dam was a mapped confluence of reaches 1A and 2A. There was no defined channel within this area where both 1A and 2A were mapped as hydrolines in Figure 5.

4.2 Reach 2A

There was no defined channel to the east of the 6th dam. The area where 2A is mapped (according to the hydroline dataset) to the east of the dam was an area of grassed paddocks, with grazed pasture grasses and evidence of a possible overland flow path between the dam upstream on Lot 59 and the 6th dam (Figure 15).

Figure 15: Photo point 7: top left: looking downstream towards dam 6; top right: looking downstream towards mapped confluence of two waterways; bottom left: looking downstream towards dam 6; bottom right: looking upstream towards dam on Lot 59.

The 6th dam was located at the north of the study area spanning Lots 57 and 58. It covered an area of approximately 1.89 ha. Immediately below the 6th dam there was a 2nd order watercourse mapped (Figure 16). During the site visit, there was no defined channel observed in this area or the immediate surrounds. There was no overflow or spillway on the downstream side of this dam. A few *C. glauca* trees and saplings were located on the downstream side of the dam and erosion around the base of these trees and sections of the downstream dam wall (which was nearly vertical in most areas) was observed Figure 16. There was very little other vegetation surrounding the 6th dam, apart from a small area of *J. usitatus* on the eastern side of the dam and exotic herbaceous species including *Conyza bonariensis* (Fleabane) and *O. acanthium*.

Figure 16: Photo point 8: Top left: looking upstream across 6th dam; top right: looking downstream from 6th dam; bottom left and right: dam wall erosion and *C. glauca* trees.

In the area immediately downstream of the 6th dam, there were a few *J. usitatus* plants (Figure 16) that indicated that the area may be occasionally inundated or have standing water present, however there was no defined channel in this area. Figure 17 shows that there was no defined channel within the central portion of Lot 58 at Photo point 9. The area was covered by exotic species, primarily herbaceous grasses.

Figure 17: Photo point 9: Left, looking upstream towards 6th dam; right, looking downstream towards Mamre Rd.

There was part of a mapped watercourse downstream of the 6th dam (Figure 18) that did meet the definition of a 'river' under the WM Act. The defined watercourse started at a patch of *Phragmites australis* (Common Reed) and flowed through the site in a westerly direction towards Mamre Road (Figure 18). Frogs could be heard calling within this area however there were no exposed areas of open water that were observed.

Figure 18: Photo point 10: Left, looking upstream towards 6th dam; right, looking downstream towards Mamre Road.

Downstream of the area of *P. australis*, the channel passed through an area of dense *Cenchrus clandestinus* (Kikuyu Grass) and where there were a few *C. glauca* trees at the top of the creek bank. Sections of the bed of the channel within this area were hard to see as they were covered in long *C. clandestinus*. Small *C. glauca* trees were located within the channel in this area and household rubbish was scattered through the channel. Photo point 11 was an area where the channel became wider and more defined (Figure 19) and there was no longer dense exotic species growing on the bed of the watercourse. Another patch of *P. australis* was growing within the channel, which at this location was approximately 1.5 m wide and 1.2 m deep.

Figure 19: Photo Point 11: Top left, looking upstream towards *Phragmites*; top right, looking downstream towards Mamre Rd; bottom left, looking upstream towards next *Phragmites* patch; bottom right, looking upstream at exposed channel bed.

Approximately 20 m upstream of the Lot 58 boundary fence, the channel became wider (approximately 2.5 m wide) and there was a small amount of standing water in the creekline. There was a break in the riparian vegetation in this section of the watercourse, with no *C. glauca* species on the top of the banks. However, there was more instream vegetation including the natives *P. decipiens*, and *Alternanthera* sp. and the exotic species *Rumex crispus* (Curled Dock) (Figure 20).

Figure 20: Photo point 12: Left, looking upstream with vegetation growing within creekline; right, looking downstream towards standing water in creekline.

At the western extent of Lot 58, the creek flowed under Mamre Road through three box culverts, each approximately 0.8 m high and 1.5 m wide with a concrete wingwall extending out to the northern and southern ends of the culverts. This area also appeared to collect roadside drainage from the north and south of Lot 58 along Mamre Road. Upstream of this point, the vegetation was densely covering the channel (Figure 21).

