MAJOR ROAD PROJECTS VICTORIA

JULY 2020

TECHNICAL REPORT L – SURFACE WATER IMPACT ASSESSMENT

YAN YEAN ROAD UPGRADE - STAGE 2: KURRAK ROAD TO BRIDGE INN ROAD

Report No: 2135645A-N-32-WAT-REP-0001 REV00

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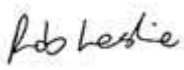
Technical Report L – Surface Water Impact Assessment
Yan Yean Road Upgrade - Stage 2: Kurrak Road to Bridge Inn Road

Major Road Projects Victoria

WSP
Level 15, 28 Freshwater Place
Southbank VIC 3006

Tel: +61 3 9861 1111
Fax: +61 3 9861 1144
wsp.com

REV	DATE	DETAILS
00	15/07/2020	Updated to address TRG comments

	NAME	DATE	SIGNATURE
Prepared by:	Louise McGinley / Leigh Doeleman	15/07/2020	
Reviewed by:	Rob Leslie	15/07/2020	
Approved by:	Jay Knight	15/07/2020	

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ABBREVIATIONS

AEP	Annual Exceedance Probability
AGRD	Austroads Guide to Road Design
ANZECC	Australian and New Zealand Environment and Conservation Council
ARI	Average Recurrence Interval
ARR	Australian Rainfall and Runoff
BPEMG	Best Practice Environmental Management Guidelines
CaLP Act	Catchment and Land Protection Act 1994
CEMP	Construction Environmental Management Plan
CMA	Catchment Management Authority
DELWP	Department of Environment, Land, Water and Planning
DS	Drainage Scheme
DSS	Development Services Scheme
EES	Environment Effects Statement
EMF	Environmental Management Framework
EPA	Environment Protection Authority
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
EPR	Environmental Performance Requirement
ERA	Environmental risk assessment
FO	Floodway Overlay
ISC	Index of Stream Condition
LSIO	Land Subject to Inundation Overlay
MNES	Matters of National Environmental Significance
MRPV	Major Road Projects Victoria
MUSIC	Model for Urban Stormwater Improvement Conceptualisation
NEC matters	matters of National Environmental Significance
NTU	Nephelometric Turbidity Units
RFO	Rural Floodway Overlay
SBO	Special Building Overlay
SEPP (Waters)	State Environment Protection Policy (Waters)
SWIA	Surface Water Impact Assessment

TSS	Total suspended solids
TP	Total Phosphorus
TN	Total Nitrogen
µg/L	Microgram per litre
µS/cm	micro Siemens per cm
VPP	Victoria Planning Provisions
WSRD	Water Sensitive Road Design

EXECUTIVE SUMMARY

PROJECT DESCRIPTION

This report provides an assessment of the surface water impact assessment (SWIA) of the *Yan Yean Road Upgrade – Stage 2* (the Project). It covers the flooding, drainage and water quality components of water environments. The proponent for the Project is Major Road Projects Victoria (MRPV).

The Project is located approximately 25 km north-east from Melbourne's CBD and runs from Kurrak Road in Yarrambat to Bridge Inn Road in Doreen. The Project is the proposed duplication from two lanes to four lanes of a 5.5 km portion of Yan Yean Road from Kurrak Road in Yarrambat to Bridge Inn Road in Doreen. Each lane of the road will be 3.5 m wide and with the majority of the Project using a 2.2 m wide centre median.

Construction will include:

- two new roundabouts (at Heard Avenue and Youngs Road)
- five new signalised intersections (Bannons Lane, Jorgensen Avenue, North Oatlands, Orchard and Bridge Inn Roads)
- upgrades to one existing signalised intersection, including an additional right hand turning lane, slip lane, and traffic island (Ironbark Road)
- new street lighting at all intersections, road signage and landscaping.

EXISTING CONDITIONS

According to Melbourne Water's 2018 Healthy Waterways strategy, the Project is located in the Yarra catchment. The strategy refers to the co-designed catchment program for a flexible framework for managing waterways in the Yarra catchment. This program locates the Project in the Plenty River Lower Sub-catchment. The performance objectives for this sub-catchment include increasing access and participation rates of local users, mitigation of threats from urbanisation, prevention of decline in stormwater condition and increased instream connectivity.

The Project does not intersect with any named waterways, although two tributaries of the Plenty River are in close proximity.

The northern portion of the Project intersects the Doreen Drainage Scheme (DS) boundary, although no DS works are proposed within the Project boundary.

The water sensitive receptors identified in this SWIA include:

- Vaucluse Wetland at Orchards Road (Melbourne Water asset)
- Nillumbik Shire Council wetland (at Youngs Road and Yan Yean Road junction)
- Yarrambat Lake (west of Bannons Lane and Yan Yean Road junction).

Anticipated works as part of the Project have the potential to impact surface water. This includes:

- the duplication of Yan Yean Road and works on transverse drainage culverts have the potential to increase upstream flood levels
- the road duplication and new shared paths will increase the impervious areas leading to increased runoff rates and pollutant loads.

ENVIRONMENTAL RISK ASSESSMENT

The environmental risk assessment determined that all residual risks are 'low' on the presumption the proposed Environmental Performance Requirements (EPRs) are implemented. EPRs include, but are not limited to, the preparation of a 3D drainage model and spills risk assessment that complies with Melbourne Water/BPEMG stormwater quality and conveyance targets.

CONSTRUCTION IMPACTS

Construction works for the Project should comply with relevant Environment Protection Authority Victoria (EPA) publications and guidance documents. A Construction Environmental Management Plan (CEMP) will be prepared and implemented for the Project in accordance with the EPRs and Environmental Management Framework (EMF). The CEMP should outline how the contractor will comply with any environmental conditions for the Project and provide a framework to ensure that environmental risks are properly managed.

OPERATIONAL IMPACTS

Stormwater quality, drainage and flood risk impact assessment modelling was undertaken for the Project alignment. Where the design has progressed since the modelling was undertaken, a qualitative impact assessment was completed. This method is considered appropriate given the current design stage.

A transverse drainage impact assessment for the Project identified changes to catchment drainage, flooding behaviour and management of stormwater runoff generated from the Project. The assessment of the proposed transverse drainage mitigated upstream afflux impacts for the 1% Annual Exceedance Probability (AEP) plus climate change and quantified the flood immunity of the Project.

Assessment of changes to outfall flow rates, peak water levels and potential detention requirements was carried out for a range of AEP events based on Council and Melbourne Water guidelines and project advice. This assessment included quantifying the increase in peak flow rates and the impact on the receiving environment and/or drainage pipe network. A summary of this assessment is presented in Table 7.1. Suggested environmental performance requirements and further consultation with authorities and asset owners is recommended during detail design.

Stormwater runoff will be managed using Water Sensitive Road Design (WSRD) elements. The Project currently allows for a total swale length of 5,130 metres. Whilst the swales achieve the objectives for the Project as a whole, a targeted approach for the local catchments of the sensitive receptors was carried out. To maintain the beneficial use of Yarrambat Lake, a 50 m² bio-retention basin is proposed at the outfall.

A high-level qualitative assessment of flood impacts for the Yan Yean/Bridge Inn/Doctors Gully Road intersection was undertaken. In general, increases to flood levels (afflux) upstream of transverse crossings and at outlets are not anticipated to be significant and can be managed through appropriate design of transverse drainage infrastructure at the next design phase.

It is anticipated stormwater quality impacts from the increase in impervious areas at the Plenty Valley Christian College carpark can be managed through detailed design of the carpark drainage system. The Yan Yean/Bridge Inn/Doctors Gully Road intersection design is not developed to functional design and currently does not include water quality management measures such as treatment swales. At the next design stage, WSRD measures to achieve compliance with Melbourne Water/Best Practice Environmental Management Guidelines (BPEMG) stormwater quality targets are to be incorporated into the Yan Yean/Bridge Inn/Doctors Gully Road intersection design.

ENVIRONMENTAL PERFORMANCE REQUIREMENTS

Based on this surface water impact assessment and in addition to standard controls, recommended EPRs include:

- SW1 – Mitigation measures to inform the CEMP to manage surface water in accordance with the relevant water objectives set out in the State Environment Protection Policy (Waters), Melbourne Water Performance Criteria and other relevant statutory requirements.
- SW2 – Measures to mitigate changes to the hydrologic and/or hydraulic regime of waterways and stormwater risks.

1 INTRODUCTION

Major Road Projects Victoria (MRPV) proposes to duplicate Yan Yean Road from Kurrak Road to Bridge Inn Road as part of the Yan Yean Road Upgrade – Stage 2 (the Project).

On 14 October 2018, the Minister for Planning decided that an Environment Effects Statement (EES) is required under the *Environment Effects Act 1978* to assess the potential environmental effects of the Project. The EES process provides for identification and analysis of the potential environment effects of the Project and the means of avoiding, minimising and managing adverse effects. It includes public involvement and allows stakeholders to understand the likely environmental effects of the Project and how they will be managed.

This surface water impact assessment report has been prepared for the EES in accordance with the Scoping Requirements released by the Minister for Planning in June 2019.

1.1 BACKGROUND

Yan Yean Road is a primary north-south arterial road and connects the growth suburb of Doreen, with major east west arterials such as Bridge Inn Road, Kurrak Road and Diamond Creek Road. The road runs through the townships of Yarrambat and Plenty and connects with established areas of Diamond Creek and Greensborough. There is a high demand for north-south travel from Doreen and surrounding towns to established northern suburbs for employment and services.

Stage 1 of the Yan Yean Road upgrade (Diamond Creek Road to Kurrak Road) was completed in 2019, and construction of Stage 2 (this Project) is due to be completed in 2025.

1.2 PROJECT DESCRIPTION

The Project would duplicate a 5.5 km portion of Yan Yean Road between Kurrak Road and Bridge Inn Road increasing the existing two lanes to four lanes (comprising two lanes in each direction). The design speed along Yan Yean Road is 70 km/h, with the exception of north of Bridge Inn Road which is 80 km/h. The design for the Project has 3.5 metre wide lanes with the majority of the Project using a 2.2 metre-wide central median. This cross section was adopted in design due to various constraints ranging from road safety issues, steep and rolling terrain, high cut and fill batters and subsequent retaining walls at certain locations, as well as seeking to limit impacts to existing properties, local accesses and trees along Yan Yean Road.

The Project will include:

- two new roundabouts (at Heard Avenue and Youngs Road)
- five new signalised intersections (Bannons Lane, Jorgensen Avenue, North Oatlands, Orchard and Bridge Inn Roads)
- upgrades to one existing signalised intersection, including an additional right hand turning lane, slip lane, and traffic island (Ironbark Road)
- new street lighting at all intersections, road signage and landscaping.

The Project will also include a new 3 metre wide shared user path on the western side and 1.2 metre wide footpath on the eastern side of Yan Yean Road. The paths links Diamond Creek to Doreen and would improve safety and connectivity for pedestrians and cyclists.

Continuous safety barriers would run along the Project's length and are proposed in the median and behind outer kerbs along the mid-block sections of the carriageways.

The project area and key project components are shown in Figure 1.1. The extended project description is presented in Appendix G.

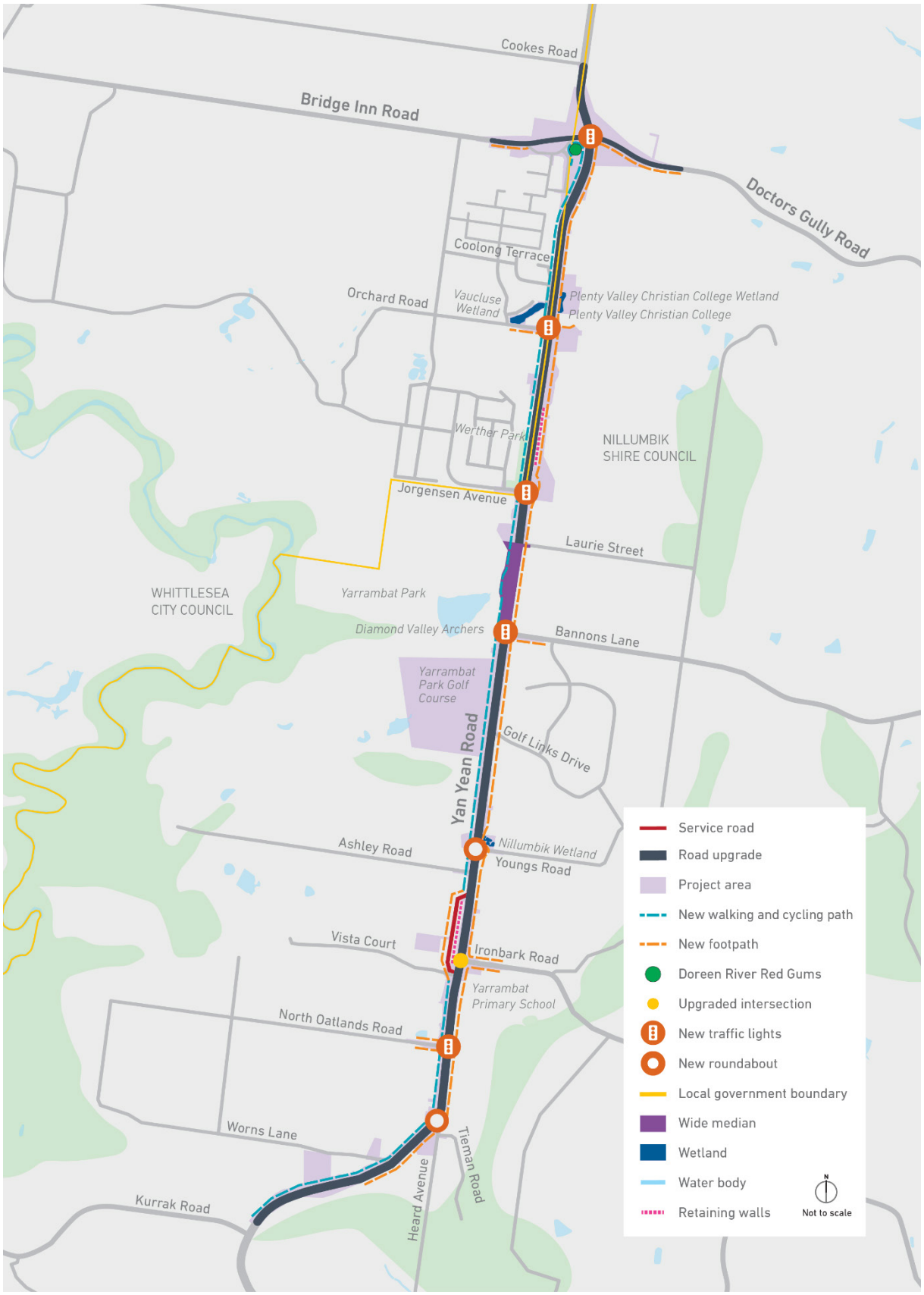
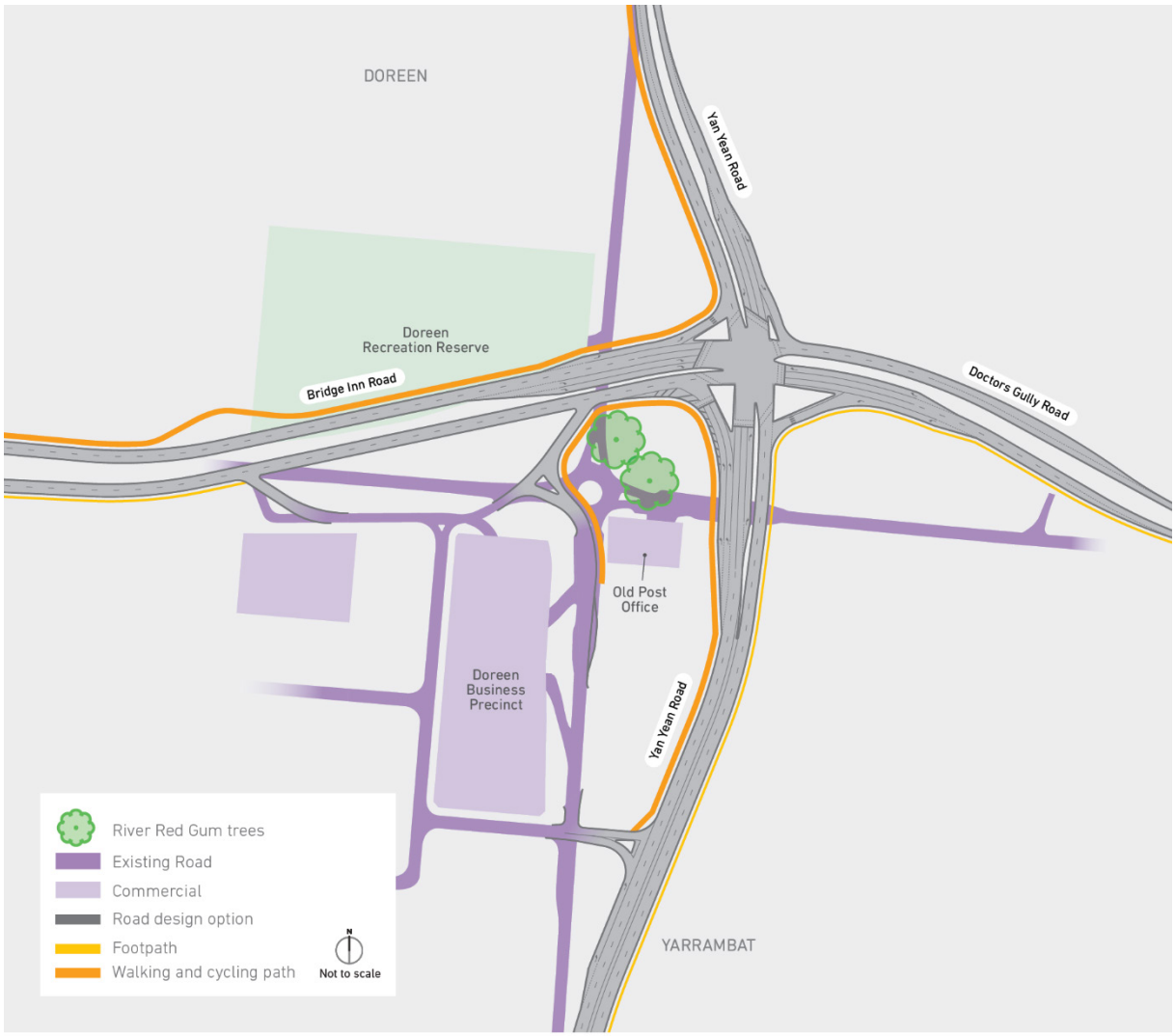


Figure 1.1 Project area

1.2.1 YAN YEAN / BRIDGE INN / DOCTORS GULLY ROAD INTERSECTION

The Yan Yean/Bridge Inn/Doctors Gully Road intersection has been designed to retain the two Doreen River Red Gums, General Store and Pet Supply/Stockfeed business situated adjacent to the current Doctors Gully and Yan Yean Road intersection by shifting the whole intersection to the north east (see Figure 1.2). This intersection design has been developed following community consultation and in response to arboricultural advice on the Doreen River Red Gums.



For illustrative purposes only and subject to change

Figure 1.2 Bridge Inn Road intersection design

1.2.2 CONSTRUCTION ACTIVITIES

Proposed construction activities would likely be standard road construction activities to be undertaken in accordance with the Environmental Performance Requirements for the Project. These construction activities would include:

- tree clearance and vegetation lopping and removal
- establishment of construction site compounds
- clearing and grubbing, temporary sediment and erosion control works
- establishment of environmental and traffic controls
- earthworks, including:
  - remediation of any existing contamination and removal of any hazardous material
  - protecting and relocating services
  - widening of existing rock cuttings (approximately 750 m of existing cut along the Project would be widened by approximately 20 metres)
  - new cuttings (approximately 1300 m of new rock cut would be required to a width of approximately 5 metres along the Project)
  - bulk earthworks and haulage
- civil and structure works, including:
  - roundabouts and intersection upgrades
  - shared user path and pedestrian path construction and connections
  - retaining walls
  - drainage works
  - pavement works
- 30–36 metre high fence along the edge of the Yarrambat Park Golf Course to avoid golf ball collisions with pedestrians, cyclists or vehicles
- traffic management systems and landscaping.

1.3 PROJECT OBJECTIVES

The Project aims to improve travel times and reliability to and from growing residential areas in Doreen and Mernda, enhance north-south travel in the area, and improve safety along the corridor. The objectives of the Project are set out below:

- **To improve road safety**: The Project will achieve this by isolating road users from hazards and improving access control through signalised intersections. Congestion and the complex road environment (poor sight lines due to undulating linear/perpendicular grades and adjacent terrain) are presently contributing to the poor safety record on Yan Yean Road.
- **To improve the customer experience**: The Project will achieve this by improving access, improving network connectivity, opportunities for active transport, and providing more road capacity.
- **To improve network efficiency**: The Project will achieve improved traffic flow and a reduction in travel times by increasing road capacity and reducing congestion.
- **To maintain environmental and amenity values**: The Project will achieve this by managing environmental effects to acceptable levels and ensuring that impacts are avoided, minimised and mitigated to the extent practicable.

2 SCOPING REQUIREMENTS

The *Scoping Requirements for Yan Yean Road (Stage 2) Upgrade Environment Effects Statement* (June 2019) have been prepared by the Department of Environment, Land, Water and Planning (DELWP) on behalf of the Minister for Planning. The Scoping Requirements set out the specific environmental matters to be investigated and documented in the EES, which informs the scope of the EES technical studies.

The following matters of the Scoping Requirements are relevant to the surface water impact assessment:

Draft evaluation objective

> *Management measures proposed in the EES to address specific issues, including commitments to mitigate adverse effects and enhance environmental outcomes should be clearly described in the Environmental Management Framework (EMF). The EMF should describe proposed objectives, indicators and monitoring requirements, including for (but not limited to) managing or addressing:*
>
> – *surface runoff, flood potential and groundwater.*

The EMF will outline how potential adverse effects on surface water will be avoided, minimised or mitigated. A separate groundwater impact assessment has been prepared for this EES, refer to EES *Technical Report J Groundwater Impact Assessment (Arcadis 2020)*.

Key issues

> *Potential impacts to MNES through erosion, sedimentation and contamination of watercourses and groundwater near and downstream from the Project site resulting from the construction and operation of the Project.*

The above key issue refers to the interaction between surface water and potential impacts to identified Matters of National Environmental Significance (MNES). A separate biodiversity impact assessment has been prepared for this EES, refer to EES *Technical Report B2: Biodiversity Impact Assessment*.

This surface water impact assessment (SWIA) presents the flooding, drainage and water quality impacts from the Project on the water environment. The interaction of surface water and biodiversity was also considered in this assessment, which includes a qualitative desktop assessment, a transverse drainage model and water quality model.

The outcomes from this SWIA will inform the assessment of the Project through the EES and the detailed design project phase.

3 METHODOLOGY

3.1 STUDY AREA

The study area for the surface water impact assessment includes the new road impervious area, cross drainage catchments and surface water receptors (including sensitive flora and fauna habitats, Melbourne Water / Council assets and private properties) located upstream and downstream of the Project.

3.2 EXISTING CONDITIONS ASSESSMENT

The existing catchments/sub-catchments, key flow paths and floodplains that interact with the Project are defined and presented in Section 5.

The existing catchment condition has been assessed based on a review of available information and stakeholder review comments.

3.2.1 AVAILABLE INFORMATION

Available information relevant to surface water on the Project includes:

- available water quality reports
- aerial photography
- topographic data (1 m interval LiDAR contour data)
- MRPV feature survey (reference: A009647-32-SV00-XRF-FS01.dgn, AA009647-32-SV00-XRF-FS02.dgn)
- GIS drainage infrastructure data of waterway, channel, underground pipe, water body, wetland and other drainage infrastructure (SiteMap)
- design drawings of Nillumbik Shire Council wetland
- drainage scheme (DS) information
- planning scheme overlays (e.g. LSIO, SBO)
- reference road design (supplied by Arcadis)
- project boundaries (SiteMap)
- available hydrologic data (sourced from Bureau of Meteorology and Australian Rainfall and Runoff (ARR) data hub).

Surface Water Overview Maps, showing some of the above information, are provided in Appendix A.

3.2.2 PREVIOUS STUDIES

No previous relevant studies to surface water, including hydrologic or hydraulic models, are available for the Project.

3.3 RISK ASSESSMENT

An environmental risk assessment (ERA) has been completed to identify environmental impacts associated with construction and operation of the Project. The risk-based approach is shown in Figure 3.1 is integral to the EES as required by Sections 3.1 and 4 of the Scoping Requirements and the *Ministerial guidelines for assessment of the environmental effects under the Environment Effects Act 1978*. The surface water risk register is provided at Appendix F and the key impacts are presented in Section 6.

Primary environmental impact pathways were identified for surface water and initial risk ratings were assessed by considering likelihood and consequence categories (Table 3.2 and Table 3.4) and applying the risk significance matrix (Table 3.1). The initial risk ratings were assessed assuming the implementation of standard controls. Standard controls include compliance with legislative requirements and best practice requirements typically incorporated into the construction contracts for the delivery of road projects. The standard controls do not include any project-specific controls or requirements.

Environmental Performance Requirements (EPRs) have been informed by the ERA, to set the minimum outcomes necessary to avoid, mitigate or manage environmental impacts and reduce environmental risks during delivery of the Project. The development of the proposed EPRs was an iterative process with input from the technical specialists and MRPV. Section 8 provides further detail of the specific EPRs developed for surface water.