Figure 21: Photo Point 13: Left, looking upstream through dense vegetation; right, culverts that carry creek flow under Mamre Road, looking south.

5. Planning and Legislative Requirements

5.1 Water Management Act 2000

Development on waterfront land (i.e. land within 40 m of a watercourse or waterbody) requires a Controlled Activity Approval (CAA) under the WM Act. To guide land use planning and decisions on watercourses and their riparian zones, NRAR published *Guidelines for Controlled Activities on Waterfront Land* (2018). These guidelines are generally used in conjunction with a ground-truthing riparian assessment. The guidelines state that watercourses should have riparian zones that are measured from the top of bank on each side of the watercourse.

During the field survey, it was ELA's assessment that Reach 1A did not meet the definition of a 'river' under the WM Act, as there were no defined channels, evidence of bed and banks or geomorphic processes existing in the areas between the dams along this reach. Reach 2A to the east of the 6th dam also did not meet the definition of a 'river', as there were no bed and banks, defined channel or geomorphological processes observed in the area.

Downstream of the 6th dam within Lot 58, part of Reach 2A meets the definition of a 'river' under the WM Act as there were bed and banks and evidence of geomorphic processes (erosion) present within this area. A 40 m buffer has been added to the mapped location of this watercourse to indicate the extent of the waterfront land associated with this watercourse. Any local development, including any future sub-divisions of this Lot, within this waterfront land would require consent from NRAR.

As per s4.41(1)(g) of the EP&A Act 1979, a separate CAA is not required for SSDA and this riparian assessment addresses the same issues that would be considered for local development.

A dam dewatering plan is recommended to be prepared prior to the decommissioning of dams 2 – 6 within the development site.

ELA consulted with Jeremy Morice of NRAR in December 2018 with regard to the lack of watercourses on lots 54-57 (via an interim riparian constraints assessment prepared by ELA in December 2018). NRAR agreed with the findings of that report, which concluded that there were no watercourses on Lots 54-57:

> *'As discussed, the Natural Resources Access Regulator (NRAR) has reviewed the Mamre Road Riparian Constraints Report V1 and is in agreement with the findings of the assessment. In particular NRAR agrees that there is no waterfront land on Lots 54-57 and watercourse restoration and riparian setbacks will not be required following removal of the dams'.*
>
> Email from Jeremy Morice, Water Regulation Officer, NRAR, to David Bonjer, Lead Planner NSW, ELA, dated 20 December 2018.

ELA and Mirvac Projects discussed the proposed realignment of the watercourse with Jeremy Morice and Jane Cameron from NRAR on 22 September 2020 in regard to the Masterplan layout (Figure 2). No objections were raised in regard to the layout of the proposed realigned creek.

6. Impact Assessment

The proposed development at Aspect Industrial Estate will involve the removal of the 2nd order watercourse currently located towards the northern part of the site and the construction of a channel at the very northern extent of the site as a replacement waterway (see Figure 22). It will also involve the removal of the five farm dams within the site. The Aspect Industrial Estate Riparian Corridor Concept Plan (AT&L, 4/9/2020, Issue P3) has been used to identify potential impacts to the riparian and aquatic habitat and water quality as a result of the proposed development.