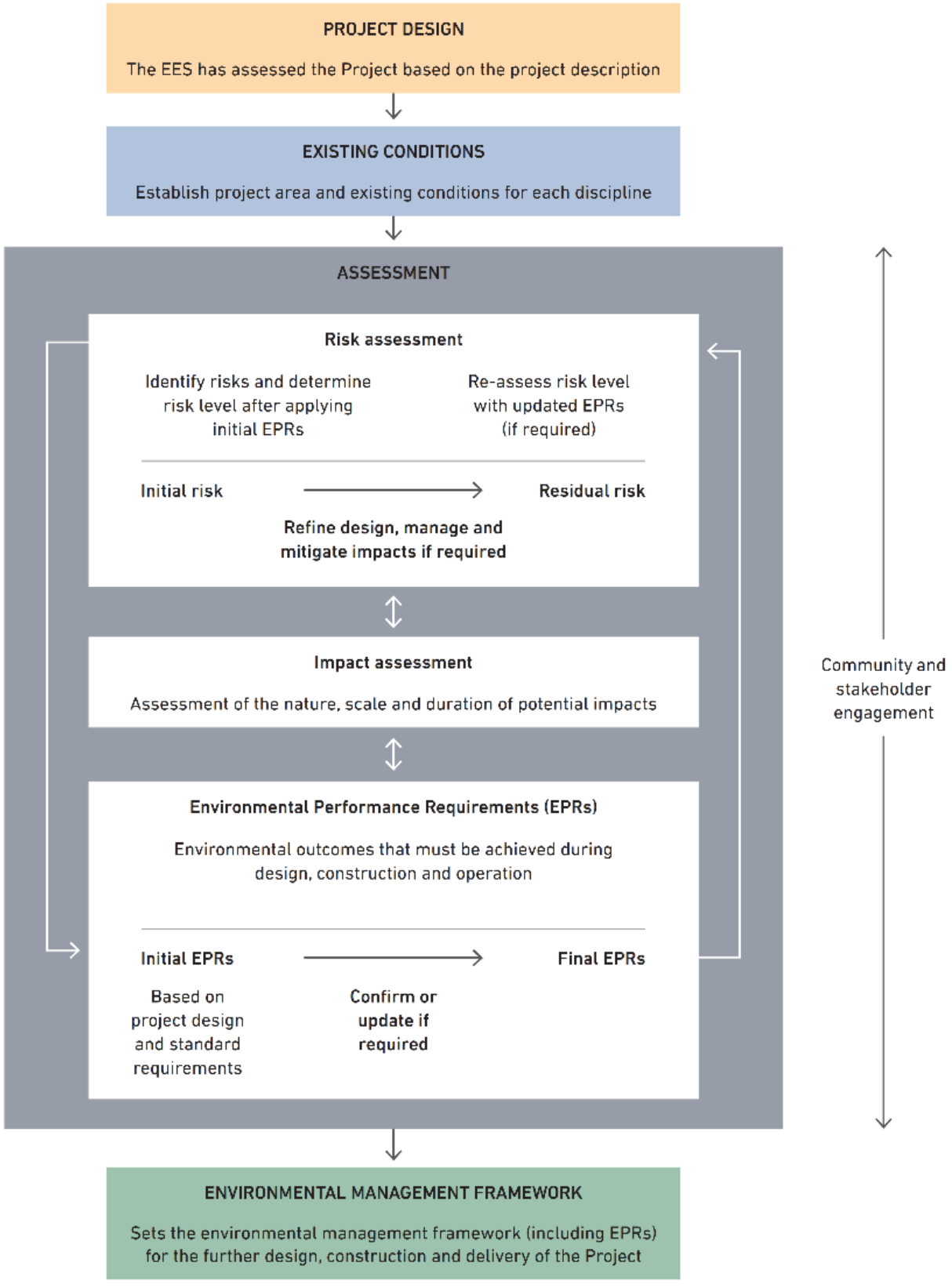


Figure 3.1 Environmental risk process

3.3.1 RISK ASSESSMENT PROCESS

The ERA has guided the environmental studies for the Project. The objectives of the ERA are to:

- identify primary environmental risks that relate to the construction and operation of the Project
- guide the level and extent of investigation and data gathering necessary for accurately characterising the existing environment and assessing the Project's environmental effects
- help identify performance requirements to avoid, minimise and mitigate environmental risks
- inform assessment of likely residual effects that are expected to be experienced after standard controls and proposed EPRs have been implemented.

The risk assessment process for the EES incorporates risk management requirements as detailed in MRPV's Environmental Risk Management Guidelines. The process includes:

- an approach to environmental management which is aligned with *ISO 31000 Risk Management – Principles and Guidelines Systems*
- systems used to manage environmental risk and protect the environment, and how these are implemented at different stages of road construction, operation and maintenance
- tools and reporting requirements which provide guidance in managing environmental issues throughout the Project.

The ERA identifies impact events for each relevant element of the environment, details the primary risks and has informed the level and range of technical reporting required to address predicted impacts. The ERA utilises a risk matrix approach where likelihood and consequence of an event occurring are considered (Table 3.1, Table 3.2, Table 3.3 and Table 3.4). Throughout the preparation of the EES, the likelihood and consequence categories were updated to ensure currency, as required.

Table 3.1 Risk significance matrix

LIKELIHOOD	CONSEQUENCE LEVEL				
	Insignificant	Minor	Moderate	Major	Critical
Almost Certain	Medium	Significant	High	High	High
Likely	Medium	Medium	Significant	High	High
Possible	Low	Medium	Medium	Significant	High
Unlikely	Low	Low	Medium	Medium	Significant
Rare	Low	Low	Low	Medium	Medium

Likelihood and generic consequence criteria, informed by the MRPV corporate risk matrix, are shown in Table 3.2 and Table 3.3 and Table 3.4.

Risk ratings were then reassessed following risk evaluation and risk treatment to generate a 'residual' risk rating. Both initial and residual risk ratings are documented in the risk register attached in Appendix F.

Table 3.2 Likelihood categories

LIKELIHOOD	DESCRIPTION
Almost certain	76-99% Has occurred before and is expected to occur again. Is expected to occur each year or more frequently. All of the controls associated with the risk are extremely weak/non-existent. Without control improvement there is almost no doubt that the risk will eventuate.
Likely	51-75% Has occurred before with a chance of it occurring again. Has occurred several times at the Department, Group, Division, Program or Project before. The majority of the controls associated with the risk are weak. Without control improvement it is more likely than not that the risk will eventuate.
Possible	26-50% Has occurred before with a chance of occurring again. Has occurred at the Department, Group, Division, Program or Project once before. There are some controls that need improvement, however unless there is improvement the risk may eventuate.
Unlikely	6-25% Has occurred elsewhere before, therefore a small chance of occurring. The majority of controls are strong with no control gaps. The strength of this control environment means that is likely that the risk eventuating would be caused by external factors not known to the organisation.
Rare	0-5% Has never occurred but may occur. Is expected to occur 1/100 or more years. All controls are strong with no control gaps. The strength of this control environment means that if this risk eventuated, it is most likely as a result of external circumstances outside of the control of the organisation.

Table 3.3 Generic consequence criteria

CONSEQUENCE	DESCRIPTION
Critical	A critical degree of impact on an environmental asset, value or use of moderate or higher significance.
Major	A high degree of impact on an environmental asset, value or use of moderate or higher significance.
Moderate	A moderate degree of impact on an environmental asset, value or use of moderate or higher significance.
Minor	A low degree of impact on an environmental asset, value or use.
Insignificant	A very low degree of impact on an environmental asset, value or use.

The scoring of likelihood considers historical occurrence of similar events (e.g. has the impact occurred on similar projects), the frequency of exposure to the risk and site-specific project knowledge.

Consequence categories for surface water have been developed in consultation with technical specialists to define what would be considered an Insignificant, Minor, Moderate, Major and Critical consequence associated with a risk event and are set out in Table 3.4.

Table 3.4 Surface water consequences categories

ASPECT	INSIGNIFICANT	MINOR	MODERATE	MAJOR	CRITICAL
Surface water	Negligible change to river health, waterway or floodplain function.	Changes to river health, waterway or floodplain function with minor implications.	Changes to river health, waterway or floodplain function with moderate implications.	River health, waterway or floodplain function significantly compromised.	Extensive impact and river health, waterway or floodplain function irreversibly disturbed.

3.4 IMPACT ASSESSMENT

The SWIA covers potential surface water impacts during both construction and operational phases, including:

- changes to flooding conditions such as frequency and duration of flooding, increases in flood levels or flow velocities
- reduction of floodplain storage or other changes to flow regimes leading to increases in peak flows or floodwater volumes
- discharge of polluted water
- interface of the Project on existing and future drainage assets.

Stormwater quality, drainage and flood risk impact assessment modelling was undertaken for the Project throughout late 2019. Where the design has progressed at the Yan Yean/Bridge Inn/Doctors Gully Road intersection since the modelling was undertaken, a qualitative impact assessment was completed. This method is considered appropriate given the current design stage.

The following design updates have been made since the completion of the surface water modelling relevant to this surface water impact assessment:

- The inclusion of a new roundabout at Youngs Road. The new roundabout has reduced the extent of the road and embankment footprint at the Nillumbik Shire Council wetland.
- Plenty Valley Christian College carpark and dam are included in the project area. The Project includes re-surfacing and newly sealed areas at the carpark. The school dam is included in the project area to allow for safer construction access should dam modifications be required at the next design stage.
- Nillumbik Shire Council pond at Worns Lane is included in project area. The capacity of the existing Nillumbik Shire Council drainage network at Worns Lane is not confirmed and at the next design stage the Project may investigate using this pond for stormwater detention.
- Vaucluse wetland is included in the project area. No modifications or projects works are proposed at the wetland. By including the wetland within the project area, the Project has access to the wetland to apply construction controls and water quality monitoring at the wetland.
- Nillumbik Shire Council wetland is included in the project area. No modifications or projects works are proposed at the wetland cells. By including the wetland within the project area, the Project has access to the wetland to apply construction controls and water quality monitoring at the wetland.
- Yarrambat Park Public Golf Course is included in the project area. The golf course was included to facilitate the installation of fencing at the golf course/Yan Yean Road boundary.

Additional feature survey information has not been provided for the surface water assets within the updated project area. At Plenty Valley Christian College carpark, additional feature survey, confirmation of the existing carpark drainage arrangement and proposed carpark levels have not been provided. However, most of the proposed carpark works will comprise re-surfacing of existing sealed carpark and newly sealed areas. Based on the information provided, a qualitative assessment of changes to the Project since the surface water modelling was carried out.

3.4.1 CONSTRUCTION PHASE

A summary of State Environment Protection Policy (Waters) (SEPP (Waters)) and Melbourne Water construction phase performance criteria is presented in Section 4.2.1.3 and 3.6.1.1 respectively.

3.4.2 OPERATIONAL PHASE

3.4.2.1 STORMWATER QUALITY ASSESSMENT

Increases to impervious areas, due to road duplication, will increase the stormwater pollutant loads from roads within the project area.

A summary of SEPP (Waters) beneficial uses for the Project, flooding and urban runoff criteria is presented in Section 4.2.1.

Water sensitive road design (WSRD) considering the principles outlined in the MRPV Integrated Water Management Guidelines Designing with Water and Melbourne Water requirements to meet the SEPP (Waters) for urban stormwater runoff was applied to the drainage design.

Best practice is defined in the SEPP (Waters) as "*the best combination of techniques, methods, processes or technology used in an industry sector or activity that demonstrably minimises the environmental impact of that industry sector or activity.*" This approach requires the Project to demonstrate that the new impervious surfaces will meet the best practice performance objectives and process outlined in Urban Stormwater Best Practice Environmental Management Guidelines (BPEMG) (Victorian Stormwater Committee 1999). The performance criteria for stormwater quality and flow regime impacts, as per Urban Stormwater BPEMG are summarised in Table 4.5.

WSRD APPROACH

The Melbourne Water Stormwater Quality Performance Criteria for the Project provides a hierarchy of stormwater treatment measures to be implemented by the projects, refer to Appendix B. In order or preference, these are:

- treat at source
- treat close-by
- treat in the wider catchment
- treat in a separate catchment
- a combination of the above
- offset contributions.

MODELLING APPROACH

Model for Urban Stormwater Improvement Conceptualisation (MUSIC) modelling software can simulate the quantity and quality of runoff from catchments ranging in size and the effect of a wide range of treatment measures on the quantity and quality of runoff downstream.

A MUSIC model was used to determine the stormwater pollutant source loads from the existing and new impervious areas within the road drainage outfall catchments. MUSIC was then used to model at-source WSRD treatment elements and calculate if the required pollutant reduction targets are met for the new impervious surfaces.

3.4.2.2 DRAINAGE FLOODING AND FLOW REGIME IMPACT ASSESSMENT

A summary of SEPP (Waters) management and protection of beneficial uses of floodplains criteria is presented in Section 4.2.1.3. Local Authority requirements for the management of stormwater is presented in Section 3.6.2.

The operational phase SWIA includes a drainage impact assessment. The scope of works for the drainage impact assessment includes:

- review of existing information and assessment of existing transverse drainage and outfalls. This assessment identified if flow bypassing of these existing systems were occurring and if Yan Yean Road is impacted by flooding for the 2% Annual Exceedance Probability (AEP) event

- assessment of proposed transverse drainage conditions including upstream afflux and flood immunity of the proposed design and outfall locations
- estimate of detention requirements at each outfall location based on initial advice provided by Councils
- an assessment of changes to flow at key locations downstream of the Project for the 20% AEP and 1% AEP plus climate change
- maps showing drainage flow paths, outfalls and catchment areas.

MODELLING APPROACH

XPSWMM 1D modelling software package was used to estimate existing drainage conditions (i.e. peak flood levels and flows) for transverse drainage crossings, using ARR2016/19 methodology.

A Design Case XPSWMM model was created based on the existing drainage model with the following key changes:

- increasing the impervious area of sub-catchments to represent the Project
- updating road catchments and outfall locations based on the Project.

3.5 LIMITATIONS AND ASSUMPTION

The following limitations apply to this SWIA:

- The transverse drainage hydrologic and hydraulic model is based on the road design supplied by Arcadis (dated July 2019). Where the design has progressed since the modelling was undertaken, a qualitative impact assessment was completed.
- The MUSIC water quality model is based on the road design supplied by Arcadis (dated July 2019). Where the design has progressed since the modelling was undertaken, a qualitative impact assessment was completed.
- Road catchments were delineated based on the supplied functional road design and outfall locations identified. The detail design of the kerb and channel system to collect runoff from the road surface was not carried out at this EES stage.
- The relevant Council should be consulted during detailed design to confirm capacity and connections of outfalls to major and minor drainage systems (e.g. council underground pipes).
- Third party approvals and permits (from all authorities and council) were not sought at this stage.
- Community engagement was not carried out.

3.6 STAKEHOLDER ENGAGEMENT

Stakeholder engagement specific to surface water has been limited to consultation with Melbourne Water, Nillumbik Shire Council and Whittlesea City Council.

3.6.1 MELBOURNE WATER REQUIREMENTS

The Project is located within the Port Phillip and Westernport Catchment Management Authority (CMA) region. Under the *Water Act 1989*, the designated waterways, regional drainage and floodplain management authority for the Port Phillip and Westernport catchment region is Melbourne Water Corporation (MWC).

Melbourne Water has provided the following document, provided in Appendix B:

- Performance Criteria for Stormwater Quality Treatment and Management.

A key Melbourne Water requirement is that there shall be no adverse flood impacts because of the Project for a range of events up to and including the '1% Annual Exceedance Probability (AEP) plus climate change' flood event. Melbourne Water has noted they do not have transverse drainage assets on Yan Yean Road.

The Melbourne Water Shared Pathways Guidelines outline a standardised approach to design, construction, upgrade and maintenance of paths along waterways. A key requirement is that paths should be located above the 10% AEP event.

The Melbourne Water Standards for Infrastructure Projects in Flood-Prone Areas (2018) require flow attenuation structures, such as retarding basins, or similar mitigation works to be undertaken where catchment imperviousness is to be increased. If filling of the floodplain is to occur, at minimum an equal offset is required to maintain floodplain storage.

3.6.1.1 CONSTRUCTION PHASE REQUIREMENTS

A key Melbourne Water waterway and floodplain management requirement for construction phase is to submit documentation for Melbourne Water's review and comment prior to construction. The submission to Melbourne Water should include:

- asset protection plan
- quality management plan
- safety and environmental management plan
- design plans and modelling to demonstrate minimum flood impacts as a result of temporary works
- waterways or floodways are to be reinstated after construction.

3.6.2 COUNCIL REQUIREMENTS

The Project is located within the Nillumbik Shire Council and Whittlesea City Council administrative boundaries. Victorian councils have a wide range of roles and responsibilities relating to floodplain management which mostly relate to their planning functions.

Within Metropolitan Melbourne, Port Phillip and Westernport, Melbourne Water is responsible for waterways and trunk and regional drains, while Councils manage the local drainage system. This arrangement typically shares drainage responsibilities such that drainage systems in catchments smaller than 60 hectares are the responsibility of Councils, while larger catchments are the responsibility of Melbourne Water.

Nillumbik Shire Council and Whittlesea City Council have the following published guidelines for urban development including stormwater criteria:

- Nillumbik Shire Council Drainage Design Guidelines (January 2013)
- Whittlesea City Council Guidelines for Urban Development (December 2015).

The key requirements of these guidelines include:

- Minor systems consisting of pipe networks are typically designed to convey the 10% AEP (1 in 10 year average recurrence interval (ARI)).
- Major systems consisting of overland routes are typically designed to convey the 1% AEP (1 in 100 year ARI).
- Adopt *Urban Stormwater – Best Practice Environmental Management Guidelines* (BPEMG) for stormwater runoff from urban areas.
- Whittlesea City Council has a requirement for detention for all commercial and industrial areas designed for the 10 year ARI (10% AEP). Ensure overflows do not comprise the Council 10% AEP network design capacity. This requirement allows for an increased volume and duration of runoff from redeveloped areas and the possibility of this delayed flow coinciding with peak flow from larger catchments.
- Whittlesea City Council has a requirement for permissible site discharge from residential areas designed for the 5 year ARI (20% AEP). Ensure council pipes do not surge more frequently because of developments.

- In addition to the above, Whittlesea City Council advised a detailed assessment of each outfall location will be carried out by Council based on the wider catchment and the capacity of exiting drainage network.
- The Nillumbik Shire Council drainage guidelines do not present specific detention requirements. Advice from Nillumbik Shire Council for discharges to open channels is that will require discharge for the impervious area to be reduced to the discharge for the natural area covered by the impervious area for the 1% AEP storm event, using detention devices.
- Advice from Nillumbik Shire Council for discharges to Council pipe networks is Council require modelling to show that discharging the increased impervious area into Council's stormwater drainage network will not have an adverse effect on that network.

Based on a review of the Council guidelines and advice provided for this project, the following on site drainage detention criteria for runoff from the new road impervious areas is adopted:

- Outfalls discharging to an open channel – site storage requirement to cater for the increase in peak flow from the 10% AEP (1 in 10 year ARI). To achieve the outcome of not increasing flood risk at downstream receptors for the 1% AEP event, an assessment to quantify the 1% AEP flood impacts to the downstream network will be carried out. Mitigation of these impacts may require changes to the road design, changes to the conveyance network or larger detention to cater for the 1% AEP flood event.
- Outfalls discharging to existing pipe networks – modelling to show that discharging the increased impervious area into Council's stormwater drainage network will not have an adverse effect on that network. Typically, drainage stormwater networks were designed to cater for runoff from the 20% AEP (1 in 5 year ARI) or 10% AEP (1 in 10 year AEP). Pre and post project flow rates are assessed for the 10% AEP (1 in 10 year ARI) and 20% AEP (1 in 5 year ARI) events.

4 LEGISLATION, POLICY AND GUIDELINES

This section assesses the Project against the Commonwealth and State legislation, policies and guidelines relevant to the surface water assessment.

4.1 COMMONWEALTH LEGISLATION

A summary of commonwealth legislative requirements for surface water for the Project is presented in Table 4.1.

Table 4.1 Commonwealth legislative requirements summary

DOCUMENT REFERENCE	SUMMARY	RELEVANCE TO THE PROJECT
Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)	The *EPBC Act* prescribes the Commonwealth's role in environmental assessment, biodiversity conservation and the management of protected areas and species, population and communities and heritage items. Actions which would have, or is likely to have, a significant impact on the environment of Commonwealth land and/or 'matters of National Environmental Significance' (MNES), are to be assessed through a referral process to the Commonwealth Department of the Environment. If the referral process determines a project is likely to have a significant impact on the environment, then approval from the Commonwealth Minister for the Environment would be required before construction works can commence.	This assessment determined that there are no Ramsar listed wetlands or other important wetlands in proximity to the Project. A referral was made under the EPBC Act and a controlled action was received due to Listed threatened species and communities. Details of these Listed threatened species and communities are detailed in *Technical Report B2: Biodiversity Impact Assessment*.

4.2 STATE LEGISLATION

A summary of state legislative requirements relevant to surface water for the Project is presented in Table 4.2.

Table 4.2 State legislation and policy summary

DOCUMENT REFERENCE	SUMMARY	RELEVANCE TO THE PROJECT
Environment Protection Act 1970	The *Environment Protection Act 1970* aims to prevent pollution and environmental damage by setting environmental quality objectives and establishing programs to meet them. The Act establishes the powers, duties and functions of the Environment Protection Authority Victoria (EPA). These include the administration of the Act and any regulations and orders made pursuant to it, recommending SEPPs, issuing works approvals, licences, permits, pollution abatement notices and implementing National Environment Protection Measures.	The Project will discharge stormwater runoff to the surrounding catchment. Clause 38 of the *Environment Protection Act 1970* requires the discharge into waters of the State of Victoria shall at all times be in accordance with SEPP.
Environment Protection Amendment Act 2018	The *Environment Protection Amendment Act 2018* is in preparation and will provide a risk-based preventative approach to environmental management through a general environmental duty and strengthening of EPA Victoria's compliance and enforcement powers. Until the *Environment Protection Amendment Act 2018* comes into effect the subordinate legislation remains unchanged.	
Environment Effects Act 1978	The *Environment Effects Act 1978* provides for assessment of proposed projects that can have a significant effect on the environment. The Act does this by enabling the Minister for Planning administering the Environment Effects Act to decide if an EES should be prepared.	The criteria for the types of potential effects on the environment that might be of significance was provided in the *Ministerial Guidelines for Assessment of Environmental Effects under the Environment Effects Act 1978* (Department of Sustainability and Environment 2006). An assessment against the criteria was completed and identified that one or more individual effects may be triggered. The Project was the subject of an EES Referral, and a determination was made by the Minister that an EES is required.

DOCUMENT REFERENCE	SUMMARY	RELEVANCE TO THE PROJECT
State Environment Protection Policy (Waters)	The SEPP (Waters) sets the framework for the protection and improvement of water quality in Victorian waters. The application of this policy extends to all waters throughout Victoria, including surface water, groundwater and state waters. The SEPP (Waters) policy sets out: — uses and values of water environments that communities want to protect (known as beneficial uses) — establishes environmental quality objectives and obligations required to protect beneficial uses and improve water quality (known as environmental quality indicators and objectives) — provides the rules for decision-making by protection agencies to protect beneficial uses and improve water quality.	The application of SEPP (Waters) relevant to the Project is summarised in Section 4.2.1 and includes: — segments assigned — beneficial uses — environmental quality indicators and objectives — urban stormwater and construction activity.
Planning and Environment Act 1987	The *Planning and Environment Act 1987* establishes a framework for planning the use, development and protection of land in Victoria. Victoria Planning Provisions (VPPs) are set out in the Act to assist in proving a consistent and coordinated framework for planning schemes.	The project area is within the Planning Scheme for Whittlesea City Council and Nillumbik Shire Council. Parts of the VPPs relevant to surface water on the Project are summarised in Section 4.2.2.1. The type and purpose of overlays relevant to surface water are also summarised in Section 4.2.2.1.
Water Act 1989	The *Water Act 1989* provides the legal framework for water management and use across Victoria, including the issuing and allocation of water entitlements and the provision of water services by State-owned water corporations and catchment management authorities. Under the Act, the designated waterways, regional drainage and floodplain management authority for the Yarra Catchment is Melbourne Water Corporation (Melbourne Water). The Act states that Melbourne Water have the power to make By-laws, which include: — By-law No. 1: Water Supply Protection, 2008 — By-law No. 2: Waterways, Land and Works Protection and Management, 2009.	A permit application must be referred to the relevant floodplain management authority (Melbourne Water Corporation) to construct or carry out works within or in proximity of designated waterways and within flood overlays (refer to Section 4.2.2.2). A summary of licenced and non-tradable licence schemes based on a search of the Victorian Water Register is presented in Section 7.2.4.

DOCUMENT REFERENCE	SUMMARY	RELEVANCE TO THE PROJECT
Melbourne Water Corporation By-Law No. 2: Waterways, Land and Works Protection and Management (2009)	The objectives of Melbourne Water By-Law No. 2, made under the *Water Act 1989*, are: — the management, protection and use of lands, waterways and works under the management and control of Melbourne Water — preventing or minimising interference with or obstruction of the flow of water — preventing or minimising the silting up of a designated waterway or designated land or works or any injury to or pollution of it or them, including prohibiting the deposit of material in or near it or them — prohibiting or regulating the removal of any material from land forming part of a designated waterway or designated land or works — regulating activities carried out on land forming part of a designated waterway or designated land or works — the general management and control of any designated waterways or designated land or works.	The By-Law prohibits works and certain activities on designated waterways or designated lands or works without a permit issued by Melbourne Water.
Catchment and Land Protection Act 1994	Victoria's framework for the integrated management of catchments is established under the *Catchment and Land Protection Act 1994* (CaLP Act). Under the CaLP Act, landowners have a responsibility to avoid causing or contributing to land degradation, including taking all reasonable steps to conserve soil, protect water resources, eradicate regionally prohibited weeds, prevent the growth and spread of regionally controlled weeds and where possible, eradicate established pest animals, as declared under the CaLP Act.	Land owners and managers have the responsibility to take all reasonable steps to prevent the growth and spread of regionally prevented and controlled weeds on their land. This is regulated by Agriculture Victoria.

4.2.1 STATE ENVIRONMENT PROTECTION POLICY (WATERS)

The SEPP (Waters) includes surface water environment segments and assigns the type and level of protection of beneficial uses for each segment. The Project is partially located within the Urban Growth Boundary for Metropolitan Melbourne and comprises the upgrade of an existing road. Therefore, the segments *Rivers and Streams – Urban* and *Rivers and Streams – Central Foothills and Coastal Plains* were assigned to the Project.

4.2.1.1 BENEFICIAL USES

The beneficial uses for *Inland Waters* (rivers and streams) and segments *Rivers and Streams: Urban* and *Central Foothills and Coastal Plains*, as set out in Table 3 Schedule 2 in the SEPP (Waters) are presented below in Table 4.3.

Table 4.3 Beneficial uses for Inland Water Segments Rivers: Urban and Central Foothills and Coastal Plains

BENEFICIAL USE	RIVERS AND STREAMS CENTRAL FOOTHILLS AND COASTAL PLAINS	RIVERS AND STREAMS URBAN
Water Dependent Ecosystems and Species That Are Slightly to Moderately Modified	✓	
Water Dependent Ecosystems and Species That Are Highly Modified		✓
Human Consumption After Appropriate Treatment	where water is sourced for supply in accordance with the special water supply catchments area set out in Schedule 5 of the *Catchment and Land Protection Act 1994* or the *Safe Drinking Water Act 2003*	
Agriculture and Irrigation	✓	✓
Human Consumption of Aquatic Foods	✓	✓
Aquaculture	where the environmental quality is suitable and an aquaculture licence has been approved in accordance with the *Fisheries Act 1995*	
Industrial and Commercial	✓	✓
Water-Based Recreation (Primary Contact, Secondary Contact and Aesthetic Enjoyment)	✓	✓
Traditional Owner Cultural Values	✓	✓
Cultural and Spiritual Values.	✓	✓

4.2.1.2 ENVIRONMENTAL QUALITY INDICATORS AND OBJECTIVES

The water quality objectives for key environmental indicators, as set out in Table 1 Schedule 3 of SEPP (Waters), are tabulated in Table 4.4.

For the beneficial use of water dependent ecosystems and species, the SEPP (Waters) recognises different levels of ecosystem protection and sediment quality objectives for inland and marine waters. Details of protecting ecosystems and species are not included in this surface water impact assessment (SWIA) and are provided in *Technical Report B2: Biodiversity Impact Assessment*.

Environmental quality indicators and objectives for aquaculture and the beneficial use of water-based recreation are also provided in SEPP (Waters). These environmental quality indicators are not impacted by the proposed Project (as they relate to wastewater indicators) and have not been included in this surface water impact assessment.

Table 4.4 Environmental quality indicators and objectives for rivers and streams segment – Urban and Central Foothills and Coastal Plains

ENVIRONMENTAL QUALITY INDICATORS	ENVIRONMENTAL QUALITY OBJECTIVES	
	Urban*	**Central Foothills and Coastal Plains****
Total Phosphorus (µg/L) 75th percentile	≤ 110	≤ 55
Total Nitrogen (µg/L) 75th percentile	≤ 1300	≤ 1100
Dissolved oxygen (percent saturation) — 25th percentile — Maximum	 ≥ 70 130	 ≥ 75 130
Turbidity (NTU) 75th percentile	≤ 35	≤ 25
Electrical Conductivity (µS/cm@ 25°C) 75th percentile	≤ 500	≤ 250
pH (pH units) — 25th percentile — 75th percentile	 ≥ 6.4 ≤ 7.9	 ≥ 6.7 ≤ 7.7
Toxicants Water (% protection)	90	95
Toxicants Sediment	Low	Low

* Lowlands of the Dandenong Creek, Mornington Peninsula, Western Port catchment and tributaries of the Yarra River

** Lowlands of Yarra, South Gippsland, Bunyip, Latrobe, Thomson, Mitchell, Tambo and Snowy basins

4.2.1.3 PERFORMANCE CRITERIA

URBAN STORMWATER RUNOFF QUALITY AND ENVIRONMENTAL FLOWS

Clause 34 of the SEPP (Waters) defines roles and responsibilities for ensuring measures are undertaken to minimise the impact from urban stormwater runoff. Therefore, runoff from the Project must meet the requirements of the SEPP (Waters) Clause 34, which includes the protection of beneficial uses and the demonstration of best practice. This approach requires proposed road projects to meet the best practice performance objectives and process outlined in:

- Urban Stormwater: Best Practice Environmental Management Guidelines, Victorian Stormwater Committee (BPEMG) (1999).
- Austroads Guidelines for Road Drainage.

As per the Urban Stormwater BPEMG, the current best practice performance objectives, post construction phase, for stormwater quality and flow regime impacts are summarised in Table 4.5.

Table 4.5 Performance criteria for water quality and flow regime impacts

INDICATORS	TARGETED REDUCTION OF TYPICAL URBAN (ROAD) ANNUAL LOAD
Total suspended solids (TSS)	80% reduction of the typical urban annual load.
Total phosphorus (TP)	45% reduction of the typical urban annual load.
Total nitrogen (TN)	45% reduction of the typical urban annual load.
Litter	70% reduction of the typical urban annual load.
Flow	Maintain discharges for the 1.5 year Average Recurrence Interval (ARI) at pre-development rates.

CONSTRUCTION RUNOFF

Clause 42 of the SEPP (Waters) requires construction works be managed:

- to minimise, the risk to beneficial uses, so far as reasonably practicable, including risks from land disturbance, soil erosion and the discharge of sediment and other pollutants to surface waters
- monitor surface waters where the construction activity adjoins or crosses surface water to assess if beneficial uses are being protected
- comply with guidelines published or approved by the Authority in relation to the construction activity.

FLOODING

Clause 46 of the SEPP (Waters) requires Councils and Catchment Management Authorities to ensure the management and protection of beneficial uses of floodplains, and in particular:

- land use development or works on flood prone areas do not increase the risk of pollutants being transported during flood events which would pose a risk to beneficial uses, and
- waterways and their floodplains retain sufficient flood detention capacity to moderate peak flows to protect the beneficial uses of downstream waterways.

4.2.2 VICTORIAN PLANNING PROVISIONS

4.2.2.1 STATE PLANNING POLICY FRAMEWORK

The State and Local Planning Policy Frameworks contain the long-term directions and outcomes sought by the scheme. The requirements relevant to surface water on the Project are presented in Table 4.6.

Table 4.6 State and Local Planning Policy Framework

CLAUSE REFERENCE	TITLE	KEY REQUIREMENTS RELEVANT TO THE PROJECT
Clause 12.03-1S	River corridors, waterways, lakes and wetlands	To protect the environmental, cultural and landscape values of all waterbodies and wetlands. To ensure development does not compromise bank stability, increase erosion or impact on a waterbody or wetland's natural capacity to manage flood flow. Consideration of *Healthy Waterways Strategy* (Melbourne Water, 2013). This SWIA references the *Healthy Waterways Strategy* in Section 5.1.
Clause 13.01-1S	Climate change impacts – Natural hazards and climate change	To identify risk areas using the best available data and climate change science. Climate change impacts are considered during the hydrologic and hydraulic transverse drainage modelling, refer to Section 7.2.1.
Clause 13.03-1S	Floodplains – Floodplain management	To identify land affected by flooding (1 in 100 year ARI flood event). To avoid intensifying the impacts of flooding through inappropriately located uses and development. The Project does not interact with defined 1 in 100 year ARI floodplains. An assessment of transverse drainage impacts for the 1 in 100 year ARI event plus climate change is presented in Section 7.2.1.

CLAUSE REFERENCE	TITLE	KEY REQUIREMENTS RELEVANT TO THE PROJECT
Clause 14.02-1S	Water – Catchment planning and management	Consider impacts of catchment management on downstream water quality and water environments. Retain natural drainage corridors with vegetated buffer zones of at least 30 m. Undertake measures to minimise the quantity and retard flow from developed areas. Require appropriate measures to filter sediment and wastes from stormwater prior to its discharge into waterways. Ensure that development at or near waterways provide for the protection and enhancement of the environmental qualities of waterways and their in stream uses. Ensure land use and development minimise nutrient contributions to waterways. Use appropriate measures to restrict sediment discharges from construction sites. Ensure planning is coordinated with activities of catchment management authorities. A summary of the SWIA during construction and operational stages is presented in Section 7.
Clause 14.02-2S	Water – Water Quality	Protect reservoirs, water mains and local storage facilities from potential contamination. Ensure that land use activities potentially discharging contaminated runoff or wastes to waterways are sited and managed to minimise such discharges and to protect the quality of surface water and groundwater resources, rivers, streams, wetlands, estuaries and marine environments. Water Sensitive Road Design (WSRD) modelling to manage operational water quality runoff is presented in Section 7.2.2.2. A summary of construction water quality impacts is presented in Section 7.1.

CLAUSE REFERENCE	TITLE	KEY REQUIREMENTS RELEVANT TO THE PROJECT
Clause 19.03-3S	Development Infrastructure – Integrated water management	Plan and coordinate integrated water management, bringing together stormwater, wastewater, drainage, water supply, water treatment and re-use, to: — take into account the catchment context — protect downstream environments, waterways and bays — manage and use potable water efficiently — minimise drainage, water or wastewater infrastructure and operational costs — minimise flood risks and provide urban environments that are more resilient to the effects of climate change. Integrate water into the landscape to facilitate cooling, local habitat improvements and provision of attractive and enjoyable spaces for community use. Ensure that development protects and improves the health of waterbodies including creeks, rivers, wetlands, estuaries and bays. Manage stormwater quality and quantity through a mix of on-site measures and developer contributions. Minimise the potential impacts of the drainage assets on the environment. The transverse drainage model considered the interface of the Project with the existing drainage infrastructure and future drainage scheme works, refer to Section 5.1.6 and Appendix A. Consultation with the relevant Authorities identified potential drainage infrastructure that may interface with the Project, refer to Section 7.2.7.

4.2.2.2 OVERLAYS

The type and purpose of overlays relevant to surface water on the Project are summarised in Table 4.7.

Table 4.7 Type and purpose of overlays

CLAUSE REFERENCE	TITLE	KEY DEFINITION OF OVERLAY AND RELEVANCE TO THE PROJECT
Clause 44.03	Floodway Overlay (FO or RFO)	The FO or RFO is defined as identified waterways, major flood paths, drainage depressions and high hazard areas, which have the greatest risk and frequency of being affected by flooding. The Project does not intersect with an FO or RFO.
Clause 44.04	Land Subject to Inundation Overlay (LSIO)	The LSIO is defined as identified land in a flood storage or flood fringe area affected by the 1 in 100 year ARI flood or any other area determined by the floodplain management authority. The Project does not intersect with an LSIO.
Clause 44.05	Special Building Overlay (SBO)	The SBO is defined as identified land in urban areas liable to inundation by overland flows from the urban drainage system as determined by, or in consultation with, the floodplain management authority. The Project does not intersect with an SBO.

4.3 LOCAL PLANNING SCHEMES

A summary of the key local planning policies relevant to this preliminary surface water impact assessment are summarised in Table 4.8.

Table 4.8 Local planning schemes

PLANNING SCHEME REFERENCE	TITLE	KEY REQUIREMENT AND RELEVANCE TO THE PROJECT
Whittlesea Planning Scheme Clause 21.02-3	Natural Resource Management – Water Management	Whittlesea City Council is the responsible authority for approving applications and implementing the Whittlesea Planning Scheme framework. This clause applies to the Plenty River sub-catchment, within which the Project is located, refer to Appendix A (Overview map). The clause identifies the establishment of wetlands systems to control stormwater and sewerage water quality prior to discharge as a preferred treatment option. However, existing areas where there are known drainage problems, including lack of capacity and water quality issues, will require on-going site specific measures to improve performance. Integrated water management solutions in association with drainage schemes are to consider impacts on the surrounding development and spatial allocation of other land uses and activities. Drainage facilities that incorporate capacity for opportunistic and incidental leisure activities are not to be included within open space contributions attributable to the development, as this creates shortfalls in useable unencumbered open space. Water Sensitive Road Design (WSRD) modelling to manage operational water quality runoff is presented in Section 7.2.2.2. A summary of construction water quality impacts is presented in Section 7.1.
Nillumbik Planning Scheme Clause 21.03-3	Municipal Profile & Key Influences – Environment, Conservation & Landscape – Catchments and Water Quality	The Nillumbik Shire Council is the responsible authority for approving applications and implementing the Nillumbik Planning Scheme framework. This clause applies to the Yarra sub-catchment of Plenty River. The clause identifies development throughout the municipality has the potential to affect stormwater quality. The ongoing and sustainable management of stormwater in accordance with best practice principles is a priority for the Shire. WSRD modelling to manage operational water quality runoff is presented in Section 7.2.2.2. A summary of construction water quality impacts is presented in Section 7.1.

4.4 GUIDELINES

A number of guidelines are relevant to surface water on the Project, including:

- Australian Rainfall and Runoff (ARR) 2016/19
- Austroads Guide to Road Design (AGRD) Parts 5
- VicRoads Supplements to AGRD
- Integrated Water Management Guidelines Designing with Water, MRPV 2019
- Urban Stormwater BPEMG, 1999
- Melbourne Water Guidelines for Development in Flood-prone areas
- Melbourne Water Flood Mapping Projects Guidelines and Technical Specifications 2018
- Melbourne Water MUSIC Guidelines
- Healthy Waterways Strategy, Melbourne Water 2018
- Co-Designed Catchment Program for the Yarra Catchment
- Victoria Floodplain Management Strategy, Department of Environment, Land, Water and Planning, 2016
- Technical Guidelines for Waterway Management, Department of Sustainability and Environment 2007
- Australian and New Zealand Guidelines for Fresh and Marine Water Quality, ANZECC 2000
- EPA Publication No. 275. Construction Techniques for Sediment Pollution Control (1991)
- EPA Publication No. 480. Environmental Guidelines for Major Construction Sites (1996)
- Integrated Water Management Framework for Victoria (DELWP, 2017).

5 EXISTING CONDITIONS

5.1 CATCHMENT DESCRIPTION

5.1.1 YARRA CATCHMENT

According to Melbourne Water's Healthy Waterways strategy, the Project is located in the Yarra catchment, which includes the Yarra (Birrarung) River, the largest river in the Port Phillip and Westernport region. The river rises in the Great Dividing Range to the east of Warburton and flows 245 kilometres until entering Port Phillip at Newport. This catchment covers an area of 4,046 km². The Yarra River, between Warburton and Warrandyte, was identified as a Victorian Heritage River, meaning that it has significant recreation, nature conservation, scenic and cultural heritage attributes.

Population modelling shows that the Yarra catchment will increase from some 1.8 million people to over 2.4 million in the next 20 years, resulting in an additional 14,000 dwellings per year. The north growth corridor from Wallan to Broadmeadows, Mernda and Epping is the main growth area in the Yarra catchment.

There are over 21,000 wetlands in the Yarra catchment, including approximately 16,000 constructed wetlands and nearly 5,100 natural wetlands that support significant environmental and social values. Poor quality stormwater inputs, drainage and clearing of vegetation have already impacted many wetlands of the Yarra catchment. Additionally, the construction of levees and harvesting of water means that river-fed wetlands, including billabongs, are less frequently inundated and less able to act as nursery and breeding areas.

5.1.2 PLENTY RIVER LOWER SUB-CATCHMENT

The Healthy Waterways Strategy refers to the co-designed catchment program for a flexible framework for managing waterways in the Yarra catchment which takes into account variable climatic and development conditions and changing community needs. The Project is in the Plenty River Lower Sub-catchment.

Plenty River rises in the Mt Disappointment State Park and flows through Whittlesea, Plenty Gorge and Greensborough before joining the Yarra River at Viewbank. Both the Yan Yean and Toorourrong water storages lie within the catchment. Water is diverted from the King Parrot Creek catchment on the northern side of the Great Dividing Range into the Toorourrong Reservoir. The river has a number of tributaries, including Falls, Jacks, Bruces, Scrubby and Barbers creeks.

The performance objectives for the Plenty River Lower Sub-catchment are to:

- identify and implement opportunities to reduce the key threat of summer low flow stress by addressing causal factors such as water for domestic and stock uses, climate change, diversions or urbanisation
- identify and implement opportunities to maintain or improve the flow regime in refuge reaches to support instream values and platypus populations
- establish a continuous riparian vegetated buffer (14 km, 57 ha) and maintain existing vegetation (32 km, 128 ha) along priority reaches
- maintain or achieve high and very high quality vegetation through effective monitoring and management of threats including protection of endangered ecological vegetation classes in these reaches. Fill data gaps and ensure additional high quality reaches are also protected
- improve understanding of the extent, composition and condition of high and very high quality vegetation, and effectively monitor and manage both values and threats
- investigate and mitigate threats to physical form and other high values (particularly along tributaries and including impacts of urbanisation)

- increase access to and along waterways (about 5 km of path) by improving connections with existing path network and extending paths into new urban areas
- increase participation rates from low to high; support community groups and build capacity through citizen science and cultural engagement. Increase participation through promotion of high value areas (e.g. Plenty Gorge Park).

5.1.3 STORMWATER WETLANDS

Stormwater wetlands were identified as waterway assets in the Healthy Waterways Strategy. The stormwater wetlands in the Yarra catchment included Galada Tamboore (Merri Creek Lower) and Dunnetts Road (Plenty River Upper) and other stormwater treatment wetlands designed to capture nutrients and sediment from urban stormwater before it enters the waterways.

The nearest stormwater wetland to the Project identified in the Heathy Waterways strategy is west of Plenty River and south of Wilton Vale Road, refer to Figure 5.1. The performance objective for stormwater wetland water quality is to maintain the design of wetlands in the Yarra catchment, to ensure that nutrients and sediments are captured, whilst considering significant biodiversity values at the site.

Figure 5.1 Location of stormwater wetlands, Plenty River (source: MRPV SiteMap)

5.1.4 YAN YEAN ROAD SUB-CATCHMENTS

The predominant land use to the east of Yan Yean Road is rural residential (rural conservation zone). Other land zoning east of Yan Yean Road include green wedge zone (north of Doctors Gully Road), special use zone (includes the school and sports fields) and low density rural development (between Iron Bark Road and Bannons Lane).

To the west of Yan Yean road, land zoning is a mixture of general residential zone (north of Jorgensen Avenue), public park and recreation zone (including riding track and golf course) and low density rural development (between the golf course and Kurrak Road).

A review of topographic data and drainage networks indicates the following general flow paths and surface water features within the Project boundary:

- stormwater catchments north of Bridge Inn Road drain via Orchard Road Drain in a south west direction along Yan Yean Road before conveying flows in a westerly direction along Bridge Inn Road
- stormwater catchments south of Bridge Inn Road and Yan Yean Road intersection use transverse drainage (culverts) beneath Yan Yean Road to convey runoff in a westerly direction towards Plenty River
- there are no Melbourne Water designated watercourse crossings at Yan Yean Road. However, there are two Melbourne Water managed open channels, tributaries of Plenty River, located to the west of Yan Yean Road. These tributaries are located approximately 70 m north of Youngs Road and Yan Yean Road intersection and approximately 115 m north of Golf Links Drive and Yan Yean Road intersection
- water sensitive receptors refer to Section 5.1.5
- Council road drainage assets (e.g. drainage pits and pipes, culverts, open channels) and pond at Worns Lane
- constructed dam at Plenty Valley Christian College
- privately owned farm dam north of Plenty Valley Christian College
- Yarra Valley assets (water tank near Ironbark Road and newly laid sewer as part of Doreen Transfer Main Project)
- Yarrambat Park Public Golf Course constructed ponds.

In addition to the above drainage review, Nillumbik Shire Council provided the following feedback:

- several properties along Yan Yean Road may require relocation of onsite greywater/stormwater treatment areas
- properties located on Yan Yean Road, between Bannons Lane and Laurie street, possibly discharge stormwater offsite to the Yan Yean Road drain.

5.1.5 WATER SENSITIVE RECEPTORS

WSP has prepared a Flora and Fauna Impact Assessment that addresses biodiversity values. Based on a review of available information and site assessments carried out by Arcadis and WSP, the type and extent of vegetation communities, the fauna habitats and potential impact of the Project on biodiversity values were identified.

Based on the WSP Flora and Fauna Impact Assessment, the following waterbodies were identified as sensitive receptors:

- Vaucluse Wetland at Orchards Road (Melbourne Water asset)
- Nillumbik Shire Council wetland (at Young's Road and Yan Yean Road junction)
- Yarrambat Lake (west of Bannons Lane and Yan Yean Road junction).

5.1.6 PLANNED DRAINAGE SCHEME WORKS

5.1.6.1 MELBOURNE WATER PLANNED WORKS

Drainage Schemes (DS) or Development Services Schemes (DSS) are master plans for drainage in specific catchments and are developed and managed by Melbourne Water.

The Project intersects one DS, being the Doreen DS (scheme no. 4681). However, this DS does not show any planning works intersecting the Project.

5.1.6.2 NILLUMBIK SHIRE COUNCIL PLANNED WORKS

Nillumbik Shire Council have advised drainage works at the east end of Ironbark Road, may have the potential to impact Council's proposed future streetscape works.

Nillumbik Shire Council require consultation with MRPV and drainage design input regarding any potential impact to Council's proposed future streetscape works.

5.2 FLOOD CONDITIONS

5.2.1 PLANNING OVERLAYS

The Project does not intersect planning scheme overlays relevant to surface water including LSIO, SBO, RFO and FO.

The Project is located within the Plenty River Water Supply Protection Area. However, the primary focus of this protection area is around water abstraction, environmental flows, diversions and dams. Given the Project does not include proposals for water abstraction and will not result in diversion of existing drainage flow paths, the requirement for a Stream Flow Management Plan does not apply.

A surface water overview map is provided in Appendix A. The project area and key water bodies are shown Figure 1.1.

5.2.2 TRANSVERSE DRAINAGE

The location of the existing transverse drainage crossings is presented in Table 5.1. Drainage layout plans which identify the crossing location is presented in Appendix C.

Table 5.1 Existing transverse crossings on Yan Yean Road

ROAD CHAINAGE	LOCATION DESCRIPTION	TRANSVERSE CROSSING SIZE CONCRETE PIPE / BOX CULVERT	FLOOD IMMUNITY AT TRANSVERSE CROSSING	WATER LEVEL UPSTREAM OF CULVERT (1% CC AEP)
320654	South of Worns Lane	300 mm Dia	20% AEP	170.84
320754	North of Worns Lane	375 mm Dia	1% AEP Climate Change	173.18
321128 & 321129	Between North Oatlands Rd and Heard Ave	375 mm Dia & 450 mm Dia	10% AEP	177.59
322360	North of Youngs Road (at Council wetland & upstream of Plenty River trib)	2 No. 750 mm Dia	20% AEP	165.49
322955	Between Bannons Lane and Golf Link Drive (upstream of Plenty River trib)	2 No. 750 mm Dia	20% AEP	166.65
323573	Between Laurie St. and Bannons Lane (upstream of Yarrambat Lake)	900 mm Dia	2% AEP	173.40

ROAD CHAINAGE	LOCATION DESCRIPTION	TRANSVERSE CROSSING SIZE CONCRETE PIPE / BOX CULVERT	FLOOD IMMUNITY AT TRANSVERSE CROSSING	WATER LEVEL UPSTREAM OF CULVERT (1% CC AEP)
324852	North of Orchard Road (between school dam & Mel Water wetland)	1200 mm ×450 mm (width x height)	10% AEP	170.49
325558	South of Bridge Inn Road	700 mm ×300 mm (width x height)	< 20% AEP	164.70
325595	North of Bridge Inn Road	900 mm ×300 mm (width x height)	< 20% AEP	164.90

An existing box culvert (800 mm x 250 mm) transverse crossing was identified in the feature survey at chainage 323,300, refer to Map in Appendix C. Based on the LiDAR and feature survey, this culvert has no catchment draining towards it and there is no gradient between upstream and downstream culvert invert levels. The function of this culvert may be to act as an overflow relief culvert from adjacent catchments during extreme storm events. However, for this drainage impact assessment the 1D XPSWMM model cannot confirm the function of this culvert. As this culvert does not have an upstream catchment, hydraulic results are not presented in Table 5.1.

5.3 WATERBODY HEALTH

5.3.1 WATER QUALITY – PLENTY RIVER

Waterwatch Victoria reports water quality monitoring records for sites across the state. There are no active sites from the Plenty River upstream or downstream of the Project.

5.3.2 INDEX OF STREAM CONDITION

River condition in Victoria is assessed using the Index of Stream Condition (ISC). The ISC measures the environmental condition of river reaches. The Index of Stream Condition – The Third Benchmark of Victorian River Condition ('ISC3') (Department of Environment and Primary Industries, 2013) report provides a summary of river health for major rivers and stream in Victoria using data collected over a six-year period from 2004–2010.