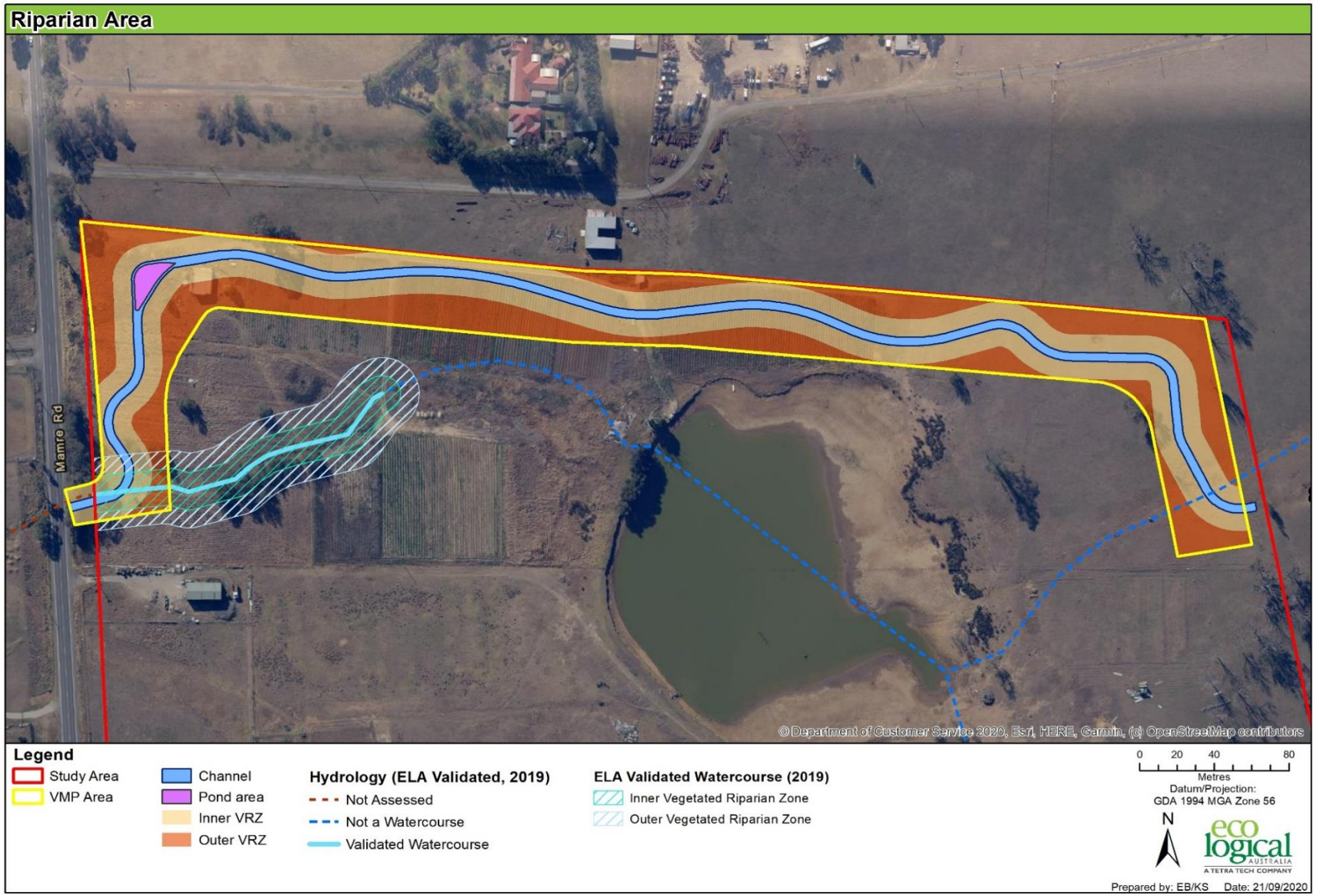

Figure 22: Proposed location of new vegetated channel

6.1 Removal of farm dams

As outlined in section 4.1 and 4.2 of this report, the farm dams within the SSDA are not connected to any watercourses that meet the definition of a 'river' under the WM Act, nor do they appear to be providing good habitat for aquatic fauna due to the lack of instream and fringing vegetation and woody debris. Mitigation measures provided in section 7 of this report outline the process for decommissioning these dams to ensure that there is little, if any, impact to aquatic fauna currently residing in these dams.

6.2 Surface erosion and sedimentation

Any clearing of vegetation or earthworks within the existing riparian zone of watercourse 2A could result in lack of soil stability. This may cause surface erosion (sheet and gully erosion) and transportation of sediment overland into the downstream waterway of South Creek. Impacts may include increased water turbidity, which could harm fish, and disrupt light penetration through the water column and impact on primary (plant) production, with flow on effects through the food web. Increased sediment loads may settle in downstream pools, causing a loss of deep habitat, promotion of dense reeds and changes to hydrologic connectivity. Sediment could also smother naturally rocky areas, resulting in a loss of habitat where macroinvertebrates shelter in the spaces between rocks.

As the main channel of South Creek is located approximately 1.4 km downstream of the development area and the fact that the during both site inspections the water in the channel was not flowing, it is unlikely that any construction activities in the development area would impact on the health and condition of the main South Creek channel.