ISC3 results show the stream condition of Plenty River varied from poor to very poor. The ISC score for the reach of the Plenty River adjacent to the Project was very poor (18%) and results are presented in Table 5.2. The scores for each category are marked out of 10.

Table 5.2 Plenty River Reach adjacent to Yan Yean Road

REACH ID	LOCATED	REACH LENGTH (KM)	HYDROLOGY	PHYSICAL FORM	STREAM SIDE ZONE	WATER QUALITY	AQUATIC LIFE	ISC SCORE	CONDITION
29	Downstream of the confluence of Plenty River and Barbers Creek	28.4	2	7	8	2	–	18	Very Poor

5.3.3 DRINKING WATER AND WATER ENTITLEMENTS

Drinking water is provided by Yarra Water, as the retail water authority. Yarra Water buys bulk water from Melbourne Water, which is mostly harvested from protected mountain catchments.

A search of the Victorian Water Register listed 21 schemes (2 domestic & stock and 19 irrigation schemes) that either directly extract surface water or harvest water using off-waterway dams from within Plenty River catchment. The total volume of water harvested or extracted from Plenty River is 459 ML.

6 RISK ASSESSMENT

The residual environmental risks identified for surface water are provided in Table 6.1. The residual risk ratings consider the standard controls and proposed EPRs. The proposed EPRs are set out in Table 8.1 in Section 8.

Table 6.1 Surface water environmental risks

RISK NO.	ASPECT	IMPACT PATHWAY	MITIGATION MEASURES TO INFORM ENVIRONMENTAL PERFORMANCE REQUIREMENT	EPR	RESIDUAL RISK RATING
CONSTRUCTION					
15	Site establishment	Potential changes to stormwater flows as a result of site works, and/or adverse impacts on water quality and beneficial uses including waterway health and listed Wetlands (if applicable)	The Construction Environmental Management Plan will include processes and measures to manage surface water in accordance with the relevant water objectives set out in the Environmental Reference Standard under the *Environment Protection Amendment Act 2018*, Melbourne Water Performance Criteria and other relevant statutory requirements. Mitigation measures to inform the Construction Environmental Management Plan will be established in accordance with Melbourne Water and Council requirements, contract specifications, EPA Publications 275, 480 and 960 and include: — best practice sediment and erosion control — maintenance of existing flow paths, drainage lines and floodplain storage, or in the case where existing flow paths will be modified, mitigate the effects of changes to flow where practicable — water quality monitoring during construction and management of drainage infrastructure to be carried out in accordance with MRPV's Integrated Water Management Guideline (2019) — stormwater or flood modelling mitigation solutions for temporary works as required — flood emergency management including consideration of scheduling works — maximise the visual and aesthetic amenity of waterways having regard to any relevant development plans in consultation with Melbourne Water — refuelling in designated areas where hardstand is present and removal of impacted soils following minor spills.	EPR SW1	Low

RISK NO.	ASPECT	IMPACT PATHWAY	MITIGATION MEASURES TO INFORM ENVIRONMENTAL PERFORMANCE REQUIREMENT	EPR	RESIDUAL RISK RATING
35	Earthworks	Potential changes to stormwater flows as a result of site works, reduction of flood conveyance or floodplain storage, and/or adverse impacts on water quality and beneficial uses including waterway health and listed Wetlands (if applicable)	The Construction Environmental Management Plan will include processes and measures to manage surface water in accordance with the relevant water objectives set out in the Environmental Reference Standard under the *Environment Protection Amendment Act 2018*, Melbourne Water Performance Criteria and other relevant statutory requirements. Mitigation measures to inform the Construction Environmental Management Plan will be established in accordance with Melbourne Water and Council requirements, contract specifications, EPA Publications 275, 480 and 960 and include: — best practice sediment and erosion control — maintenance of existing flow paths, drainage lines and floodplain storage, or in the case where existing flow paths will be modified, mitigate the effects of changes to flow where practicable — water quality monitoring during construction and management of drainage infrastructure to be carried out in accordance with MRPV's Integrated Water Management Guideline (2019) — stormwater or flood modelling mitigation solutions for temporary works as required — flood emergency management including consideration of scheduling works — maximise the visual and aesthetic amenity of waterways having regard to any relevant development plans in consultation with Melbourne Water — refuelling in designated areas where hardstand is present and removal of impacted soils following minor spills.	EPR SW1	Low

RISK NO.	ASPECT	IMPACT PATHWAY	MITIGATION MEASURES TO INFORM ENVIRONMENTAL PERFORMANCE REQUIREMENT	EPR	RESIDUAL RISK RATING
55	Civils and structures	Potential changes to stormwater flows as a result of site works, reduction of flood conveyance or floodplain storage, and/or adverse impacts on water quality and beneficial uses including waterway health and listed Wetlands (if applicable)	The Construction Environmental Management Plan will include processes and measures to manage surface water in accordance with the relevant water objectives set out in the Environmental Reference Standard under the *Environment Protection Amendment Act 2018*, Melbourne Water Performance Criteria and other relevant statutory requirements. Mitigation measures to inform the Construction Environmental Management Plan will be established in accordance with Melbourne Water and Council requirements, contract specifications, EPA Publications 275, 480 and 960 and include: — best practice sediment and erosion control — maintenance of existing flow paths, drainage lines and floodplain storage, or in the case where existing flow paths will be modified, mitigate the effects of changes to flow where practicable — water quality monitoring during construction and management of drainage infrastructure to be carried out in accordance with MRPV's Integrated Water Management Guideline (2019) — stormwater or flood modelling mitigation solutions for temporary works as required — flood emergency management including consideration of scheduling works — maximise the visual and aesthetic amenity of waterways having regard to any relevant development plans in consultation with Melbourne Water — refuelling in designated areas where hardstand is present and removal of impacted soils following minor spills.	EPR SW1	Low

RISK NO.	ASPECT	IMPACT PATHWAY	MITIGATION MEASURES TO INFORM ENVIRONMENTAL PERFORMANCE REQUIREMENT	EPR	RESIDUAL RISK RATING
75	Reinstatement	Potential changes to stormwater flows as a result of site works, and/or adverse impacts on water quality and beneficial uses including waterway health and listed Wetlands (if applicable)	The Construction Environmental Management Plan will include processes and measures to manage surface water in accordance with the relevant water objectives set out in the Environmental Reference Standard under the *Environment Protection Amendment Act 2018*, Melbourne Water Performance Criteria and other relevant statutory requirements. Mitigation measures to inform the Construction Environmental Management Plan will be established in accordance with Melbourne Water and Council requirements, contract specifications, EPA Publications 275, 480 and 960 and include: — best practice sediment and erosion control — maintenance of existing flow paths, drainage lines and floodplain storage, or in the case where existing flow paths will be modified, mitigate the effects of changes to flow where practicable — water quality monitoring during construction and management of drainage infrastructure to be carried out in accordance with MRPV's Integrated Water Management Guideline (2019) — stormwater or flood modelling mitigation solutions for temporary works as required — flood emergency management including consideration of scheduling works — maximise the visual and aesthetic amenity of waterways having regard to any relevant development plans in consultation with Melbourne Water — refuelling in designated areas where hardstand is present and removal of impacted soils following minor spills.	EPR SW1	Low

RISK NO.	ASPECT	IMPACT PATHWAY	MITIGATION MEASURES TO INFORM ENVIRONMENTAL PERFORMANCE REQUIREMENT	EPR	RESIDUAL RISK RATING
OPERATION AND MAINTENANCE					
95	Operations	Potential changes to stormwater flows as a result of operation, and/or adverse impacts on water quality and beneficial uses including waterway health and listed Wetlands (if applicable), due to changes to ground levels, ground surface imperviousness or increases in stormwater pollutants	To mitigate changes to the hydrologic and/or hydraulic regime of waterways and stormwater risks, the following will be completed: — develop a detail drainage model based on the 3D road detail design to comply with Austroads, Council and Melbourne Water guidelines. A spill risk assessment should be conducted for each outfall based on the likelihood of a spill, which is estimated based on the road characteristics (geometry) of the outfall catchment, and its proximity to the downstream water sensitive receptors (i.e. consequence of the spill). Outfalls with a high spill risk are to provide spill containment — detailed design drainage works in accordance with Melbourne Water, Austroads and Council requirements — discharge and runoff to meet the relevant water objectives set out in the Environmental Reference Standard under the *Environment Protection Amendment Act 2018*, Melbourne Water Performance Criteria and other relevant statutory requirements — for outfalls to major main drains or waterways, Melbourne Water will be consulted to determine specific requirements — an assessment and provision of flood mitigation measures during detailed design where the works result in an increase to flood risk — investigate and mitigate interfaces with private, Council and Melbourne Water drainage assets — comply with Melbourne Water Stormwater Quality Performance Criteria Yan Yean Road Upgrade – Stage 2 publication and MRPV's Integrated Water Management Guideline (2019) — in accordance with Emergency Response Procedures, complete spills risk assessment during detail design and provide spill containment for high risk locations.	EPR SW2	Low

RISK NO.	ASPECT	IMPACT PATHWAY	MITIGATION MEASURES TO INFORM ENVIRONMENTAL PERFORMANCE REQUIREMENT	EPR	RESIDUAL RISK RATING
115	Maintenance	Potential changes to stormwater flows as a result of maintenance activities such as weed control spraying, and/or adverse impacts on water quality and beneficial uses including waterway health and listed Wetlands (if applicable)	Any potential impacts during maintenance will be managed in accordance with the Department of Transport's standards for managing declared roads in Victoria.	EPR EMF5	Low

7 IMPACT ASSESSMENT

Anticipated works as part of the Project have the potential to impact surface water. This includes:

- the duplication of Yan Yean Road and works on transverse drainage culverts have the potential to increase upstream flood levels
- the road duplication and new shared paths will increase the impervious areas leading to increased runoff rates and pollutant loads.

7.1 CONSTRUCTION IMPACTS

The placement of temporary works, stockpiles, equipment and plant can result in a reduction in flood conveyance or floodplain storage, potentially leading to increases to flood levels, flow velocities and flood frequency.

Erosion from construction sites has the potential to contribute large sediment loads to downstream areas. Clause 42 of the SEPP (Waters) requires construction works to be managed to minimise land disturbance, soil erosion and the discharge of sediment and other pollutants to surface waters. To achieve this, construction works should be consistent with guidance in the EPA publications *Construction Techniques for Sediment Pollution Control* (1991) and *Environmental Guidelines for Major Construction Sites* (1996).

Water supplies may be needed during construction for controlling dust and other purposes. Depending on the quantities required and the source of the water, this may have potential impacts on users of the water resource and aquatic fauna and flora.

A CEMP will be prepared and implemented for the Project in accordance with the EPRs and EMF for the Project. The CEMP should outline how the contractor will comply with any environmental conditions for the Project and provide a framework to ensure that environmental risks are properly managed. Construction works should be carried out in consultation with Melbourne Water and MRPV. MRPV is to review the CEMP prior to construction works commencing on site to ensure it is compliant. Regular supervision to ensure the CEMP is being fully implemented and, reviews and improvements to the CEMP to be carried out when necessary.

The updates to the Project since surface water modelling occurred include extending the project area. The additional water assets (refer to Section 3.4) included within the extended project area will need to be protected from increases in pollution loads during the construction stage. The CEMP is to outline how these assets will be protected and managed so as not to cause negative water quality impacts on the receiving environment.

7.2 OPERATIONAL IMPACTS

7.2.1 FLOODING – TRANSVERSE DRAINAGE IMPACT ASSESSMENT

Changes to ground levels, including new embankments or widening of existing roads, and changes to drainage elements, including bridges, culvert extensions and road drainage catchments, can result in changes to drainage or flooding behaviour during operation.

The Austroads Guide to Road Design (AGRD) Part 5 Drainage – General and Hydrology Considerations criteria for cross drainage systems for arterial roads is 2% AEP (1 in 50 year ARI).

The drainage impact assessment of the proposed flood conditions at all transverse crossings for the Project alignment is presented in Table 7.1. A map presenting the locations of the transverse crossings is provided in Appendix C. The table also presents the change in flood level (afflux) for the highest flood event assessed, which was the 1% AEP with climate change. This event was chosen to determine the likely worst case impacts on surrounding land. However, it is possible that impacts may be greater for more frequent flood events and more frequent events will be modelled during detailed drainage design to confirm impacts.

A drainage assessment of likely impacts to the flood conditions at the transverse crossings based on the updates to the Project since the surface water modelling is included in Table 7.1.

The likely drainage impacts for the Yan Yean/Bridge Inn/Doctors Gully Road intersection are assessed in Table 7.2.

Table 7.1 Proposed Project transverse crossings

ROAD CHAINAGE	LOCATION DESCRIPTION	EXISTING TRANSVERSE CROSSING SIZE CONCRETE PIPE / BOX CULVERT	PROPOSED TRANSVERSE CROSSING SIZE PIPE / BOX CULVERT	FLOOD IMMUNITY OF ROAD UPGRADE	WATER LEVEL UPSTREAM OF CULVERT (1% CC AEP)	AFFLUX IN FLOOD LEVEL UPSTREAM	COMMENTS ON UPSTREAM IMPACTS
320654	South of Worns Lane	300 mm Dia	300 mm Dia	<20% AEP	170.88	0.04	Private property located near upstream boundary of the transverse crossing. LiDAR indicates afflux impacts are confined to the road corridor. Flood immunity has reduced. An initial estimate of the road raising required to achieve 2% AEP flood immunity is approximately 0.02 m. Investigating raising the road level to achieve AustRoads criteria is recommended during detail design.
320754	North of Worns Lane	375 mm Dia	2 No. 375 mm Dia	1% AEP Climate Change	173.21	0.03	No property or sensitive receptor upstream of crossing. LiDAR indicates upstream flood impacts can be confined to Project boundary. Flood immunity exceeds AustRoads criteria. The inclusion of the Council pond at Worns Lane does not impact the afflux results at the transverse crossing.

ROAD CHAINAGE	LOCATION DESCRIPTION	EXISTING TRANSVERSE CROSSING SIZE CONCRETE PIPE / BOX CULVERT	PROPOSED TRANSVERSE CROSSING SIZE PIPE / BOX CULVERT	FLOOD IMMUNITY OF ROAD UPGRADE	WATER LEVEL UPSTREAM OF CULVERT (1% CC AEP)	AFFLUX IN FLOOD LEVEL UPSTREAM	COMMENTS ON UPSTREAM IMPACTS
321128 & 321129	Between North Oatlands Rd and Heard Ave	375 mm Dia & 450 mm Dia	375 mm Dia & 450 mm Dia	5% AEP	177.62	0.03	Private building and properties located near upstream crossing. LiDAR indicates flood impacts can be confined to Project boundary. Flood immunity has improved. An initial estimate of the road raising required to achieve 2% AEP flood immunity is approximately 0.54 m. Investigating raising the road level and additional culverts or increasing culvert size to achieve AustRoads criteria is recommended during detail design.

ROAD CHAINAGE	LOCATION DESCRIPTION	EXISTING TRANSVERSE CROSSING SIZE CONCRETE PIPE / BOX CULVERT	PROPOSED TRANSVERSE CROSSING SIZE PIPE / BOX CULVERT	FLOOD IMMUNITY OF ROAD UPGRADE	WATER LEVEL UPSTREAM OF CULVERT (1% CC AEP)	AFFLUX IN FLOOD LEVEL UPSTREAM	COMMENTS ON UPSTREAM IMPACTS
322360	North of Youngs Road (at Council wetland & upstream of Plenty River trib)	2 No. 750 mm Dia	3 No. 1800 mm x 1200 mm (width x height)	1% AEP plus Climate Change	165.49	0.00	Nillumbik Shire Council wetland located upstream of crossing. No afflux impacts and flood immunity exceeds AustRoads criteria. The updates to the Project since the surface water modelling include a roundabout at Yan Yean Road and Youngs Road and the project area including the Nillumbik Shire Council wetland. The extent of the latest road design results in a shorter transverse crossing length. Provided the transverse crossing size, gradient and road levels are based on the surface water modelling, afflux is not anticipated to occur at the transverse crossing inlet and AustRoads flood immunity criteria will be met.

ROAD CHAINAGE	LOCATION DESCRIPTION	EXISTING TRANSVERSE CROSSING SIZE CONCRETE PIPE / BOX CULVERT	PROPOSED TRANSVERSE CROSSING SIZE PIPE / BOX CULVERT	FLOOD IMMUNITY OF ROAD UPGRADE	WATER LEVEL UPSTREAM OF CULVERT (1% CC AEP)	AFFLUX IN FLOOD LEVEL UPSTREAM	COMMENTS ON UPSTREAM IMPACTS
322955	Between Bannons Lane and Golf Link Drive (upstream of Plenty River trib)	2 No. 750 mm Dia	4 No. 1200 mm x 900 mm (width x height)	1% AEP plus Climate Change	166.60	-0.05	No properties near upstream crossing. LiDAR indicated impacts confident to upstream Project boundary. Flood immunity exceeds AustRoads criteria. The updates to the Project since the surface water modelling include providing fencing at the boundary of the Golf Course and Yan Yean Road. This fencing will not impact afflux provided it does not obstruct flows of the tributary of Plenty River.
323573	Between Laurie St. and Bannons Lane (upstream of Yarrambat Lake)	900 mm Dia	900 mm Dia	10% AEP	173.36	-0.04	Properties near upstream crossing. LiDAR indicated no impacts beyond upstream Project boundary. Flood immunity has reduced. An initial estimate of the road raising required to achieve 2% AEP flood immunity is approximately 0.62 m. Investigating raising the road level and increasing the culvert number / size to achieve AustRoads criteria is recommended during detail design.

ROAD CHAINAGE	LOCATION DESCRIPTION	EXISTING TRANSVERSE CROSSING SIZE CONCRETE PIPE / BOX CULVERT	PROPOSED TRANSVERSE CROSSING SIZE PIPE / BOX CULVERT	FLOOD IMMUNITY OF ROAD UPGRADE	WATER LEVEL UPSTREAM OF CULVERT (1% CC AEP)	AFFLUX IN FLOOD LEVEL UPSTREAM	COMMENTS ON UPSTREAM IMPACTS
324852	North of Orchard Road (between school dam & Mel Water wetland)	1200 mm ×450 mm (width x height)	1200 mm ×450 mm (width x height)	10% AEP	170.45	-0.046	A school dam is located upstream of crossing. Mitigation of encroachment of road corridor on dam is required in consultation with School. Flood immunity has not changed. An initial estimate of the road raising required to achieve 2% AEP flood immunity is approximately 0.08 m. Investigating raising the road level to achieve AustRoads criteria is recommended during detail design. The updates to the Project since surface water modelling include upgrading the carpark at Plenty Valley Christian College. Most of the proposed works comprise re-surfacing of existing sealed carpark with minor newly sealed areas. Increases in peak discharge from the carpark should be managed within the carpark drainage network or at the school dam so as not to negatively impact on downstream flood levels.

ROAD CHAINAGE	LOCATION DESCRIPTION	EXISTING TRANSVERSE CROSSING SIZE CONCRETE PIPE / BOX CULVERT	PROPOSED TRANSVERSE CROSSING SIZE PIPE / BOX CULVERT	FLOOD IMMUNITY OF ROAD UPGRADE	WATER LEVEL UPSTREAM OF CULVERT (1% CC AEP)	AFFLUX IN FLOOD LEVEL UPSTREAM	COMMENTS ON UPSTREAM IMPACTS
325558	South of Bridge Inn Road	700 mm ×300 mm (width x height)	5 No 700 mm ×300 mm (width x height)	1% AEP plus Climate Change	164.68	-0.026	Post office and supply store located upstream of crossing. Reduction in flood level will not have negative impact on upstream flooding. Flood immunity exceeds AustRoads criteria.
325595	North of Bridge Inn Road	900 mm ×300 mm (width x height)	6 No 900 mm ×300 mm (width x height)	1% AEP plus Climate Change	164.87	-0.034	No buildings or sensitive receptors upstream of crossing. Reduction in flood level will not have a negative impact on upstream flooding. Flood immunity exceeds AustRoads criteria.

Table 7.2 Transverse crossings upstream afflux impacted by Yan Yean/Bridge Inn/Doctors Gully Road intersection design

ROAD CHAINAGE	LOCATION DESCRIPTION	LIKELY IMPACTS OF CHANGES TO INTERSECTION DESIGN SINCE SURFACE WATER MODELLING
325 558	South of Bridge Inn Road	At this transverse crossing, the intersection design has shifted east resulting in the post office and general store being located downstream of the modelled transverse crossing. The intersection layout has not significantly changed from the modelled design other than in this location. There are no sensitive water receptors upstream of the proposed transverse crossing that would be affected by afflux caused by the Project at this location. Provided the proposed transverse crossing and gradient is the same size as presented in Table 7.1, upstream afflux issues are not anticipated.
325 595	North of Bridge Inn Road	At this transverse crossing, the intersection layout has not significantly changed from the modelled design other than in this location. There is no sensitive water receptor located upstream of the proposed transverse crossing that would be affected by afflux caused by the Project at this location. Provided the proposed transverse crossing size and gradient remains the same as presented in Table 7.1, upstream afflux issues are not anticipated.

7.2.2 DRAINAGE IMPACT ASSESSMENT – OUTFALLS

7.2.2.1 FLOW REGIME AND DETENTION ASSESSMENT

The Project is located within the Nillumbik Shire Council and Whittlesea City Council administrative boundaries. Increases to impervious areas, due to road duplication, may increase stormwater runoff flow rates at outfall locations. The increase in peak flow rates may result in an increase in water volumes and flood levels at downstream receptors. An assessment of changes to the flow regime, flood risk and potential detention requirements is presented in Table 7.3. In the table the discharges to pipe systems are assessed for the 10% and 20% AEP events as these events are typically the design events for piped drainage systems. Discharges to open channels are assessed for the 10% and 1% AEP events, which have been selected to represent medium and high flood events in the channels.

A map presenting the locations of the outfalls is provided in Appendix C and hydrographs at each outfall (pre and post project) is presented in Appendix E.

It is noted the assessment is based on the functional design and outlet locations and connection will be reviewed during subsequent design stages.

A qualitative flow regime assessment of likely changes to the flood conditions at outfalls for the updates to the Project since the surface water modelling are presented in Table 7.3.

The likely outfall flow regime changes for the Yan Yean/Bridge Inn/Doctors Gully Road intersection are assessed in Table 7.4.

Table 7.3 Changes to flow regime, flood risk and potential detention required at each outfall

OUTFALL NAME	CHAINAGE (m)	OUTFALL TYPE	FLOW REGIME	FLOOD RISK	POTENTIAL DETENTION REQUIREMENTS (VOLUME DIFFERENCE ABOVE PRE-PROJECT PEAK FLOW) (m^3)	COMMENTS
Outfall A	Ch 320,654	Minor channel located downstream of existing culvert	10% AEP peak flow increases to 0.235 m^3/s (+ 0.074 m^3/s) 1% AEP peak flow increases to 0.718 m^3/s (+ 0.076 m^3/s)	10% AEP flood level increases from 169.874 m AHD to 169.881 m AHD (+ 7 mm) 1% AEP flood level increases from 169.919 m AHD to 169.920 m AHD (+ 1 mm)	10% AEP volume 57 m^3 1% AEP volume 15 m^3	As flows from this catchment are very minor the increase in peak runoff has only a negligible impact on water levels in the downstream channel. A review of aerial photography shows there are no properties or buildings immediately downstream of this outlet. The flood risk at this location is low. Detention at this outfall to mitigate for flood impacts is not required. However, based on a review of aerial images, the Project should have adequate area to accommodate the 10% detention volume within the Project boundary.

OUTFALL NAME	CHAINAGE (m)	OUTFALL TYPE	FLOW REGIME	FLOOD RISK	POTENTIAL DETENTION REQUIREMENTS (VOLUME DIFFERENCE ABOVE PRE-PROJECT PEAK FLOW) (m^3)	COMMENTS
Outfall B	Ch 320,754	375 mm diameter pipe	20% AEP peak flow increases to 0.146 m^3/s (+ 0.076 m^3/s) 10% AEP peak flow increases to 0.716 m^3/s (+ 0.092 m^3/s)	No overland flows at this location for the 1% AEP based on pre and post project models.	20% AEP volume 25 m^3 10% AEP volume 32 m^3	The flow rates to the existing pipe network are minor, however, as the pipe network comprises 375 mm diameter, it is likely any increases in frequent discharges (20% or 10% AEP) could create pipe capacity issues. No flood risk issues are identified at this location. Discharges from the Project are confined to the pipe network. Based on a review of aerial images and the location of swales within the sub-catchment, the Project should have sufficient area to accommodate detention for the 10% AEP event. Since the surface water modelling, the project area was updated to include a Council pond on Worns Lane. At the next design stage, if Council confirms the capacity of the existing drainage network is lower than the 20% AEP, drainage options may need to consider using the Council dam in addition to swales to store the peak design discharge prior to connecting to the existing drainage network. A feature survey of the Council pipe network and pond is required to confirm if using the Council pond for additional peak storage is a viable option.