6.3 Degradation of water quality

There is the potential for sediment and waste material generated as part of the construction activities to enter the waterway. This would increase the turbidity of the water and potentially introduce chemicals to the creek, and ultimately degrading the water quality not only in the immediate works area but also in downstream environments.

6.4 Weed Invasion

Where disturbance from construction associated with the proposed Masterplan results in bare ground or increased sunlight penetration into currently vegetated riparian areas, there is the potential for invasion of exotic flora species. The movement of construction vehicles in and around the riparian area can also act as a vector for weed propagules. Impacts include introduction of new weeds to the area and extended penetration of weeds into native plant communities. This may result in a loss of biodiversity and habitat value, smothering of native juvenile plants, harbouring of feral animals and alteration of vegetation structure and riparian function.

6.5 Polluted Surface Water Runoff

In areas where the proposed development includes the construction of new car parks, roads and other impervious surfaces, there is an increased risk of motor vehicle oils, litter and warmer surface water entering the creek. Subsequent impacts may include water quality issues (heavy metals, oil and grease pollution from vehicles), inorganic clogging of aquatic habitats (litter / rubbish) and destruction of macroinvertebrate communities (warm water inflows). Another impact common in urban areas is when

mass leaf drops from deciduous street trees wash into the creek. Large amounts of non-native leaves deposited in a short period of time create water quality issues during decomposition. These leaves are also not a suitable food resource for macroinvertebrates, which prefer slow-decomposing native leaves that are evenly deposited throughout the year.

6.6 Water Management Act 2000

The proposed vegetated channel construction and removal of the 2nd order watercourse within the development area is not in line with the *Guidelines for Controlled Activities on Waterfront Land* (NRAR, 2018). In this case, the principles of the WM Act can guide activities that are to take place on waterfront land and be used to provide a merit-based assessment of the proposed development.

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

Generally:

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

In relation to controlled activities:

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

The removal of the 2nd order watercourse and construction of a vegetated channel on the northern boundary of the development area allows for a protected, rehabilitated watercourse to be established. In its current state, the 2nd order stream within the development area is devoid of aquatic habitat and lacking in native riparian species apart from a few *C. glauca* trees in one area alongside the bank. As a dedicated waterway managed under a VMP, this vegetated channel will become a protected waterway within the new development area which is a marked improvement on the current position the 2nd order

watercourse is in, as it receives no observable maintenance, contains scattered litter and is not providing any form of habitat connectivity for aquatic or terrestrial fauna.

The construction of the vegetated channel would allow for an improvement in water quality within this tributary of South Creek, as stable bed and banks would be created and the revegetation of the riparian areas would allow for a buffer between the proposed warehouses and the waterway itself. The 2nd order watercourse that is to be removed is currently downstream of informal market gardens, where historical rubbish is buried in the soil and there is no demarcation of the riparian area.

The vegetated channel would allow for the increase in the amount of native vegetation within the development area, which will improve the amenity and habitat values of the area. The current 2nd order watercourse is surrounded predominantly by exotic flora species, whereas the vegetated channel would be fully vegetated with native species and maintained for the period as specified in the VMP prepared for the development area.

The existing 2nd order watercourse is approximately 180 m long and its riparian corridor covers an area of approximately 0.75 ha. The new channel to be constructed would be approximately 800 m in length and the riparian zone would cover an area of approximately 3.33 ha. This increase in channel length and size of riparian area represents a significant increase in the amount of waterfront land within the development area and creates a larger area to be maintained as a vegetated riparian zone and a continuous vegetated corridor, providing the east-west connectivity that was behind the linear E2 zoning within the site.

While the removal of the 2nd order watercourse is a controlled activity, there would be no impacts to other water users downstream, as mitigation measures described below would be incorporated into the design, construction and ongoing management of the site. Mirvac Projects have engaged Cardno to complete flood modelling incorporating the change in Manning's n as a result of the revegetation of the riparian area post development. This work has identified that there would be minimal impact on flood depths and velocity throughout the realigned riparian corridor following dense revegetation of the area.

6.7 State Environmental Planning Policy (Western Sydney Employment Area) 2009

6.7.1 E2 Land zoning

The proposed development of the Aspect Industrial Estate will take place on land recently zoned E2 as part of the SEPP WSEA.

The objectives of land zoned E2 are to protect, manage and restore areas of high ecological, scientific, cultural or aesthetic values. The proposed realignment of the 2nd order watercourse and establishment of a vegetated channel is in accordance with the objectives of the E2 zone. However, the proposed location of this realigned channel and parts of the proposed warehouses are not in line with the location of this zoning; that is, the realigned channel will be outside of some of the area of E2 zone and proposed warehouses are encroaching into the E2 zone in some areas. The realigned channel will be in line with the E2 zoning where it enters and leaves the SSDA site.

There is 2.5 ha of area zoned as E2 within the study area (Figure 6). The proposed new channel will create an area managed for environmental conservation that is 3.33 ha, including a 4.75 m wide channel, which is more than the area of the E2 zone within the Aspect Industrial Estate site.

6.7.2 Part 6 Miscellaneous provisions

Works proposed within watercourses and riparian areas within the site involve the realignment of a 2nd order watercourse and establishment of a vegetated riparian zone. A number of clauses within Part 6 of the SEPP WSEA are relevant to these works.

6.7.2.1 Clause 33H Earthworks

Prior to any earthworks commencing on site, an Erosion and Sediment Control Plan would need to be developed and implemented, to ensure that there is no detrimental impact on environmental functions and processes within the site as well as downstream. This plan would outline where erosion and sediment control measures are to be constructed to prevent mobilisation of soil from the site, particularly within the watercourse, as sediment entering the watercourse (even when dry) has the potential to degrade water quality within the site and downstream.

The proposed watercourse realignment works have been designed with consideration for drainage patterns of the whole site, as well as downstream environments and properties. Therefore, the proposed works are unlikely to disrupt or have a detrimental effect on existing drainage patterns within the site or downstream of the development site.

The realignment of the 2nd order watercourse requires filling of the existing waterway and construction of a new, realigned channel. To ensure that there are no adverse impacts on waterways as a result of the proposed works, the existing watercourse should be used as a clean water diversion channel while works on the new channel are being undertaken. Installation and maintenance of erosion and sediment controls are also required. This would reduce the likelihood of sediment entering the existing watercourse and impacting on water quality.

6.7.2.2 Clause 33I Development on flood prone land

The realignment of the 2nd order watercourse on site will involve construction of an entirely new channel. This provides the opportunity to ensure that the creek bed and banks are constructed with materials that ensure the long-term stability of the channel. This would ensure the long-term stability of the channel bed and banks, which would prevent detrimental impacts on aquatic habitat and water quality.

The existing watercourse on site does not have a fully vegetated riparian corridor. As outlined in Section 4.2, the vegetation alongside the watercourse is predominantly exotic and includes only a few native canopy trees. As part of the realignment of this watercourse, there would be destruction of the existing riparian vegetation. However, revegetation of the entire riparian corridor with fully structed endemic species would take place, which would allow for a better outcome than the existing condition.

6.7.2.3 Clause 33L Stormwater, water quality and water sensitive urban design

The development of the Aspect Industrial Estate will include installation and ongoing maintenance of Water Sensitive Urban Design (WSUD) components such as biofiltration swales. This will ensure that once the development is completed and during the ongoing operation of the Aspect Industrial Estate, stormwater management systems will be integrated into the landscape and allow for improvement of water quality within the site, as stormwater and overland flow originating from the site will be delivered to the watercourse (and ultimately downstream environments) via WSUD features and with an improved water quality when compared to the existing situation.

Realignment of the 2nd order watercourse will allow for instream habitat features (such as pool, riffle and run sequences) to be constructed, ultimately increasing the areas of aquatic habitat within the watercourse, compared to the existing watercourse, where instream habitat features are limited.

While the proposed development will include realignment of the existing watercourse and removal of existing riparian vegetation, it will also allow for an increase in the area of managed riparian vegetation, as the VMP prepared for the site requires the new riparian corridor to be fully vegetated, allowing for rehabilitation and restoration of riparian land. This vegetation will also be maintained over the course of the implementation of the VMP, allowing for continual suppression of exotic species and replacement planting where required.