OUTFALL NAME	CHAINAGE (m)	OUTFALL TYPE	FLOW REGIME	FLOOD RISK	POTENTIAL DETENTION REQUIREMENTS (VOLUME DIFFERENCE ABOVE PRE-PROJECT PEAK FLOW) (m^3)	COMMENTS
Outfall C	Ch 321,128	450 mm diameter pipe	20% AEP peak flow increases to 0.483 m^3/s (+ 0.035 m^3/s) 10% AEP peak flow decreases to 0.618 m^3/s (- 0.029 m^3/s)	The drainage model indicates a reduction in peak flows for the 1% AEP event at this outfall. The pre project model indicates there is an overland flow path for the 1% AEP event. The post project model indicates there are no overland flows occurring at this location.	20% AEP volume 12 m^3 10% AEP volume 0 m^3	The reduction in peak flows for the 10% and 1% AEP events may be because of changes to drainage catchments, the proposed swales providing conveyance and transverse drainage restricting downstream discharge rates for less frequent events. No flood risk issues are identified at this location. Discharges from the Project are confined to the pipe network. The Project should have sufficient area to accommodate detention for the 20% AEP event. It is likely this detention requirement could be provided in the sub-catchment swales.

OUTFALL NAME	CHAINAGE (m)	OUTFALL TYPE	FLOW REGIME	FLOOD RISK	POTENTIAL DETENTION REQUIREMENTS (VOLUME DIFFERENCE ABOVE PRE-PROJECT PEAK FLOW) (m^3)	COMMENTS
Outfall D	Ch 322,360	Tributary of Plenty River (Melbourne Water asset)	10% AEP peak flow increases to 3.622 m^3/s (+ 0.06 m^3/s) 1% AEP peak flow decreases to 10.351 m^3/s (- 0.39 m^3/s)	The drainage model indicates there is a reduction in peak flows from the 1% AEP at the outlet location. The slight increase in flows for the 10% AEP event does not result in an increase to flood levels at the outfall.	10% AEP volume 13 m^3 1% AEP volume 0 m^3	The reduction in peak flows for the 1% AEP event is due to the road gradient being raised to improve the flood immunity of Yan Yean Road. An assessment of the impacts of raising the road level on upstream afflux is provided in Table 7.1. No downstream flood risk issues are identified at this outfall. The Project should have sufficient area to accommodate detention for the 10% AEP event. It is likely this detention requirement could be provided in the sub-catchment swales. The updates to the Project since surface water modelling include a shorter transverse crossing length at this outfall. Provided the transverse crossing size, gradient and outlet arrangement are based on the drainage design, it is not anticipated the design updates will impact flood risk at this outfall.

OUTFALL NAME	CHAINAGE (m)	OUTFALL TYPE	FLOW REGIME	FLOOD RISK	POTENTIAL DETENTION REQUIREMENTS (VOLUME DIFFERENCE ABOVE PRE-PROJECT PEAK FLOW) (m^3)	COMMENTS
Outfall E	Ch 322,955	Tributary of Plenty River within golf course (Melbourne Water asset)	10% AEP peak flow increases to 4.00 m^3/s (+ 1.05 m^3/s) 1% AEP peak flow decreases to 10.14 m^3/s (- 0.28 m^3/s)	The channel located between Yan Yean Road and the waterbody at the golf course indicates flood levels may increase by 82 mm for the 10% AEP event (flood level increase at downstream section of channel).	10% AEP volume 175 m^3 1% AEP volume 0 m^3	The hydrograph for the 10% AEP post project hydrograph peaks quicker and higher than pre-project indicating the increase in peak flow is primarily related to a conveyance (rather than detention). The hydrograph indicates the proposed sizing of the transverse drainage is too large, allowing water to release quicker into the downstream catchment. At detail design, it is recommended the drainage network is refined to mitigate the impact of the increase in post project peak flow. The total area beneath the post project hydrograph is approximately 175 m^3 greater than pre- project volumes for the 10% AEP. From reviewing aerial images, the Project does not have adequate space to provide detention for the 10%AEP. Further analysis is recommended at the next stage of design to model the impact on flows and flood levels in detail to determine the extent and level of impact for the 10% AEP event. While the flow is increased, it is anticipated that this will not translate to a significant change in flood level upstream or downstream of the road corridor and minor changes to flood levels may be acceptable given the relatively low sensitivity of the adjacent

OUTFALL NAME	CHAINAGE (m)	OUTFALL TYPE	FLOW REGIME	FLOOD RISK	POTENTIAL DETENTION REQUIREMENTS (VOLUME DIFFERENCE ABOVE PRE-PROJECT PEAK FLOW) (m^3)	COMMENTS
						land. Consultation with adjacent landowners on these impacts should be undertaken as required if the flood level changes are found to be significant. It is noted the outfall is to a golf course and approximately 100 m downstream of the outfall there is an existing basin/waterbody followed by a series of basins along this reach of the tributary of the Plenty River. The estimated increase in volume from the 10% AEP would take approximately 0.2 m additional depth in the nearest golf course basin (basin surface area is approximate and based on Site Map aerial image). Discussions with the Golf Course and Melbourne Water is recommended to understand if mitigation of peak flows for the 10% AEP event is required. The updates to the Project since surface water modelling include providing fencing at the boundary of the Golf Course and Yan Yean Road. This fencing will not impact flood risk provided it does not to obstruct flows of the tributary of Plenty River.

OUTFALL NAME	CHAINAGE (m)	OUTFALL TYPE	FLOW REGIME	FLOOD RISK	POTENTIAL DETENTION REQUIREMENTS (VOLUME DIFFERENCE ABOVE PRE-PROJECT PEAK FLOW) (m^3)	COMMENTS
Outfall F	Ch 323,573	Upstream of Yarrambat Lake	10% AEP peak flow increases to 1.419 m^3/s (+ 0.18 m^3/s) 1% AEP peak flow increases to 3.667 m^3/s (+ 0.32 m^3/s)	The outfall is immediately upstream of a large lake. The estimated increase in volume from the 1% AEP at the lake is approximately 5 mm depth.	10% AEP volume 60 m^3 1% AEP volume 85 m^3	The flood risk from the Project at this outfall is low as the receptor is a large lake. As a result, it is not anticipated detention is required to mitigate flows for the 1% AEP. The Yarrambat Lake was identified by the biodiversity team as being a water quality sensitive receptor. A WSRD design for a 50 m^3 bio-retention basin is proposed to treat road discharge prior to runoff entering the lake, refer to Section 7.2.2.2. It is noted there are numerous trees at this outfall and the Project will need to site a suitable location for the bio-retention basin.
Outfall G	Jorgensen Avenue	Werther Park adjacent to Jorgensen Avenue (hydraulic model outlet is open channel)	10% AEP peak flow increases to 0.385 m^3/s (+ 0.014m^3/s) 1% AEP peak flow increases to 0.428 m^3/s (+ 0.01 m^3/s)	As pre and post flow rates for the 1% AEP are similar an increase in flood risk at this location is not anticipated.	10% AEP volume 1.26 m^3 1% AEP volume 3.12 m^3	No flood risk issues are identified at this location. The drainage model is currently showing a decrease in flood level pre and post project at the outlet. The very minor increase to detention volumes can be accommodated within the road drainage network without requiring additional land purchase.

OUTFALL NAME	CHAINAGE (m)	OUTFALL TYPE	FLOW REGIME	FLOOD RISK	POTENTIAL DETENTION REQUIREMENTS (VOLUME DIFFERENCE ABOVE PRE-PROJECT PEAK FLOW) (m^3)	COMMENTS
Outfall H	Orchard Road	375 mm diameter pipe (transverse crossing at Orchard Road)	20% AEP peak flow increases to 0.97 m^3/s (+ 0.20 m^3/s) 10% AEP peak flow increases to 1.19 m^3/s (+ 0.24 m^3/s)	While discharge to this location is to a pipe network there is an overland flow path for both pre and post project. The flood depth over Orchard Road for the 1% AEP increases by 30 mm post project development.	20% AEP volume 30 m^3 10% AEP volume 40 m^3	The pre and post project hydrographs show the existing pipe capacity is reached at the 20% AEP. Detention to store the 10% AEP volume will need to be provided prior to discharge to the Orchard Road 375 mm diameter pipe. While the Project has an area available for a detention adjacent to Orchard Road, additional area may be required to accommodate associated basin earthworks. Detail drainage modelling will need to demonstrate the benefits of the detention basin and mitigate the identified 1% AEP overland flow afflux.

OUTFALL NAME	CHAINAGE (m)	OUTFALL TYPE	FLOW REGIME	FLOOD RISK	POTENTIAL DETENTION REQUIREMENTS (VOLUME DIFFERENCE ABOVE PRE-PROJECT PEAK FLOW) (m^3)	COMMENTS
Outfall I	Ch 324,800	Upstream of Vaucluse wetland (Melbourne Water asset)	10% AEP peak flow increases to 1.545 m^3/s (+ 0.30 m^3/s) 1% AEP peak flow reduces to 3.37 m^3/s (-0.018 m^3/s)	The drainage model is indicating there is an approximate 20 mm reduction in water level downstream of the outfall. Flood risk for this outfall is considered low.	10% AEP volume 122 m^3 1% AEP volume 0 m^3	This wetland acts as a water quality treatment system for the nearby residential development. Melbourne Water require no increase in volumes to this wetland for AEPs up to 1%AEP. While the flood risk at this outfall is low, the functionality of the wetland can't be comprised. A range of AEP events were analysed in the 1D drainage model with the 10% AEP producing the highest increases in volume. However, the hydrograph for the 10% AEP indicates total volumes to the wetland decrease (i.e. the increase in hydrograph peak is a conveyance issue). It is recommended at detail design stage, refined hydraulic modelling of the outlet arrangement of the school dam and the proposed transverse crossing is carried out. Changes to the outlet from the school dam is likely to mitigate this increase in peak flow to the wetland. It is noted should detention be required following detail design modelling, there is sufficient capacity in the reduced school dam to accommodate the 122 m^3 volume. The outlet arrangement may need to be modified to utilise available dam storage volume.

OUTFALL NAME	CHAINAGE (m)	OUTFALL TYPE	FLOW REGIME	FLOOD RISK	POTENTIAL DETENTION REQUIREMENTS (VOLUME DIFFERENCE ABOVE PRE-PROJECT PEAK FLOW) (m^3)	COMMENTS
						The updates to the Project since surface water modelling include upgrading the carpark at Plenty Valley Christian College. Most of the proposed works comprise re-surfacing of existing sealed carpark with minor newly sealed areas. It anticipated any increase in peak discharges from the carpark can be managed within the carpark drainage network or at the school dam so as not to negatively impact on Vaucluse wetland.
Outfall J	Ch 325,595	Open channel. Existing stormwater pipe located between Bridge Inn Road and Yan Yean Road roundabout and Yellow Brick Road.	20% AEP peak flow increases to 0.425 m^3/s (+ 0.038 m^3/s) 10% AEP peak flow increases to 0.669 m^3/s (+ 0.05 m^3/s)	1% AEP flood level increases by 10 mm	20% AEP volume 6 m^3 10% AEP volume 11 m^3	The flood risk from the Project at this outfall is low. The volume increase above peak flow rate is very minor and it is anticipated this increase in volume can be mitigated within the proposed drainage network at detail design stage (i.e. no additional land purchase requirement identified).

OUTFALL NAME	CHAINAGE (m)	OUTFALL TYPE	FLOW REGIME	FLOOD RISK	POTENTIAL DETENTION REQUIREMENTS (VOLUME DIFFERENCE ABOVE PRE-PROJECT PEAK FLOW) (m^3)	COMMENTS
Outfall K	Bridge Inn Road	1500 mm diameter pipe. Large diameter pipe is Orchard Road drain located on Bridge Inn Road.	20% AEP peak flow increases to 3.049 m^3/s (+ 0.378 m^3/s) 10% AEP peak flow increases to 4.886 m^3/s (+ 0.527 m^3/s) 2% AEP peak flow increases to 7.207 m^3/s (+ 0.286 m^3/s)	Overland flow path for the 1% AEP event is showing a decrease in flood level of 25 mm.	20% AEP volume 60 m^3 10% AEP volume 117 m^3 2% AEP volume 57 m^3	According to both existing and proposed case drainage models, the 1500 mm diameter Orchard Road Drain has capacity to convey 2% AEP storm. As this is a DS asset, changes to the pipe capacity was reviewed for the 20%, 10% and 2% AEPs. The decrease in the 1% AEP peak flow is due to a slight delay in stormwater discharge at the upstream of the proposed culverts north of Bridge Inn Road. The delay in stormwater discharge is due to the improved road flood immunity. At detail design the capacity of the 1500 mm diameter pipe will need to be confirmed and incorporated into the detail drainage model. Utilising the proposed swales to attenuate additional runoff volumes prior to the connection to Orchard Road drain is recommended.

Table 7.4 Outfalls and changes to flow regime for Yan Yean/Bridge Inn/Doctors Gully Road intersection

OUTFALL NAME	OUTFALL TYPE	LIKELY IMPACTS OF CHANGES TO INTERSECTION DESIGN SINCE SURFACE WATER MODELLING
Outfall J	Open channel	The intersection design and proposed transverse crossing has shifted east resulting in the post office and general store being located downstream of Outfall J. Provided the total road extent, profile and transverse crossing design remains similar to the modelled design, the environmental impacts do not change and it is anticipated the estimated volume increase above peak discharge can be mitigated within the proposed drainage network at detail design stage.
Outfall K	1500 mm diameter pipe (Orchard Road drain)	Two River Red Gum trees are located downstream of the proposed transverse crossing. Outfall K is the 1500 mm diameter Orchard Road pipe. The intersection design provides land within the project area upstream of the two River Red Gum trees that potentially could manage peak flows and volumes prior to connection to Orchard Road drain. Specific flow regime criteria at the downstream outlet of the transverse crossing due to the proximity of the two River Red Gum trees should be confirmed during the detailed design stage.

7.2.2.2 STORMWATER QUALITY

STORMWATER TREATMENT ELEMENTS

The proposed road surface drainage (impervious area) will be collected via kerb and channel. Table drains are proposed to intercept external catchment runoff and to collect runoff from the Project embankments. To achieve the BPEMG stormwater criteria, it is proposed the table drains located at the toe of embankments are upgraded to grassed swales and connections are made to the kerb outlets. This allows the swales to collect and treat runoff from the impervious areas within the project area. A total of 13 grassed swales with a combined length of 5.13 km of has been identified where a gravity connection to the kerb outlet is achievable.

In addition to swales, a bioretention basin is proposed upstream of Yarrambat Lake. They provide efficient treatment of stormwater through filtration, extended detention and some biological uptake.

A map presenting the Project sub-catchments contributing runoff to each outfall and the location of WSRD treatment elements, is presented in Appendix C.

MUSIC MODELLING INPUTS

Using the Melbourne Water Rainfall distribution map (2010), the Project was found to be located within the Melbourne City weather station region. A Melbourne Water MUSIC meteorological template consisting of a ten-year record of rainfall and evaporation data was available for this station and was adopted with a 6 minute timestep for continuous simulation in MUSIC.

Default model parameters for source nodes were adopted, with the exception of pervious area soil storage capacity and field capacity which has been set to 120 mm and 50 mm respectively as per the 2018 Melbourne Water MUSIC Guidelines.

Grassed swales with a vegetation height of 0.1 m and an exfiltration rate of 0 mm/hr was adopted per the guidelines. A 50 m² of bioretention basin was proposed at the stormwater outfall upstream of Yarrambat Lake, a sensitive receptor. The properties adopted for the grassed swales and bioretention basin are presented in Appendix D.

The grassed swales and bioretention system service a total road catchment area of 26.6 hectares and uniform impervious percentage of 80%. The pollutant load reduction (kg/yr) achieved from the treatment measures and their respective sub-catchment areas is compared to the source loads from the new impervious areas (i.e. proposed sealed road surfaces) to identify if the target percentage reduction is achieved for each pollutant constituent.

MUSIC MODELLING RESULTS

The project-wide results of the MUSIC modelling are summarised in Table 7.5. The MUSIC results of individual sub- catchments are provided in Appendix D.

Table 7.5 Proposed project wide MUSIC modelling results

POLLUTANT TYPE	SOURCE LOADS – NEW IMPERVIOUS AREAS	SOURCE LOADS – TREATMENT AREAS	RESIDUAL LOADS – TREATMENT AREAS	% REDUCTION FROM NEW IMPERVIOUS AREAS	TARGET % REDUCTION	TARGET MET?
TSS [kg/y]	19,775	44,040	8,513	179	80	YES
TP [kg/y]	33	74	26	144	45	YES
TN [kg/y]	135	308	217	67	45	YES
Litter [kg/y]	2,041	4,912	673	207	70	YES

The MUSIC modelling showed it is possible to achieve and exceed the WSRD targets for the Project utilising the Project swales. At a minimum, the Project requires 2.89 km of swale, servicing a road catchment area of 15 hectares to achieve the BPEMG targets. This represents approximately 55% of the current length of project swales proposed (5.13 km). However, it is noted the function of the project swales is not only to provide water quality treatment but to prevent erosion and ponding of water at the base of the proposed road embankments.

WATER QUALITY SENSITIVE RECEPTOR RESULTS

Based on the WSP Flora and Fauna Impact Assessment and feedback from Nillumbik Shire Council and Melbourne Water, the following waterbodies were identified as sensitive receptors, where runoff from the Project must be treated to best practice water quality standards at the sub-catchment prior to discharge:

- **Vaucluse wetland** at Orchards Road is a Melbourne Water asset (chainage 324,852): Melbourne Water require the stormwater quality from the Project entering the Vaucluse Wetland to meet BPEMG criteria.

  According to the Project reference drainage design, there is a net decrease in the imperviousness of the road catchment contributing to Vaucluse wetland. This is due to the proposed road re-grading and the subsequent diversion of existing stormwater flows to a southern outfall.

  The Project therefore does not have the potential to increase the stormwater pollutant load contributing to this sensitive receptor. The MUSIC model determined no additional stormwater treatment elements, other than the proposed road swales, were required upstream of Vaucluse wetland to meet BPEMG criteria.

  The updates to the Project since surface water modelling include upgrading the carpark at Plenty Valley Christian College with minor newly sealed areas. At the next design stage, if water quality impacts at Vaucluse wetland are identified due to the carpark, WSRD elements will be required prior to Vaucluse wetland receiving carpark runoff.

- **Nillumbik Shire Council wetland** at Young's Road and Yan Yean Road junction (chainage 322,360):

  In terms of stormwater runoff from the project area, the MUSIC model determined the road sub-catchment at this sensitive receptor meets BPEMG criteria.

  The extent of the latest road design including embankments do not impact on the wetland cells or wetland embankments. Changes to the transverse crossing inlet arrangement at Yan Yean Road are required, however, these can be managed so as not to impact on the water quality treatment function of the wetland.

- The updated project area includes Nillumbik Shire Council wetland. Nillumbik Shire Council are to be consulted prior to the Construction Stage and provided with the opportunity for input on the management construction risks that could impact on water quality at the wetland.

- **Yarrambat Lake** west of Bannons Lane and Yan Yean Road junction (chainage 323,560):

  The MUSIC model identified the Project had the potential to increase the pollutant loading at Yarrambat Lake based on providing swale treatment only. To maintain the beneficial use of this receptor, a 50 m² of bioretention basin is required upstream of Yarrambat Lake. MUSIC results show in this sub-catchment, the proposed swales and bioretention will treat stormwater pollutants to BPEMG criteria.

  The MUSIC modelling results at Yarrambat Lake, a sensitive receptor, are summarised in Table 7.6. The results demonstrate with the proposed grass swales and bioretention basin, it is possible to achieve and exceed the WSRD targets for the Project at this outfall.

Table 7.6 Proposed Project MUSIC modelling results upstream of Yarrambat Lake

POLLUTANT TYPE	SOURCE LOADS – NEW IMPERVIOUS AREAS	SOURCE LOADS – TREATMENT AREAS	RESIDUAL LOADS – TREATMENT AREAS	% REDUCTION FROM NEW IMPERVIOUS AREAS	TARGET % REDUCTION	TARGET MET?
TSS [kg/y]	3180	4570	811	118	80	YES
TP [kg/y]	5.4	7.7	2.7	92	45	YES
TN [kg/y]	22	32	19	61	45	YES
Litter [kg/y]	331	509	0	154	70	YES

7.2.3 STORMWATER QUALITY ASSESSMENT – YAN YEAN / BRIDGE INN / DOCTORS GULLY ROAD INTERSECTION

A qualitative assessment of the impacts to stormwater quality for the Yan Yean/Bridge Inn/Doctors Gully Road intersection based on the 2019 MUSIC model was undertaken. The intersection design does not significantly increase the impervious area of the Project. The 2019 stormwater quality modelling, that included swales at the Yan Yean/Bridge Inn/Doctors Gully Road intersection, indicate Outfall K (the catchment contributing runoff towards the two River Red Gum trees) is achieving compliance with Melbourne Water/BPEMG stormwater quality targets.

However, the swale lengths provided in the 2019 model have not yet been included in the current design for the Yan Yean/Bridge Inn/Doctors Gully Road intersection. If the detailed design proceeds with swales similar to those proposed in the 2019 model, compliance with Melbourne Water/BPEMG stormwater quality targets should be met.

While the residual environmental risk is considered low for stormwater quality, it is on the presumption that a 3D drainage model is prepared during the detailed design and storm water quality modelling is confirmed to meet Melbourne Water/BPEMG stormwater quality targets.

7.2.4 WATER ENTITLEMENTS

A search of the Victorian Water Register listed 21 schemes (2 domestic & stock and 19 irrigation schemes) that either directly extract surface water or harvest water using off-waterway dams from within Plenty River catchment. The total volume of water harvested or extracted from Plenty River is 459 ML per annum.

The location of each licence location should be determined prior to the construction phase and should inform the surface water risk assessment and management procedures within the CEMP.

7.2.5 RECREATION, AESTHETICS AND ENVIRONMENTAL VALUES

Melbourne Water provide key environmental value rankings for the Plenty River Lower Sub-catchment within the Yarra Catchment (Healthy Waterways Strategy, 2018 and Co-Designed Catchment Program for the Yarra Catchment). A summary of the current state, current trajectory, and target trajectory measure of health condition for key environmental values is summarised in Table 7.7.

Table 7.7 Key Values in the Plenty River Lower Sub-catchment

KEY VALUE (10-50 YEAR TARGETS)	CURRENT STATE	CURRENT TRAJECTORY	TARGET TRAJECTORY
Platypus	Very Low	Very Low	Low
Fish	Moderate	High	High
Frog	Very Low	Very Low	Very Low
Bird	Moderate	Very Low	Moderate
Vegetation	Moderate	Low	High
Macroinvertebrate	Low	Low	Low
Amenity	High	High	Very High

Construction works have the potential to impact the key environmental values if not managed appropriately. Prior to construction, a CEMP will be prepared and implemented for the Project to mitigate construction impacts.

7.2.6 DRINKING WATER

Drinking water is provided by Yarra Water, as the retail water authority. Yarra Water buys bulk water from Melbourne Water, which is mostly harvested from protected mountain catchments.

It is not considered likely that regional drinking water would be sourced from the surface water bodies located in the project area. The risk of construction activities directly impacting drinking water, other than the planned works at Yarra Water pumping station, is negligible.

7.2.7 INTERFACE WITH PRIVATE AND COUNCIL DRAINAGE ASSETS

7.2.7.1 PRIVATE ASSETS

Nillumbik Shire Council has identified several properties that may require relocation of onsite wastewater treatment areas. Nillumbik Shire Council has also identified 17 properties located on Yan Yean Road, between Bannons Lane and Laurie street, which may discharge stormwater offsite to the road side drain (then to Yarrambat Lake).

To mitigate the risk of impacting water management systems within private properties or outlets from private properties to the existing drainage network, investigations will need to be conducted to confirm if onsite systems are being impacted by the Project. If the onsite water management systems are impacted, options during detailed design may include upgrading the existing systems at the properties or incorporating connections from private properties into the detailed drainage design.

The Project footprint directly impacts on the capacity of the school dam. This will need to be addressed as required during detail design and in consultation with School authority.

7.2.7.2 COUNCIL DRAINAGE WORKS AND ASSETS

Proposed Project drainage works at the east end of Ironbark Road, may have the potential to impact on Nillumbik Shire Council's proposed future streetscape works. Nillumbik Shire Council will be consulted regarding potential impacts to proposed future streetscape works.

The Project works directly impact the Nillumbik Shire Council wetland located north of Youngs Road. Nillumbik Shire Council will be consulted regarding any potential mitigation measures for this wetland during the detailed design phase.

The Orchard Road drain collects runoff an upstream urban area and the existing Yan Yean Road. Whittlesea Shire Council is to be consulted during detail design to ensure the impacts to the Orchard Road drain is acceptable and does not comprise any future Council plans for this asset.

8 ENVIRONMENTAL PERFORMANCE REQUIREMENTS

Table 8.1 lists the proposed EPRs based on this SWIA assessment and in addition to standard controls.