7. Mitigation Measures

The construction of a new vegetated channel in place of the existing 2nd order stream will be an impact to the existing waterway. However, the current condition of the 2nd order stream is highly degraded, lacking in riparian vegetation in the ground, shrub and canopy layers and contains very little instream habitat. The construction of a vegetated channel in place of the watercourse labelled 2A is likely to cause a net increase in aquatic habitat within the development area

7.1 Construction Environmental Management Plan

A Construction Environmental Management Plan (CEMP) is to be prepared prior to commencement of any construction works to address measures required to be implemented prior to, during and after works to minimise impacts on the environment. This CEMP should include a Sediment and Erosion Control Plan, prepared in accordance with *The Blue Book – Managing Urban Stormwater: Soils and Construction* (Landcom, 2004) and implemented prior to works, with the aim of achieving an outcome of 'no visible turbid plumes migrating through the waterway'. The Plan must include, as a minimum, the locations and type of erosion and sediment controls to be erected within and adjacent to the existing waterway and the new vegetated channel.

7.2 Required features of the new vegetated channel

In order to increase the merits of the new channel and reduce the impact to aquatic fauna within the development area, the vegetated channel is to be designed and constructed with features typically found in a natural watercourse. These features are explained below.

7.2.1 Stable banks

The channel is to be constructed from material that is conducive to the ongoing stability of the waterway. Materials such as sandstone should be used to construct the channel so that the banks remain stable and no excess sediment is contributed to the channel. While erosion and deposition are natural processes within waterways, these processes can be exacerbated in urban areas and altered flow regimes can contribute to degradation of the waterway. It is recommended that rough cut sandstone blocks are used as part of the construction materials as these can create habitat within the bank as well as provide roughness to the channel which will slow down the flow and reduce the chance of erosion within the waterway. The banks of the existing 2nd order watercourse are mainly bare soil, so the use of rough sandstone blocks will ensure stability of the new channel.

Where new stormwater outlets are to be constructed on or in the creek banks, the outlet structures should be designed as per Office of Water's Controlled *Activities on Waterfront Land: Guidelines for outlet structures on waterfront land* (2012). These guidelines aim to ensure that new outlets discharging into a watercourse provide a stable transition from a constructed drainage system to a natural flow regime.

7.2.2 Vegetated riparian zone

The new vegetated channel is to have a riparian zone adjacent to and on both banks of the channel that is planted out with natives which ae diagnostic species of the endangered ecological community, River-flat Eucalypt-forest in all of the vegetative strata. The dense planting will not only provide habitat for

fauna within the area but will also provide additional stability to the banks of the channel and a filter for runoff which may contain excess nutrients. The existing 2nd order watercourse is surrounded by a buffer of predominantly exotic vegetation with limited complexity regarding vegetation structure. The proposed new channel will have native plants in each of the ground, shrub and canopy layers, as well as aquatic macrophytes within the low flow channel and pond. The vegetated riparian zone associated with the new channel will also encompass a larger area than the riparian zone for the existing channel.

7.2.3 Geomorphic Variability

Construction of the vegetated channel needs to also replicate habitat variety and micro-habitats, including riffles, runs, pools, fringing reeds, riparian vegetation, natural shading, variable depths, variable widths, large woody debris and a variety of gravel, pebble, cobble and boulder substrate in order to provide microhabitats for fauna and invertebrates. The proposed riparian corridor incorporates high and low flow channels and proposes to use sandstone boulders and blocks to provide building materials that are sympathetic to the surrounding environment.

7.3 Habitat Restoration and Weed Control

Initial weed control would be required to limit the impact of the widespread weed species that are currently growing onsite. The riparian zones will then require ongoing maintenance to ensure areas remain relatively weed free. The amount of maintenance work will, in part, be dictated by the adjacent land use and associated condition of surrounding land. ELA has prepared a VMP for the site which covers the vegetated channel and dictates the management strategies appropriate for the site.

The first phase of revegetation would include primary weed control which can be achieved through mechanical removal, hand removal and where appropriate, broadscale herbicide application. Creek banks lacking native cover would require revegetation works to provide immediate stabilisation Species to be utilised and the density required are outlined in VMP prepared by ELA (2020). Regular maintenance would be required to continue to control emerging weeds, such as pasture grasses, herbaceous species, aquatic weeds and woody weeds.