Table 8.1 EPRs relevant to surface water

PERFORMANCE OBJECTIVE	APPLICABLE LEGISLATION, POLICY AND GUIDELINE	EPR CODE	RISK NO.	ENVIRONMENTAL PERFORMANCE REQUIREMENT	PROJECT PHASE
Effects on physical environment: Identify other potential adverse environmental effects of the project, such as on social and community amenity canvass an environmental management approach and performance measures to ensure any effects are identified and avoided, minimised or mitigated.					
Surface water To maintain or improve existing surface water quality and protect beneficial uses	State Environment Protection Policy (Waters) *Water Act 1989* Melbourne Water Performance Criteria EPA Publications 275, 480 and 960 MRPV Integrated Water Management Guideline (2020)	SW1	15, 34, 55 and 75	**Surface water management** The CEMP must include processes and measures to manage surface water in accordance with the relevant water objectives set out in the State Environment Protection Policy (Waters), Melbourne Water Performance Criteria and other relevant statutory requirements. Mitigation and management measures would be informed by Melbourne Water and Council requirements, EPA Publications 275, 480 and 960 and include: — best practice sediment and erosion control, including measures to prevent contamination of surface waters from contaminated soils if/when encountered and the management of dewatering of earthworks areas following storm events — maintenance of existing flow paths, drainage lines and floodplain storage or, where modification of existing flow paths cannot be avoided, mitigating the effects of changes to flow to the extent practicable — water quality monitoring during construction and management of drainage infrastructure to be carried out in accordance with MRPV's Integrated Water Management Guideline (2020) — stormwater or flood modelling and implementation of mitigation solutions and management measures for temporary works as required — flood emergency management including consideration of scheduling works — maximising the visual and aesthetic amenity of waterways having regard to any relevant development plans in consultation with Melbourne Water — refuelling in designated areas where hardstand is present and removal of impacted soils following minor spills.	Design and construction

PERFORMANCE OBJECTIVE	APPLICABLE LEGISLATION, POLICY AND GUIDELINE	EPR CODE	RISK NO.	ENVIRONMENTAL PERFORMANCE REQUIREMENT	PROJECT PHASE
		SW2	95	**Design to minimise surface water impacts** Design the Project to minimise impacts on the hydrologic and/or hydraulic regime of waterways and stormwater risks, including: — develop a detailed drainage model based on the 3D road detailed design to comply with Austroads, Council and Melbourne Water guidelines. A spill risk assessment will be conducted for each outfall based on the likelihood of a spill, which is estimated based on the road characteristics (geometry) of the outfall catchment, and its proximity to the downstream water sensitive receptors (i.e. consequence of the spill). Outfalls with a high spill risk are to provide spill containment — discharge and runoff to meet the relevant water objectives set out in the State Environment Protection Policy (Waters), Melbourne Water Performance Criteria and other relevant statutory requirements — for outfalls to major main drains or waterways, determine specific requirements in consultation with Melbourne Water — minimise risk from changes to flood levels, flows and velocities. Permanent works must not increase overall flood risk at relevant locations or modify the flow regime of waterways without the acceptance of the relevant flood plain manager, drainage authority or asset owner — minimise impacts on private, Council and Melbourne Water drainage assets — comply with Melbourne Water Performance Criteria and MRPV's Integrated Water Management Guideline (2020).	Design and construction
Environmental Management Framework	*Legislation and policy as identified in all EPRs*	EMF5	115	**Operation and maintenance** Any potential impacts during operation and maintenance will be managed in accordance with the Department of Transport's environmental management system and standards for managing declared roads in Victoria.	Operation and maintenance

9 CONCLUSION

This SWIA identified the key surface water impacts of the Project. It covers the flooding, drainage and water quality components of water environments.

This assessment identified changes to catchment drainage, flooding behaviour and management of stormwater runoff generated from the Project. The assessment of the proposed transverse drainage mitigated upstream afflux impacts for the 1% AEP plus climate change and quantified the flood immunity of Yan Yean Road based on the Project.

Assessment of changes to outfall flow rates and peak water levels was carried out for the 1% AEP plus climate change at key crossing locations (i.e. upstream of sensitive receptors and Melbourne Water tributaries of Plenty River). In general, the Project causes a decrease in peak flow and peak water level at downstream receptors, except Vaucluse wetland which shows a 20 mm increase for the 1% AEP plus climate change.

Where the design has progressed since the modelling was undertaken, a high-level qualitative assessment of flood impacts was completed. In general, increases to flood levels (afflux) upstream of transverse crossings and at outlets are not anticipated to be significant and can be managed through the drainage design at the next design phase.

BPEMG targets are achieved for stormwater runoff at the Project by applying WSRD elements. The WSRD treatment elements include project swales and a bioretention basin.

A high-level qualitative assessment of stormwater quality impacts was undertaken where the design has progressed since the modelling was completed. The Plenty Valley Christian College carpark is not developed to functional design. The proposed carpark includes minor increases to sealed impervious areas. It is anticipated stormwater quality impacts from the increase in impervious areas can be managed through carpark drainage design.

The Yan Yean/Bridge Inn/Doctors Gully Road intersection design is not developed to functional design and currently does not include swale lengths, as per the modelled design. A treatment swale system or similar will need to be incorporated for the intersection design to ensure compliance with Melbourne Water/BPEMG stormwater quality targets.

Environmental performance requirements are proposed to reduce risks and impacts and further consultation with authorities and asset owners is recommended during detail design in accordance with the EPRs.

An environmental risk assessment includes the likely impact of the modelled design and the refined Yan Yean/ Bridge Inn/Doctors Gully Road intersection design. The environmental risk assessment has determined that all residual risks ‘low’ assuming the proposed EPRs are implemented. This includes, but is not limited to, a 3D drainage model and spills risk assessment that comply with Melbourne Water/BPEMG stormwater quality and conveyance targets.

A CEMP will be prepared and implemented for the Project in accordance with the EPRs and EMF for the Project. The CEMP should outline how the contractor will comply with any environmental conditions for the Project and provide a framework to ensure that environmental risks are properly managed. The environmental impact of construction on surface water is considered low.

As the Project progresses to detailed design and construction stages, MRPV will need to consult with Councils and Melbourne Water to demonstrate the detailed design satisfies the applicable criteria in accordance with the EPRs. Recommendations from this SWIA are to be incorporated into the detailed design phase in accordance with the EPRs.

10 LIMITATION STATEMENT

This Report is provided by WSP Australia Pty Limited (WSP) for MRPV (Client) in response to specific instructions from the Client and in accordance with WSP's scope of works and agreement with the Client.

10.1 PERMITTED PURPOSE

This Report is provided by WSP for the purpose described in the Agreement and no responsibility is accepted by WSP for the use of the Report in whole or in part, for any other purpose (Permitted Purpose).

10.2 QUALIFICATIONS AND ASSUMPTIONS

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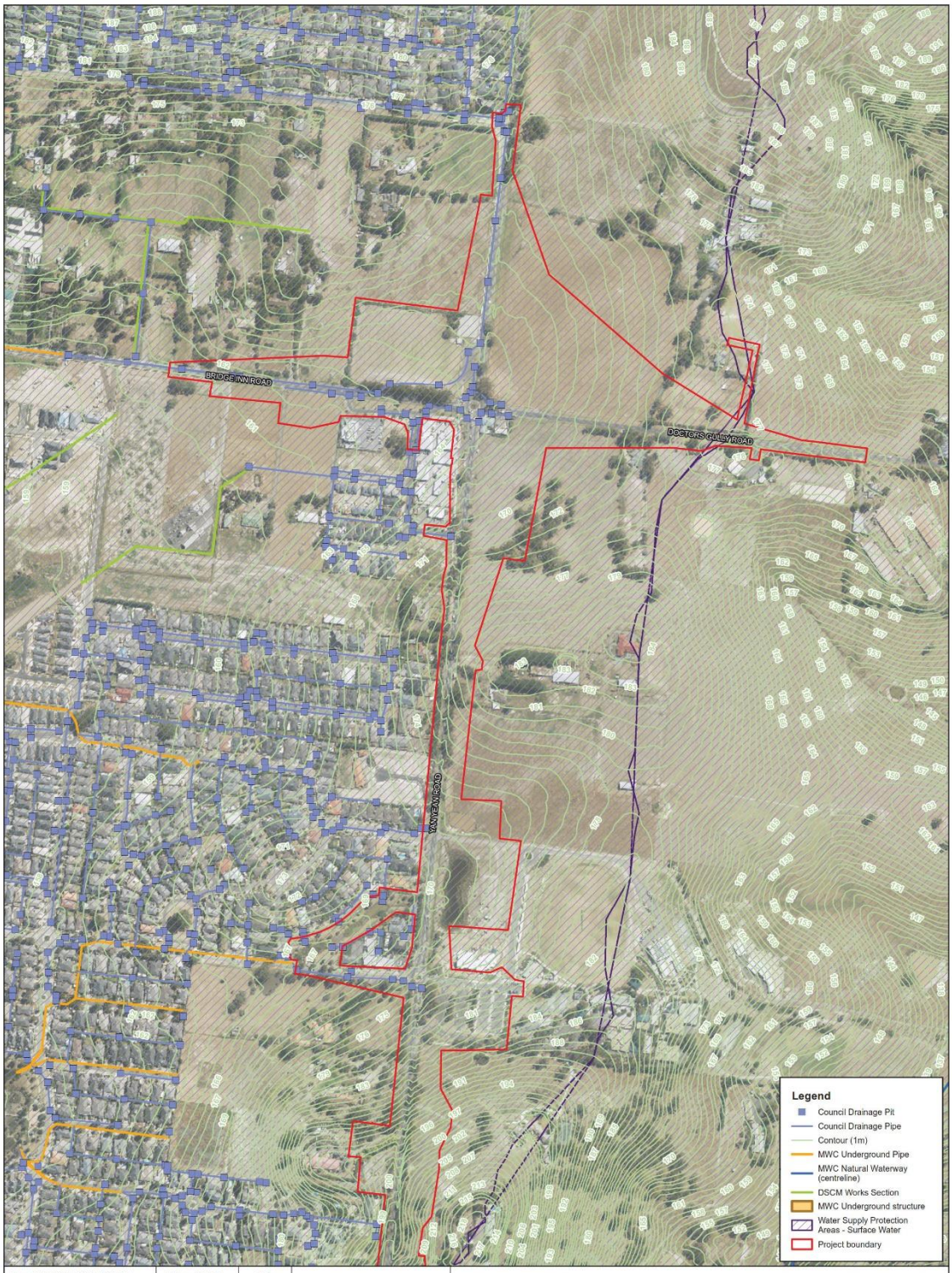
APPENDIX A

SURFACE WATER OVERVIEW MAPS



Map: 2135645A_GIS_1429_B1	Author: AS/RP
Date: 3/25/2020	Approved by: MG

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VICTORIA State Government

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Engineering and Technical Services for Yan Yean Road Upgrade EES

Surface Water Assessment

Figure 1

Drainage Scheme and Surface Water overview - Map 1

Map: 2135645A_GIS_1429_B1	Author: AS/RP
Date: 3/25/2020	Approved by: MG

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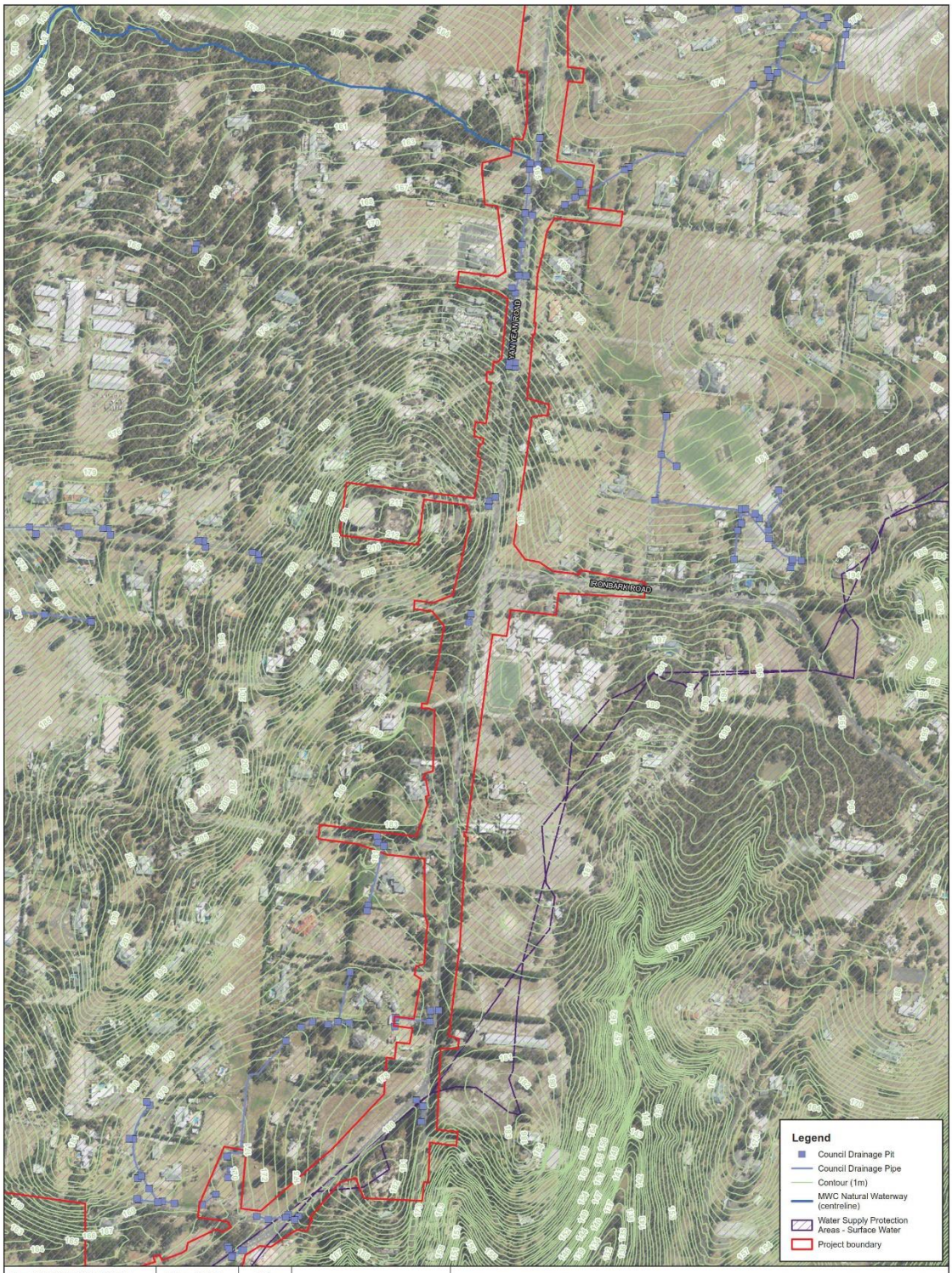
Engineering and Technical Services for Yan Yean Road Upgrade EES
Surface Water Assessment
Figure 1
Drainage Scheme and Surface Water overview - Map 2



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Date: 3/25/2020	Approved by: MG

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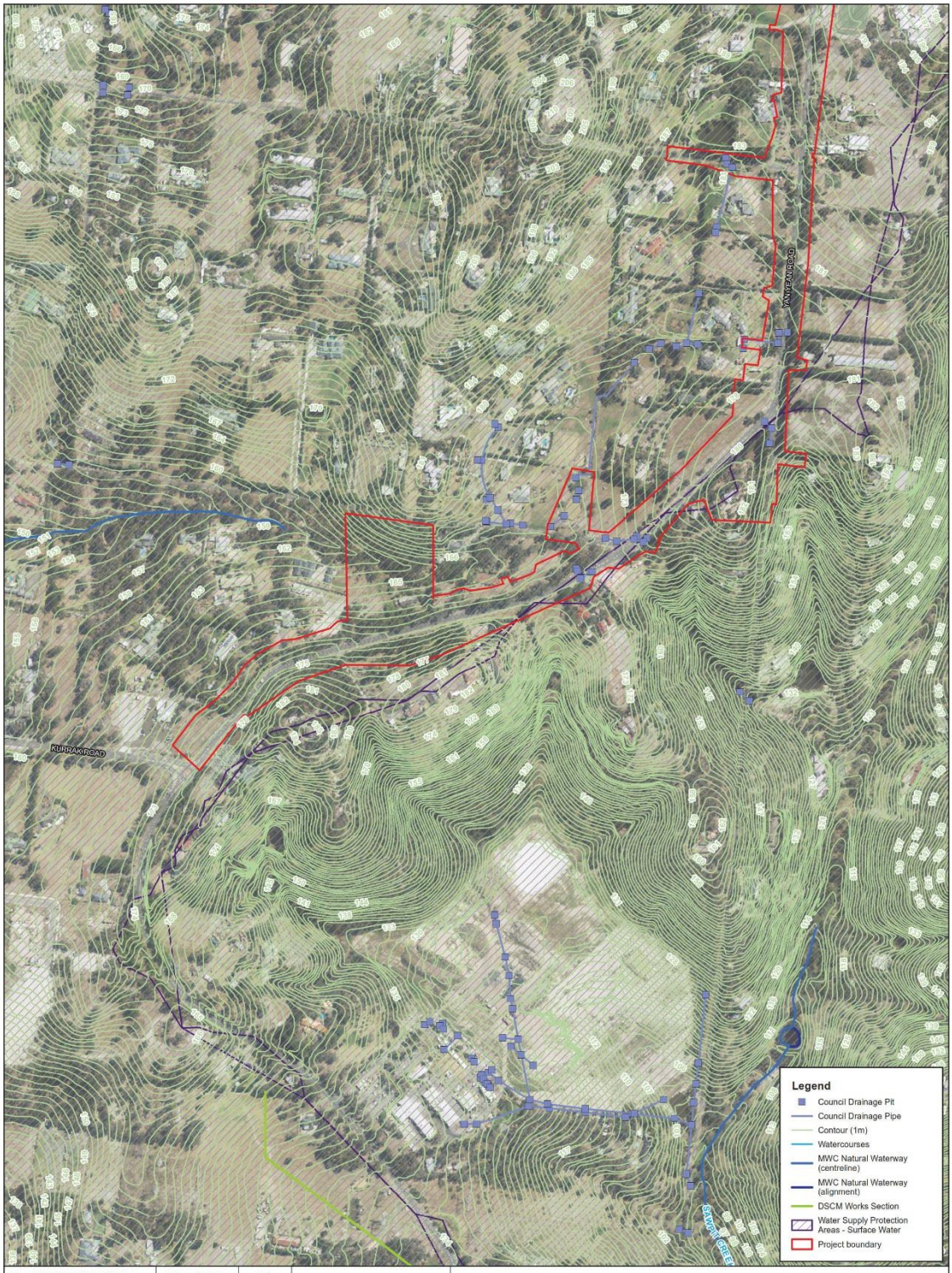
Engineering and Technical Services for Yan Yean Road Upgrade EES
Surface Water Assessment
Figure 1
Drainage Scheme and Surface Water overview - Map 3



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Date: 3/25/2020	Approved by: MG

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Engineering and Technical Services for Yan Yean Road Upgrade EES
Surface Water Assessment
Figure 1
Drainage Scheme and Surface Water overview - Map 4

APPENDIX B

MELBOURNE WATER REQUIREMENTS

Stormwater Quality Performance Criteria

Yan Yean Road Upgrade Stage 2

April 2019
Melbourne Water

Version History

Date	Version	Description	Author
14/04/2017	1.1	OSAR Rev01	S Kelly
18/04/2019	1.2	Yan Yean Road Upgrade Stage 2	C Gantonas

1. Stormwater Quality Treatment (SWQT)

1.1 Stormwater Quality Treatment Requirements

As part of protecting waterways from current and future contamination from road runoff, the State Environment Protection Policy (SEPP) (Waters) (2018) classifies runoff from roads as urban stormwater. Therefore as part of its responsibilities, VicRoads must meet the SEPP for urban stormwater runoff, which requires the protection of beneficial uses and the demonstration of the application of best practice.

The SEPP (Waters) defines 'best practice' as 'the best combination of techniques, methods, processes or technology used in an industry sector or activity that demonstrably minimises the environmental impact of that sector or activity'. Best practice requires project proponents to demonstrate that the operational impacts of their project are mitigated to an appropriate level. This approach requires demonstration that the proposed road design will meet the best practice performance objectives and process outlined in Urban Stormwater: Best Practice Environmental Management Guidelines. Victorian Stormwater Committee (1999) (BPEMG).

At a minimum, these are as follows:

- 80% retention of the typical urban annual load of total suspended solids (TSS):
- 45% retention of the typical urban annual load of total phosphorus (TP):
- 45% retention of the typical urban annual load of total nitrogen (TN):
- 70% retention of the typical urban annual load of gross pollutants (GP):

2. Water Sensitive Urban Design (WSUD)

2.1 Water Sensitive Urban Design Hierarchy

The hierarchy of how stormwater quality treatment measures are implemented by the project is shown below in order of preference;

1. **WSUD at source -** Within the project corridor via passive diffuse systems implementing 'Water Sensitive Road Design' (WSRD). This includes but is not limited to swales, infiltration swales, wetlands and porous paving etc.

2. **WSUD outside of the project corridor -** WSUD with the focus on protecting sensitive receiving waters, aka "Hotspots" impacted by the project. Many waterways have been classified and identified for specific protection or management actions. The receiving water sensitivity must be understood to determine where treatment measures are focused

3. **WSUD in the wider catchment -** Construction of WSUD measures within the wider catchment. These should focus first on locations directly impacting the receiving waters within the wider catchment and elsewhere in catchment secondly.

4. **WSUD in a separate catchment –** Construction of WSUD measures to meet equivalent treatment requirements in another catchment.

5. A **combination** of the above to meet best practice requirements

6. **Offset Water Quality Treatment Contributions** - Stormwater offsets are a financial contribution for regional water quality works that are undertaken elsewhere within the wider catchment, to offset treatment that is not provided on site. Offsets funds will be levied to account for the capital and operational (recurrent) phases of the WSUD infrastructure. Offsets should only be sought as a last resort as the treatment of pollutant at source is preferable. Should the project necessitate offsets, the project should still seek to maximise the amount of on-site treatment that can be delivered.

The ultimate project aim should be a road network which has a drainage system disconnected from receiving waterways. It is understood that in some areas site constraints (e.g. topography, ground conditions, and space) can make the implementation of WSUD challenging so the above list should serve as a guide as to the available options and the order of preference for their adoption.

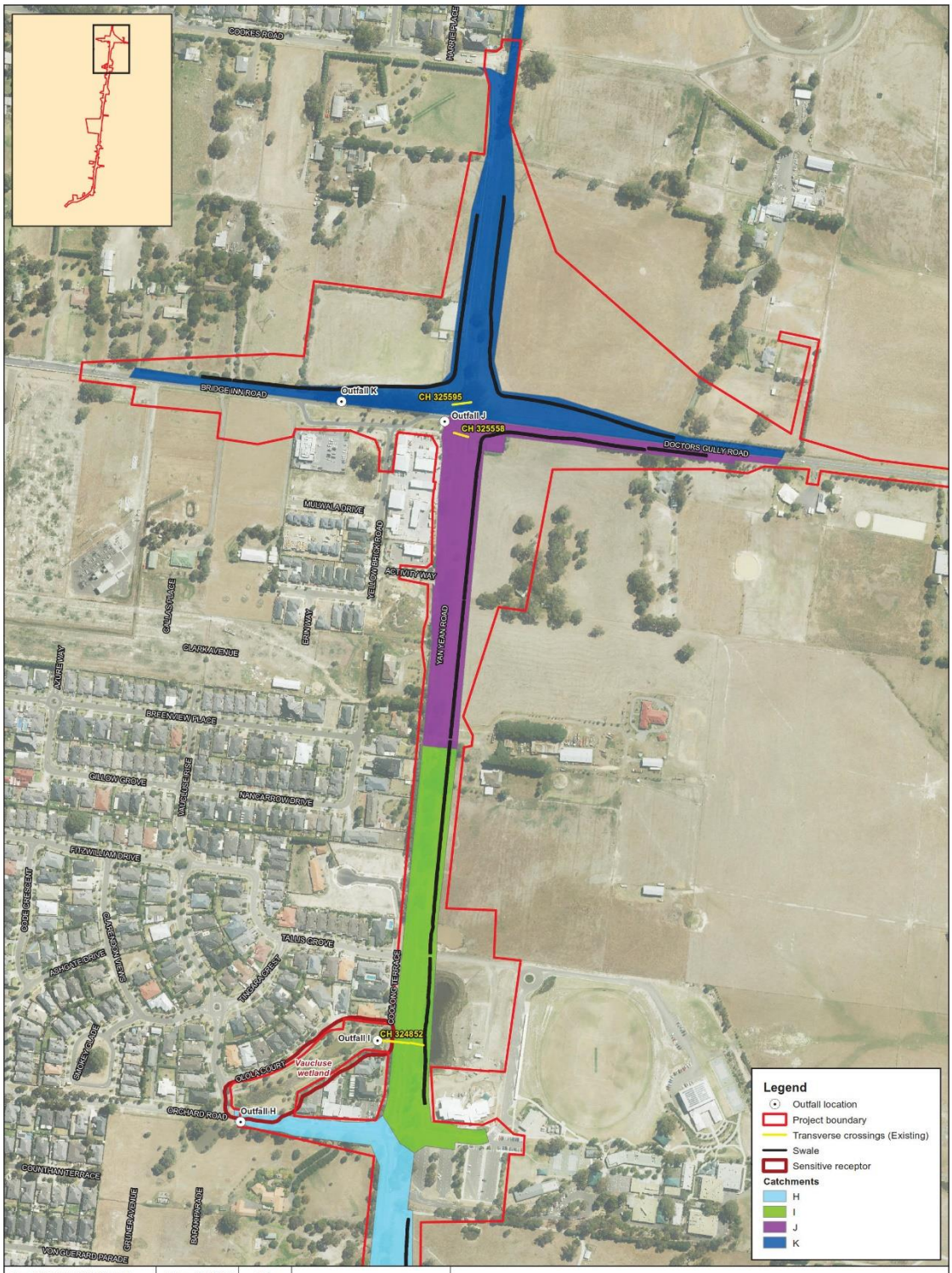
Acceptable methods for the design of treatment measures include the stormwater treatment modelling software package 'Model for Urban Stormwater Improvement Conceptualisation' (MUSIC), or the 'Water Sensitive Urban Design Engineering Procedures manual' available at http://www.publish.csiro.au/book/4974 which provides the procedure for design of various treatment measures.