7.4 Protection of Water Quality and Habitat Condition

Water quality protection measures are recommended for use where the construction-related activities require:

- Clearing of groundcover (grasses, herbs and shrubs, including exotic species) to bare earth
- Clearing of any native vegetation or mechanical weed removal within the riparian buffer zone
- Construction of any permanent car parks and roads
- Temporary staging areas, compounds and storage areas of oils and chemicals
- Wastewater discharge points, including pumping of groundwater from any below-ground excavation and vehicle wash down bays.

Key protection measures suitable to mitigate the above activities include:

- Gross Pollutant Traps to capture litter from car parks and roads.
- Sediment fences to slow overland flow and trap sediments created from surface erosion.

- Identify opportunities for re-use of water from any on-site dewatering activities site including dust suppression.

Urban design should aim to reduce organic pollutants entering the waterway, such as:

- Use native street trees where leaves may enter the stormwater system. Deciduous trees should only be used if leaf drop is contained within a parkland environment.
- Provide a small buffer between mown lawns in public space and stormwater drains. This aims to reduce grass clippings entering the creek.

7.5 Aquatic Fauna Protection

Aquatic fauna is required to be protected during construction activities, including the decommissioning of the farm dams. In order to ensure that aquatic fauna is protected during the dam decommissioning process, the appointed aquatic ecologist in charge of fauna relocation should possess the following licenses/permits:

- Section 37 *Fisheries Management Act 1994* (for fish), issued by NSW Department of Primary Industries - Fisheries
  Animal Research Authority (for the welfare of all animals), issued by the Secretary's Animal Care & Ethics Committee. This Authority describes permitted euthanasia techniques (e.g. for Redfin Perch and sick or diseased fauna).

The aquatic ecologist is to notify NSW Fisheries of the activity 48 hours prior to fish relocation (unless an agreement is in place), including locations of dewatered and relocation sites.

The dewatering schedule should allow time for fish rescue, especially during the final 0.3 m water depth (to be advised by Aquatic Ecologist). Fauna should be captured in one day, so pumps need to be of adequate size and placed in an area free from mud and debris (e.g. inside excavator bucket or screened sump pit).

Native fish healthy enough for relocation are to be contained and transported in an aerated tub/bucket/tank to an appropriate dam/lake/waterhole/creek. It is recommended that native species are relocated to a nearby dam or creek line with landholder's permission. NSW Fisheries advise that the host location should be large enough to accommodate additional fish, especially predatory eels. If a large number of predatory fish such as *Anguilla reinhardtii* are captured during the aquatic fauna relocation process, an additional release point may be required.

8. Conclusion

In ELA's professional opinion, the mapped waterway labelled 1A within the development site did not meet the definition of a 'river' under the WM Act and therefore the dams along this waterway can likely be removed without the need for consent under the WM Act. The condition of the riparian and aquatic habitat within the existing channel labelled 2A that does meet the definition of a 'river' under the WM Act is poor, with steep banks, exotic ground covers dominating the riparian areas and very little instream woody debris.

The vegetated channel that is to be constructed as part of the proposed development within the Aspect Industrial Estate is to be vegetated along both banks with native vegetation in all strata, ensuring that a densely vegetated riparian buffer is created. While the location of this channel is not in the same position as the current 2nd order watercourse, this vegetated area is likely to be a vast improvement on the existing riparian vegetation alongside watercourse 2A in regard to the dominance of native vegetation of the riparian zone and the habitat features available to aquatic and terrestrial fauna.

The current length of the section of watercourse 2A that meets the definition of a 'river' under the WM Act is 180 m. The length of the proposed vegetated channel is 800 m, therefore creating a longer watercourse than is currently within the development area. The existing 2nd order watercourse to be realigned has a riparian area of 0.75 ha. The new channel will have a total riparian area of 3.33 ha, comprised of a 4.75 m wide channel that occupies an area of 0.41 ha, an inner Vegetated Riparian Zone of approximately 1.58 ha and an outer Vegetated Riparian Zone of approximately 1.34 ha.

The vegetated channel will also incorporate instream woody debris to create instream aquatic habitat, have a range of different surfaces along the bed and banks of the channel to create different geomorphic features such as pools and riffles during high flow events and be maintained under a VMP for a period of five years to ensure that the vegetation is not dominated by exotic species. The proposed construction of the vegetated channel meets the objectives of the WM Act, in that the watercourse (including geomorphic variability) is to be restored and aquatic habitat is to be created.

9. References

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