Resources and Further Reading:

- Melbourne Water, Stormwater Management (WSUD)
- Melbourne Water, 2016, MUSIC Guidelines: Input parameters and modelling approaches for MUSIC users in Melbourne Water's Service Area,
- Melbourne Water, Stormwater Quality Offsets
- VicRoads Integrated Water Management Guidelines 2013
- EPA Best Practice Environmental Management Guidelines (BPEMG)

APPENDIX C

DRAINAGE AND MUSIC MODELLING MAP



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Date: 3/25/2020	Approved by: -

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Coordinate system: GDA 1994 MGA Zone 55
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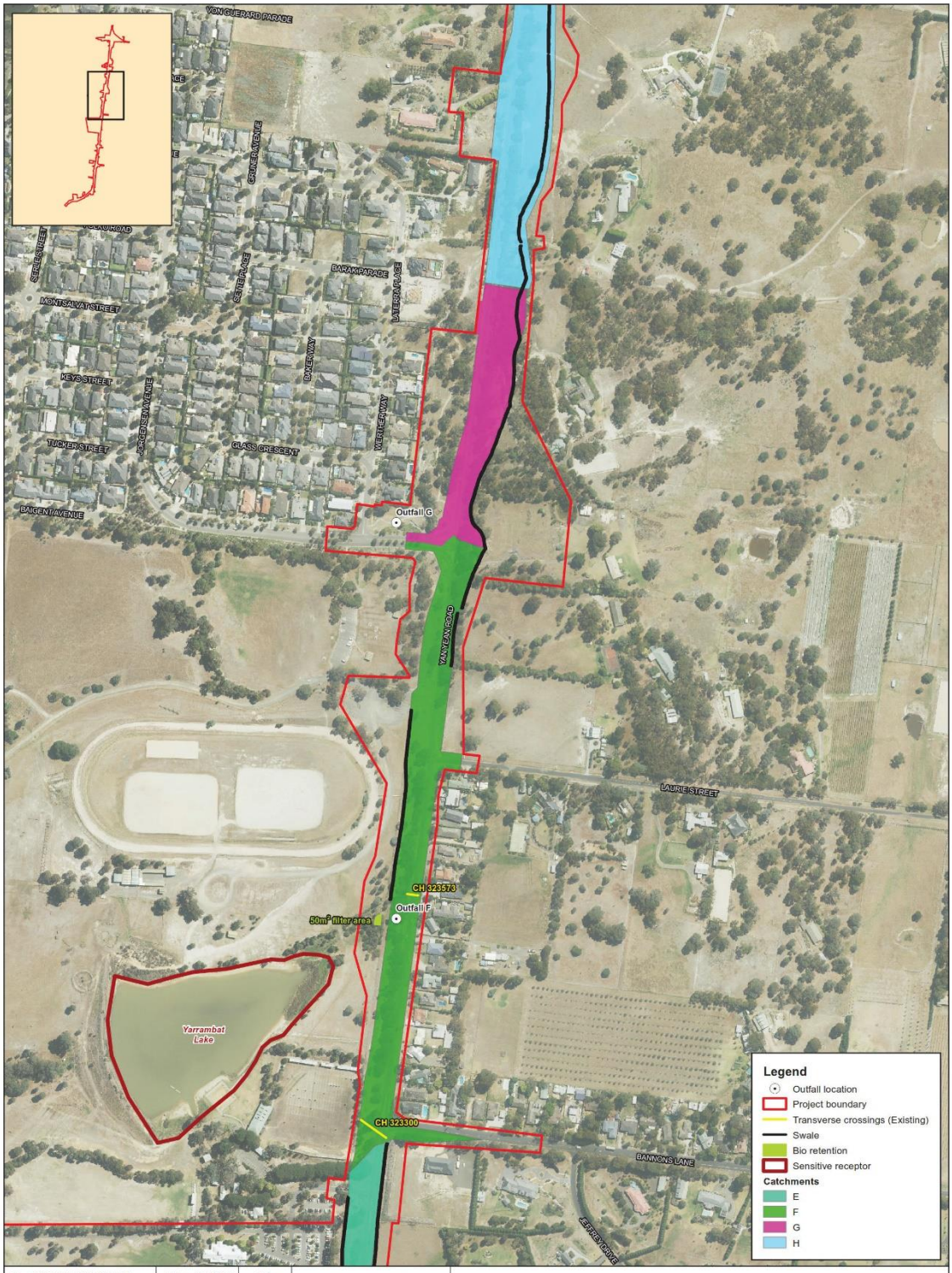
WSRD and drainage
Map 1



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Coordinate system: GDA 1994 MGA Zone 55
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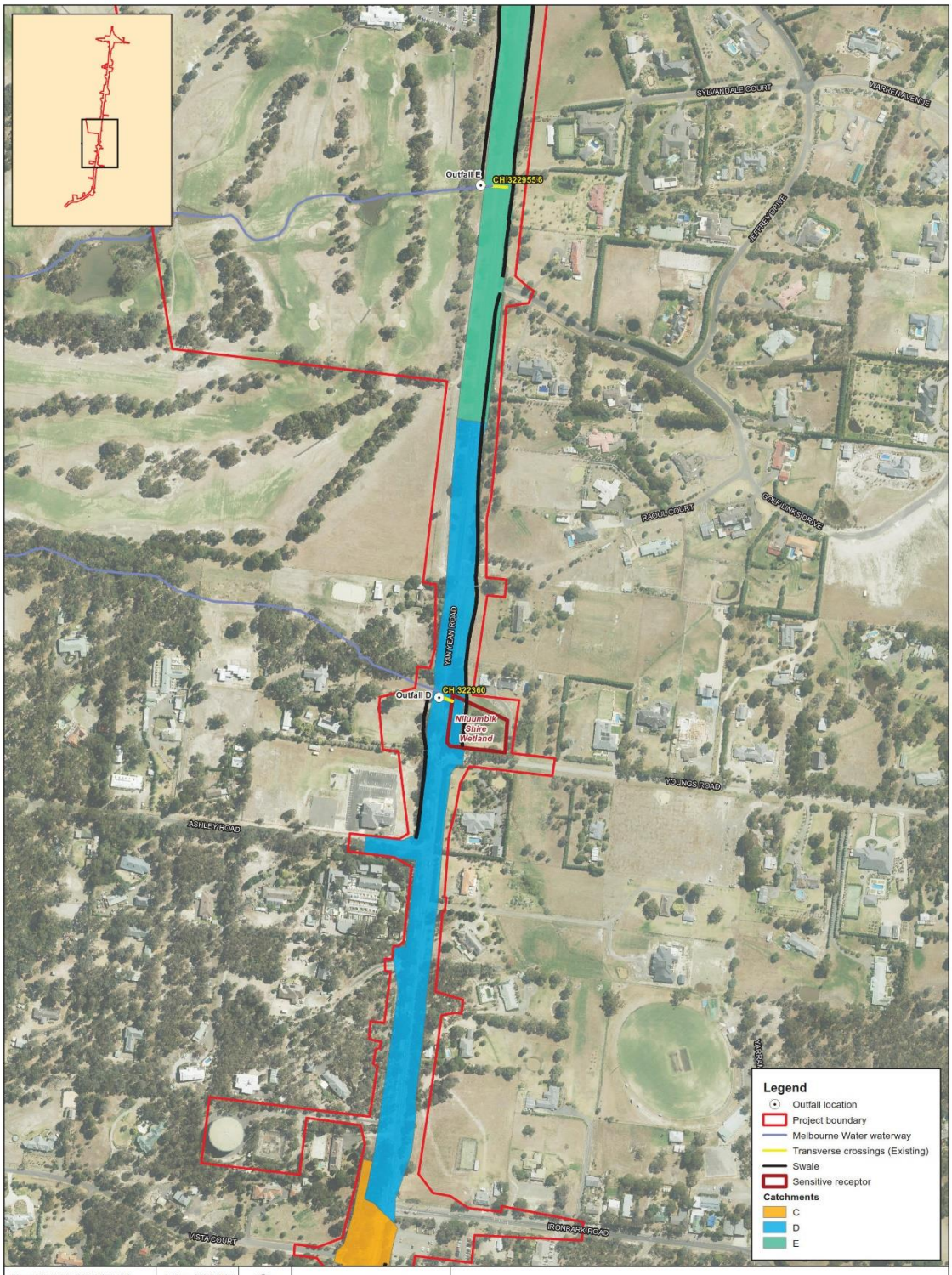
Engineering and Technical Services for Yan Yean Road Upgrade EES

WSRD and drainage
Map 2



Map: 2135645A_GIS_1857_B4	Author: AS/MB/RP
Date: 3/25/2020	Approved by: -

Data source: VicRoads.

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Coordinate system: GDA 1994 MGA Zone 55
Scale ratio correct when printed at A3

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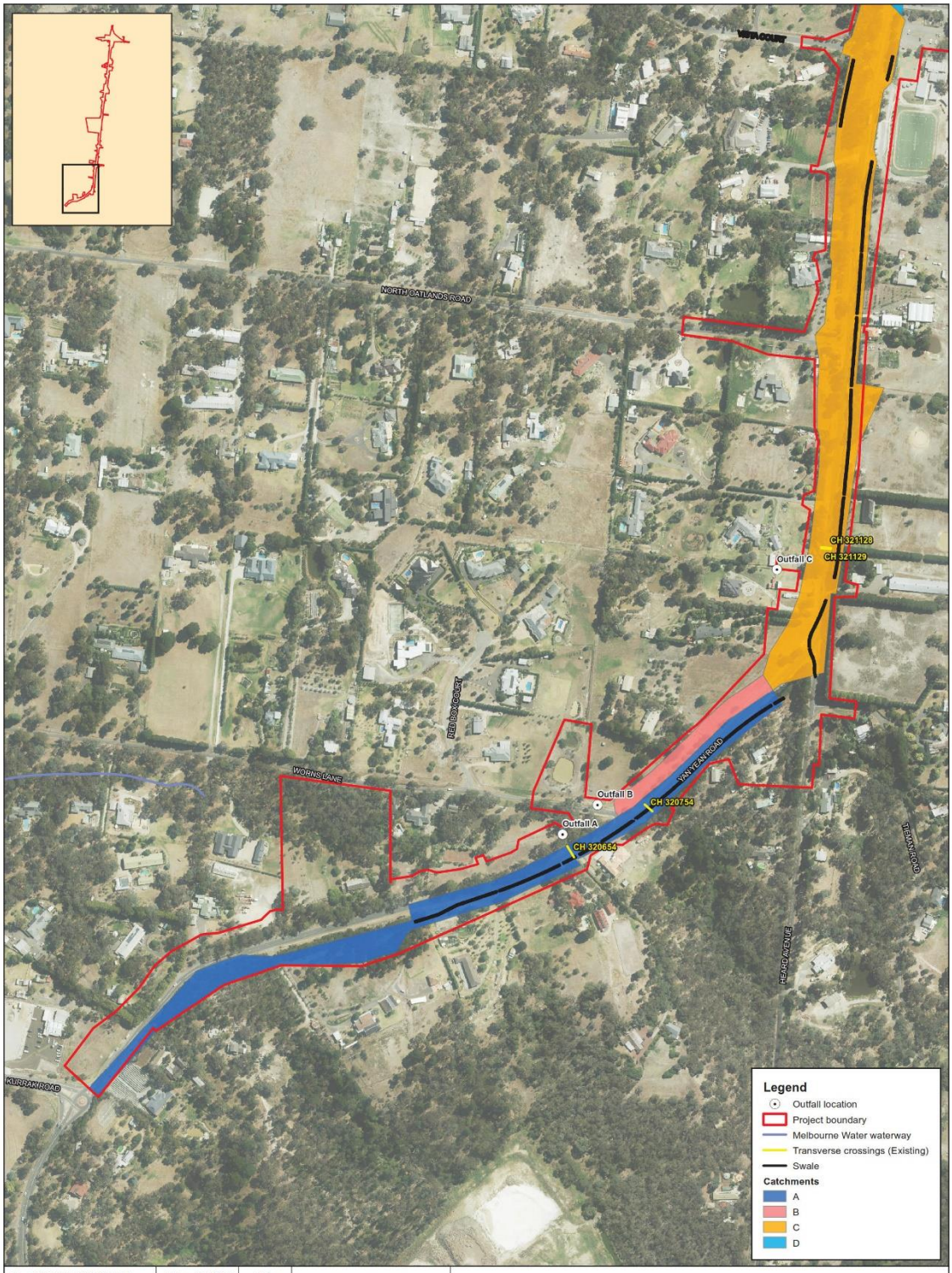
Engineering and Technical Services for Yan Yean Road Upgrade EES

WSRD and drainage
Map 3



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Engineering and Technical Services for Yan Yean Road Upgrade EES

WSRD and drainage
Map 4

APPENDIX D

MUSIC MODELLING DETAILS

D1 MUSIC MODELLING DETAILS

Table D.1 Project catchment characteristics

OUTFALL REFERENCE IN MUSIC	NEW IMPERVIOUS AREA [HA]	SWALE CATCHMENT AREA [HA]	SWALE LENGTH [M]	SWALE IMPERVIOUS CATCHMENT AREA [%]
A	0.778	2.12	475	80
B	0.323	0.44	0	
C_east	1.535	1.92	580	
C_west		2.02	78	
D_east	1.499	1.4	385	
D_west		1.94	165	
E_east	0.814	0.99	570	
E_west		1.04	250	
F_east	1.567	1.48	0	
F_west		1.28	220	
G_east	0.532	0.82	0	
G_west		0.54	0	
H	1.137	2.71	550	
I_east	0	1.11	415	
I_west		0.95	0	
J_east	0.834	1.29	530	
J_west		0.9	0	
K_east	0.648	2.5	435	
K_west		1.19	475	

Note:

(1) Red text indicates that within the sub-catchment there is stormwater treatment by bioretention device in addition to swale.

(2) East/West labels denote the direction of road cross fall.

Table D.2 MUSIC swale properties

PARAMETER	VALUE
Bed Slope [%]	0.5 (assumed, to be updated in detailed design)
Base Width [m]	1
Top Width [m]	5
Depth [m]	0.3
Vegetation Height [m]	0.100
Exfiltration Rate [mm/hr]	0

Table D.3 MUSIC bioretention properties (Outfall F)

PARAMETER	VALUE
High Flow Bypass [m³/s]	1.4 (equal to the 10% AEP peak flow estimate from Hydraulic modelling)
Extended Detention Depth [m]	0.3
Filter Area [m²]	50
Saturated Hydraulic Conductivity [mm/hr]	100
Filter Depth [m]	0.5
TN content of Filter Media [mg/kg]	800
Orthophosphate Content of Filter Media [mg/kg]	55
Exfiltration Rate [mm/hr]	0
Lining	Yes
Vegetation	Effective nutrient removal plants
Outlet	Underdrain present, with overflow weir width (2 metres)

Table D.4 Project MUSIC results and summary

WATER QUALITY PARAMETER	SOURCE LOADS – NEW IMPERVIOUS AREAS	SOURCE LOADS – TREATMENT AREAS	RESIDUAL LOADS – TREATMENT AREAS	LOAD REDUCTION	% REDUCTION – NEW IMPERVIOUS AREAS	TARGET % REDUCTION	TARGET MET?
TSS [kg/y]	19775.00	44040.00	8513.00	35527.00	179.7	80	**Yes**
TP [kg/y]	33.20	74.45	26.42	48.03	144.7	45	**Yes**
TN [kg/y]	135.42	308.12	217.02	91.10	67.3	45	**Yes**
Litter [kg/y]	2041.20	4912.10	673.10	4239.00	207.7	70	**Yes**

Table D.5 Individual catchment MUSIC results

OUTFALL	CHARACTERISTIC	SOURCE LOADS – NEW IMPERVIOUS AREAS	SOURCE LOADS – TREATMENT AREAS	RESIDUAL LOADS – TREATMENT AREAS	% REDUCTION FROM TREATMENT AREAS	% REDUCTION FROM NEW IMPERVIOUS AREAS
Outfall A	TSS [kg/y]	1580	3470	151	95.6	210.1
	TP [kg/y]	2.74	5.94	1.37	76.9	166.8
	TN [kg/y]	10.9	24.5	15.7	35.9	80.7
	Litter [kg/y]	164	391	0	100.0	238.4
Outfall B	TSS [kg/y]	655	730	730	0.0	0.0
	TP [kg/y]	1.1	1.24	1.24	0.0	0.0
	TN [kg/y]	4.52	5.12	5.12	0.0	0.0
	Litter [kg/y]	68.2	81.1	81.1	0.0	0.0
Outfall C	TSS [kg/y]	3130	6540	475	92.7	193.8
	TP [kg/y]	5.28	11	2.87	73.9	154.0
	TN [kg/y]	21.7	45.7	33.5	26.7	56.2
	Litter [kg/y]	324	726	0	100.0	224.1
Outfall D	TSS [kg/y]	3070	5470	275	95.0	169.2
	TP [kg/y]	5.14	9.35	2.25	75.9	138.1
	TN [kg/y]	20.9	38.6	27	30.1	55.5
	Litter [kg/y]	317	616	0	100.0	194.3
Outfall E	TSS [kg/y]	1670	3360	142	95.8	192.7
	TP [kg/y]	2.8	5.67	1.31	76.9	155.7
	TN [kg/y]	11.4	23.6	15	36.4	75.4
	Litter [kg/y]	172	374	0	100.0	217.4
Outfall F	TSS [kg/y]	3180	4570	811	82.3	118.2
	TP [kg/y]	5.38	7.67	2.73	64.4	91.8
	TN [kg/y]	22	32	18.6	41.9	60.9
	Litter [kg/y]	331	509	0	100.0	153.8
Outfall G	TSS [kg/y]	1090	2240	2240	0.0	0.0
	TP [kg/y]	1.83	3.81	3.81	0.0	0.0
	TN [kg/y]	7.45	15.7	15.7	0.0	0.0
	Litter [kg/y]	112	251	251	0.0	0.0

OUTFALL	CHARACTERISTIC	SOURCE LOADS – NEW IMPERVIOUS AREAS	SOURCE LOADS – TREATMENT AREAS	RESIDUAL LOADS – TREATMENT AREAS	% REDUCTION FROM TREATMENT AREAS	% REDUCTION FROM NEW IMPERVIOUS AREAS
Outfall H	TSS [kg/y]	2340	4500	196	95.6	183.9
	TP [kg/y]	3.84	7.64	1.75	77.1	153.4
	TN [kg/y]	15.8	31.3	20.2	35.5	70.3
	Litter [kg/y]	240	500	0	100.0	208.3
Outfall I	TSS [kg/y]	0	3400	1650	51.5	*N/A*
	TP [kg/y]	0	5.73	3.36	41.4	*N/A*
	TN [kg/y]	0	23.8	19	20.2	*N/A*
	Litter [kg/y]	0	380	175	53.9	*N/A*
Outfall J	TSS [kg/y]	1730	3660	1580	56.8	120.2
	TP [kg/y]	2.87	6.1	3.34	45.2	96.2
	TN [kg/y]	11.7	25.3	19.7	22.1	47.9
	Litter [kg/y]	176	404	166	58.9	135.2
Outfall K	TSS [kg/y]	1330	6100	263	95.7	438.9
	TP [kg/y]	2.22	10.3	2.39	76.8	356.3
	TN [kg/y]	9.05	42.5	27.5	35.3	165.7
	Litter [kg/y]	137	680	0	100.0	496.4

Note:

(1) Red text indicates that within the sub-catchment there is stormwater treatment by bioretention device in addition to swale. For this sub-catchment, BPEM water quality targets were met at a local scale.

APPENDIX E

DRAINAGE IMPACT ASSESSMENT HYDROGRAPHS

OUTFALL A

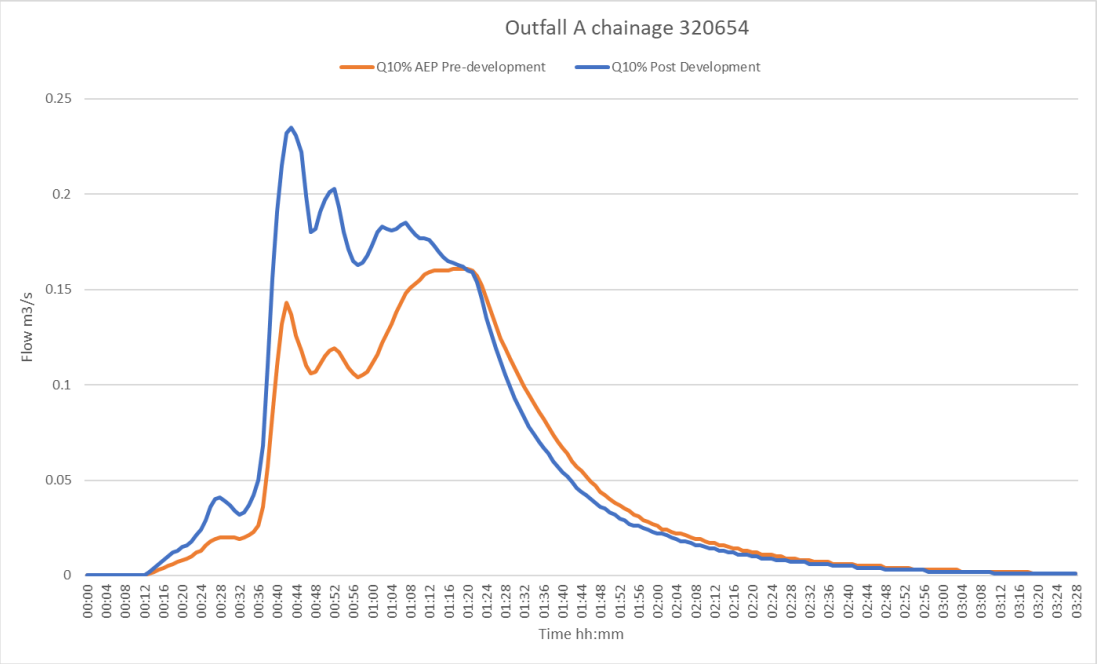


Figure E.1 Outfall A discharge hydrograph for 10% AEP

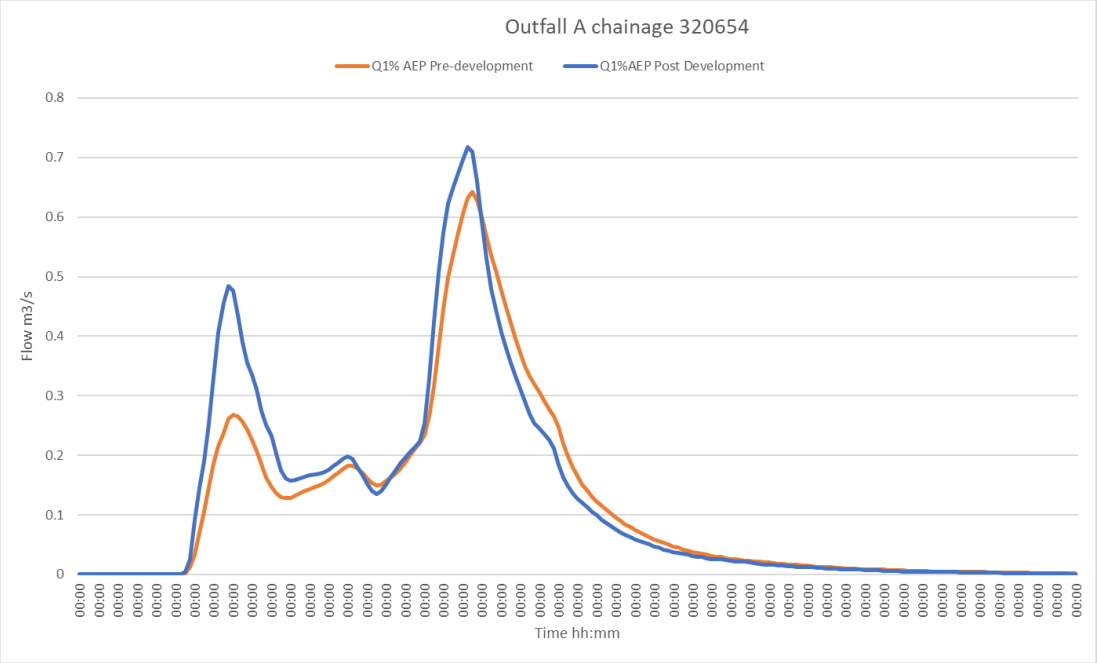


Figure E.2 Outfall A discharge hydrograph for 1% AEP

OUTFALL B

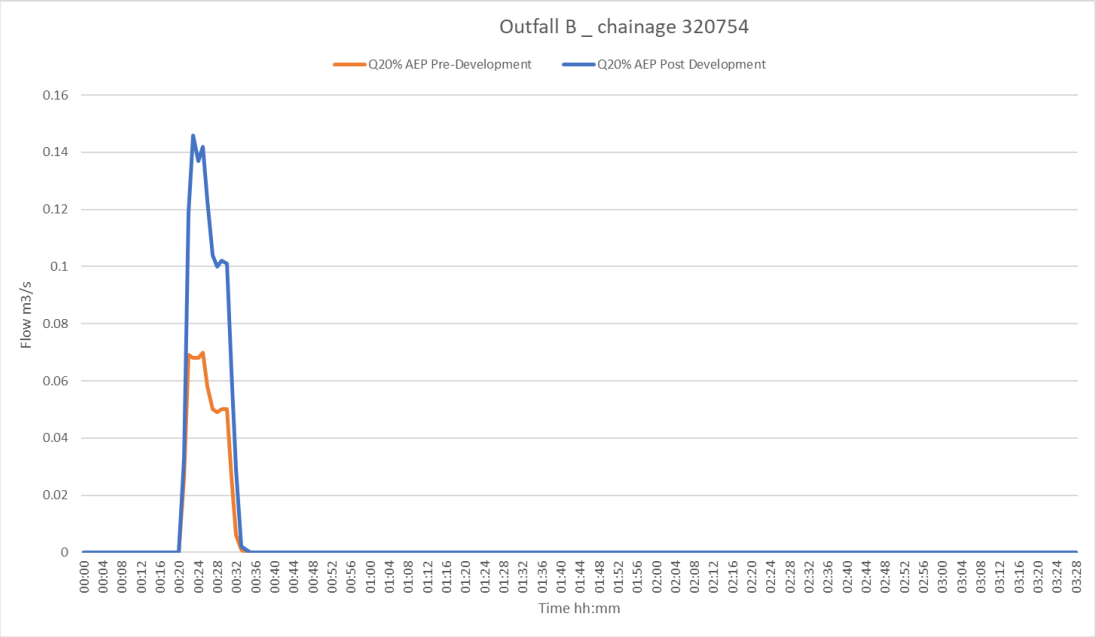


Figure E.3 Outfall B discharge hydrograph for 1% AEP

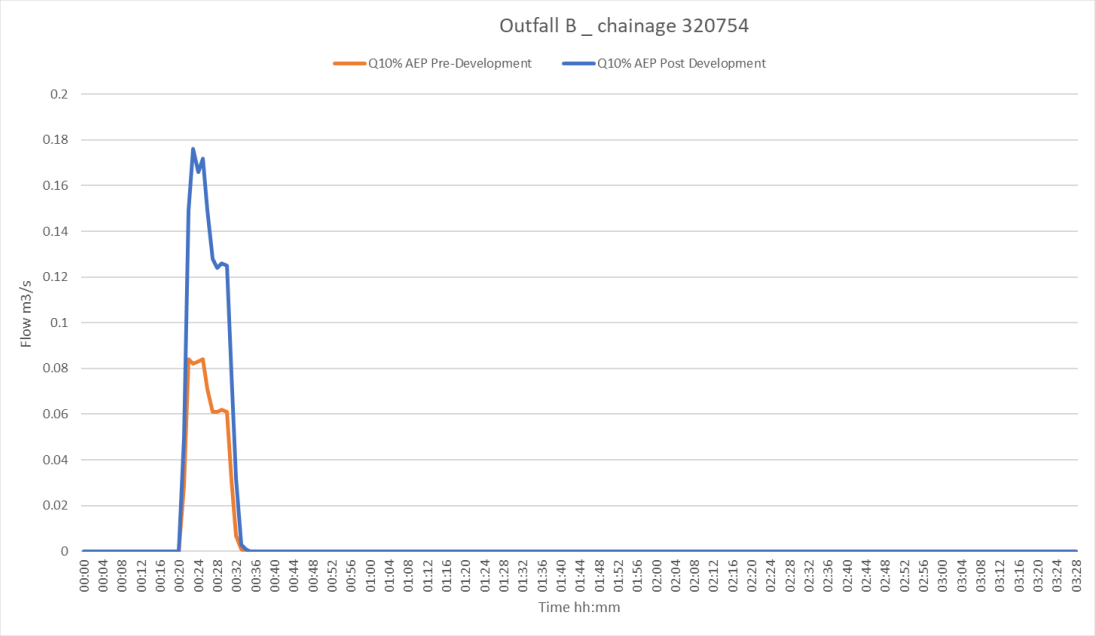


Figure E.4 Outfall B discharge hydrograph for 1% AEP

OUTFALL C

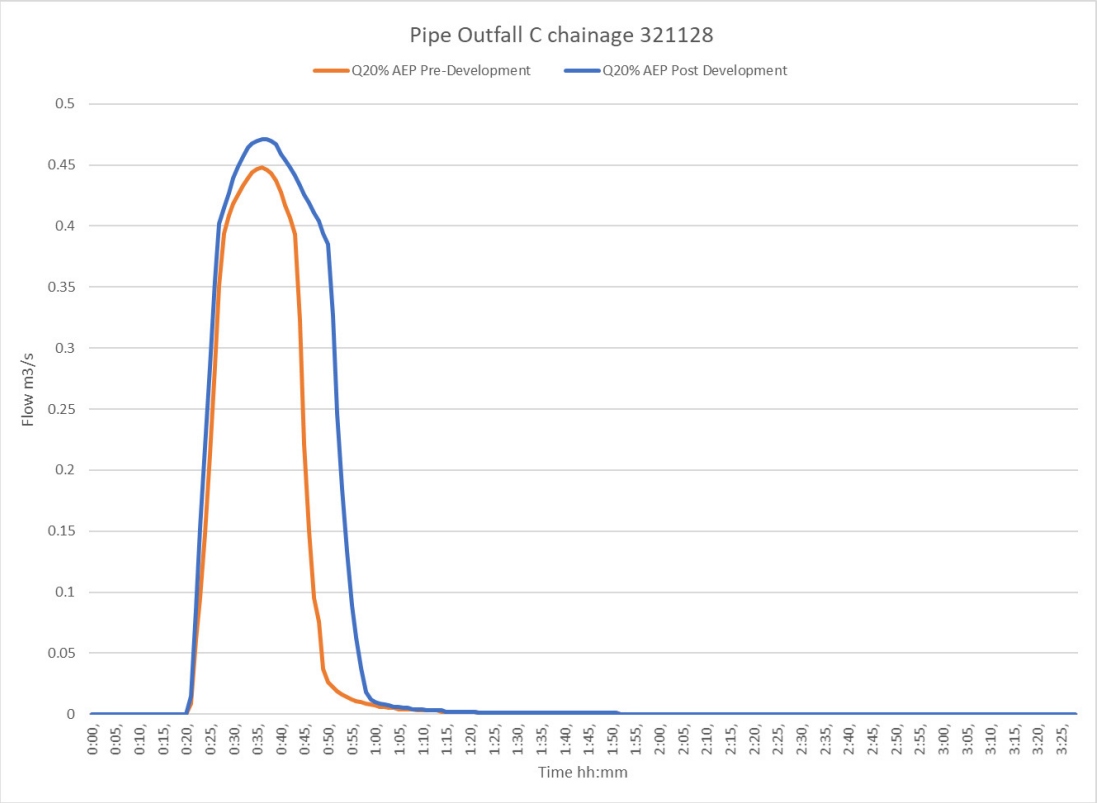


Figure E.5 Outfall C hydrograph discharge results for 20% AEP (existing pipe)

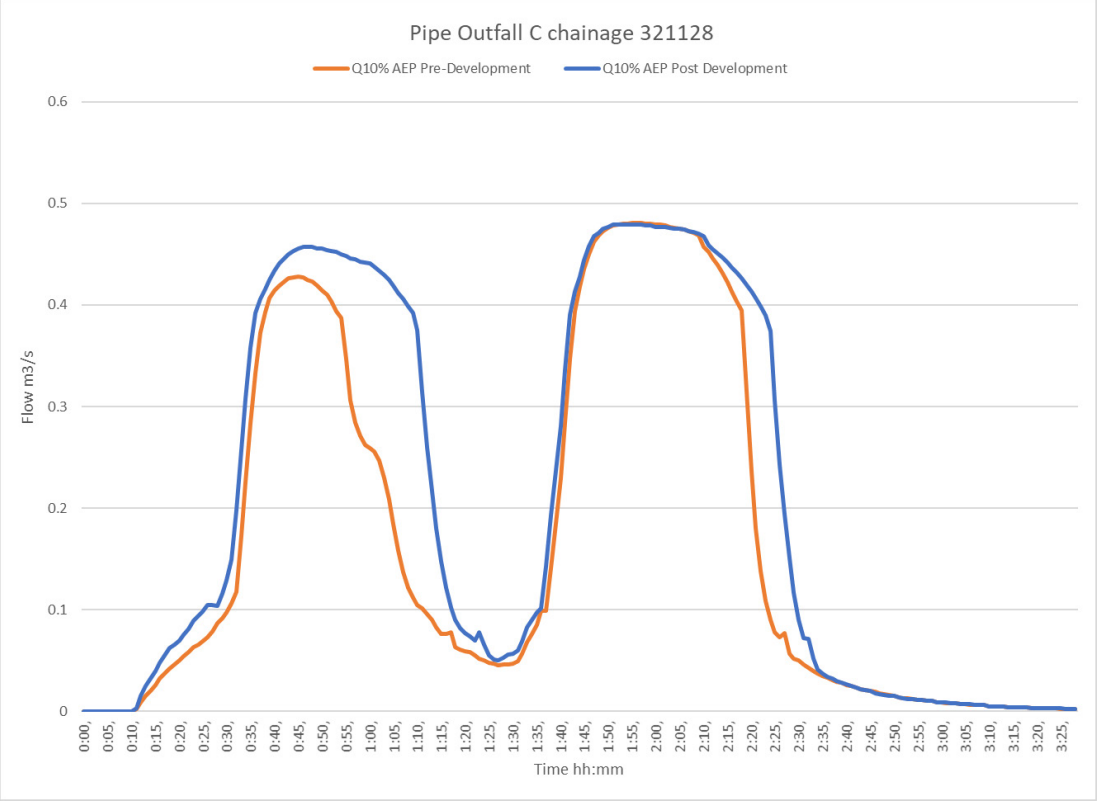


Figure E.6 Outfall C hydrograph discharge results for 10% AEP (existing pipe)

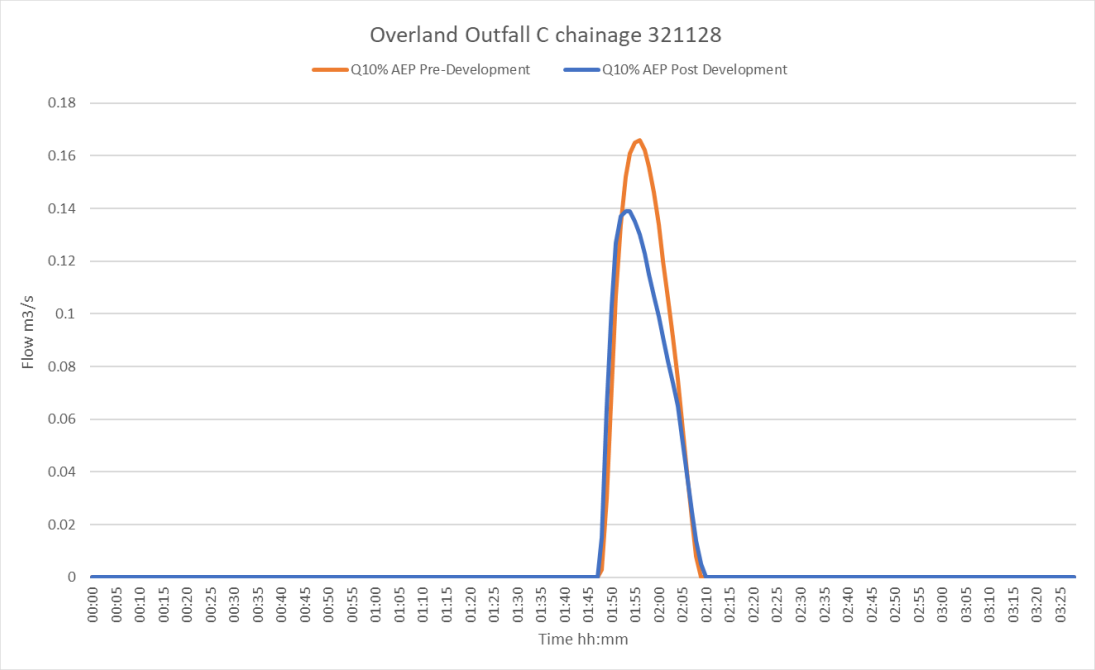


Figure E.7 Outfall C hydrograph discharge results for 10% AEP (overland flow)

OUTFALL D

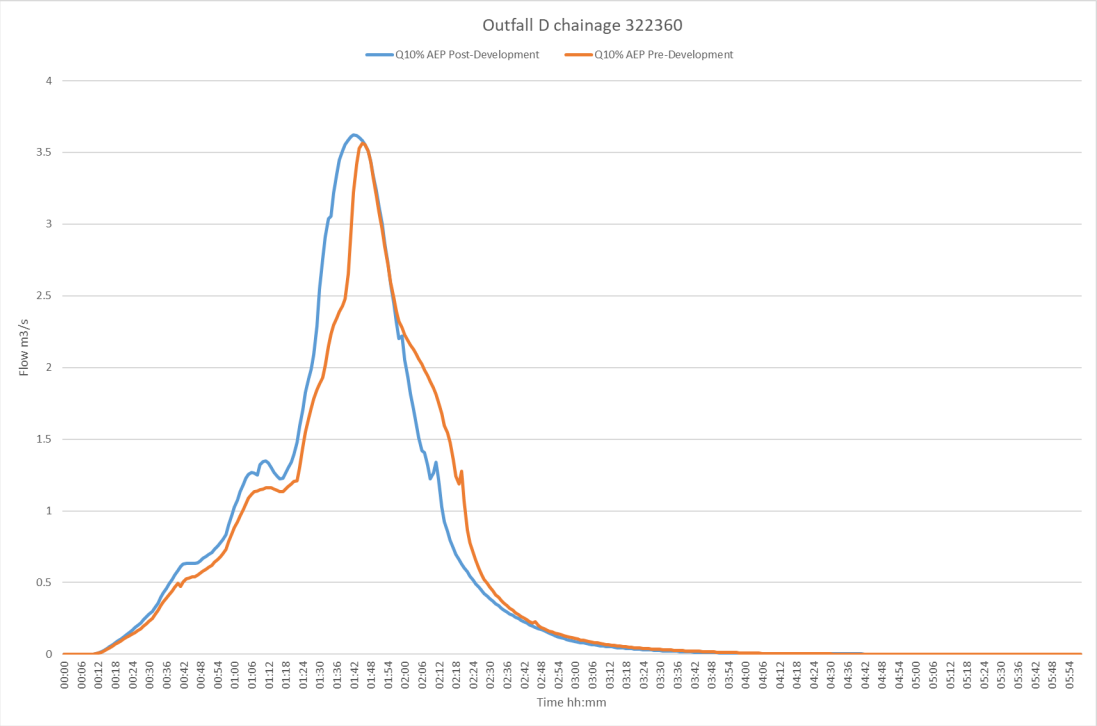


Figure E.8 Outfall D hydrograph discharge results for 10% AEP

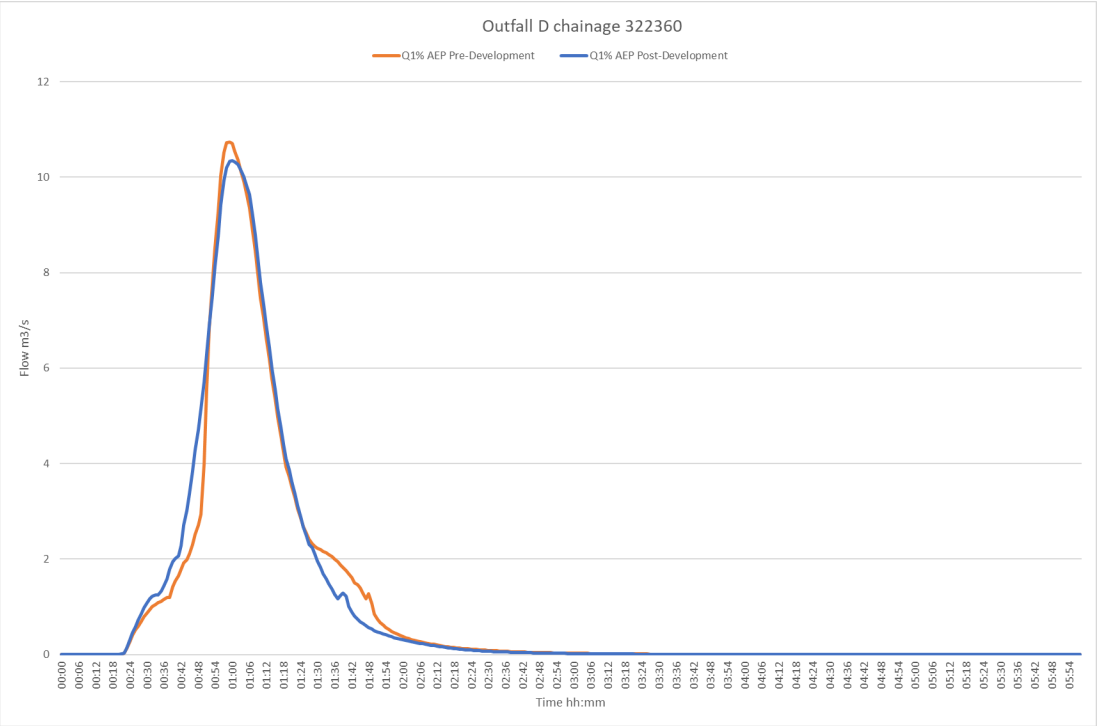


Figure E.9 Outfall D hydrograph discharge results for 1% AEP

OUTFALL E

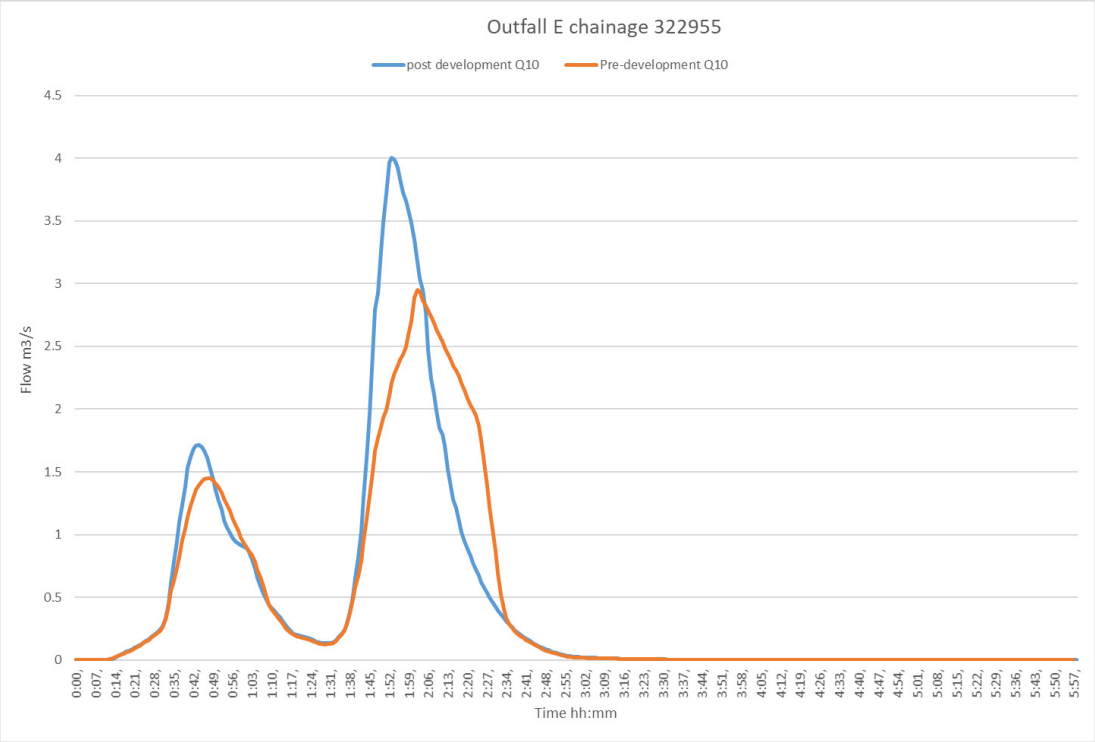


Figure E.10 Outfall E hydrograph discharge results for 10% AEP

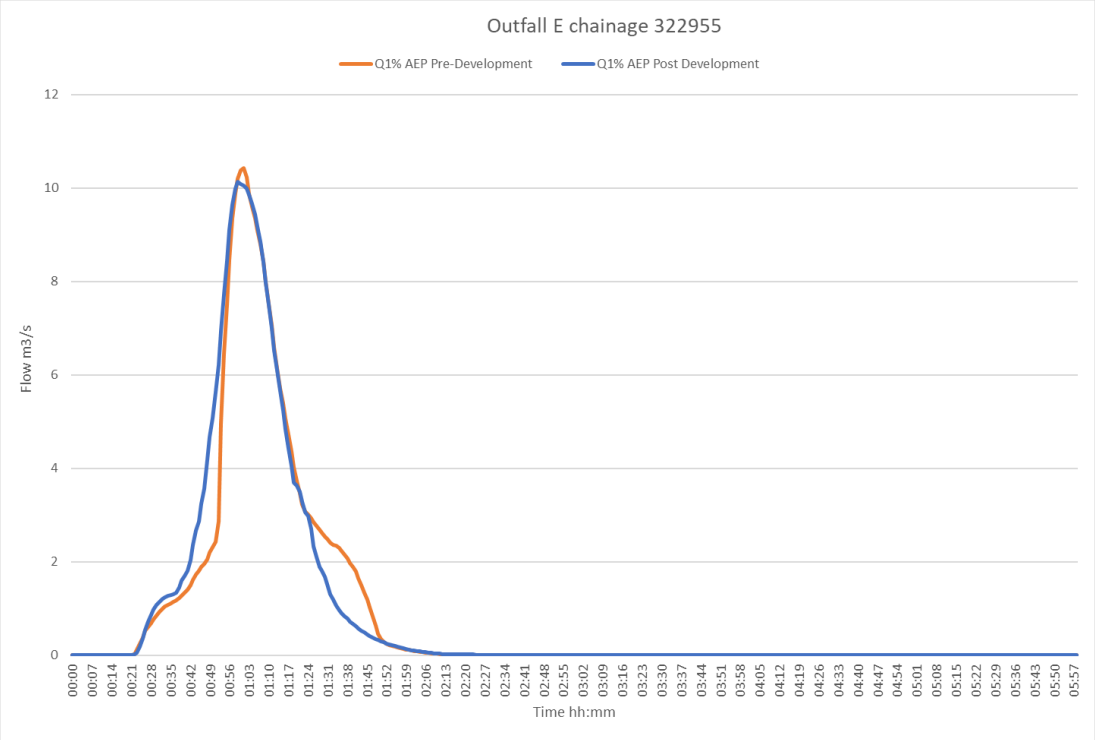


Figure E.11 Outfall E hydrograph discharge results for 1% AEP

OUTFALL F

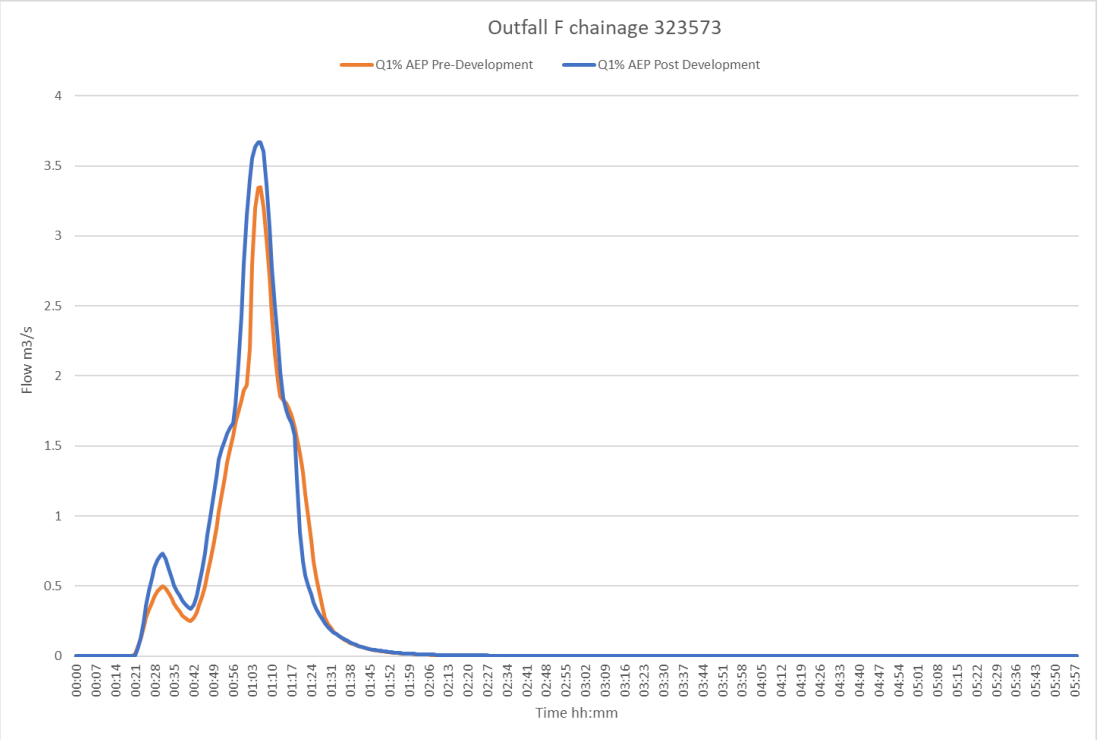


Figure E.12 Outfall F hydrograph discharge results for 1% AEP

OUTFALL G

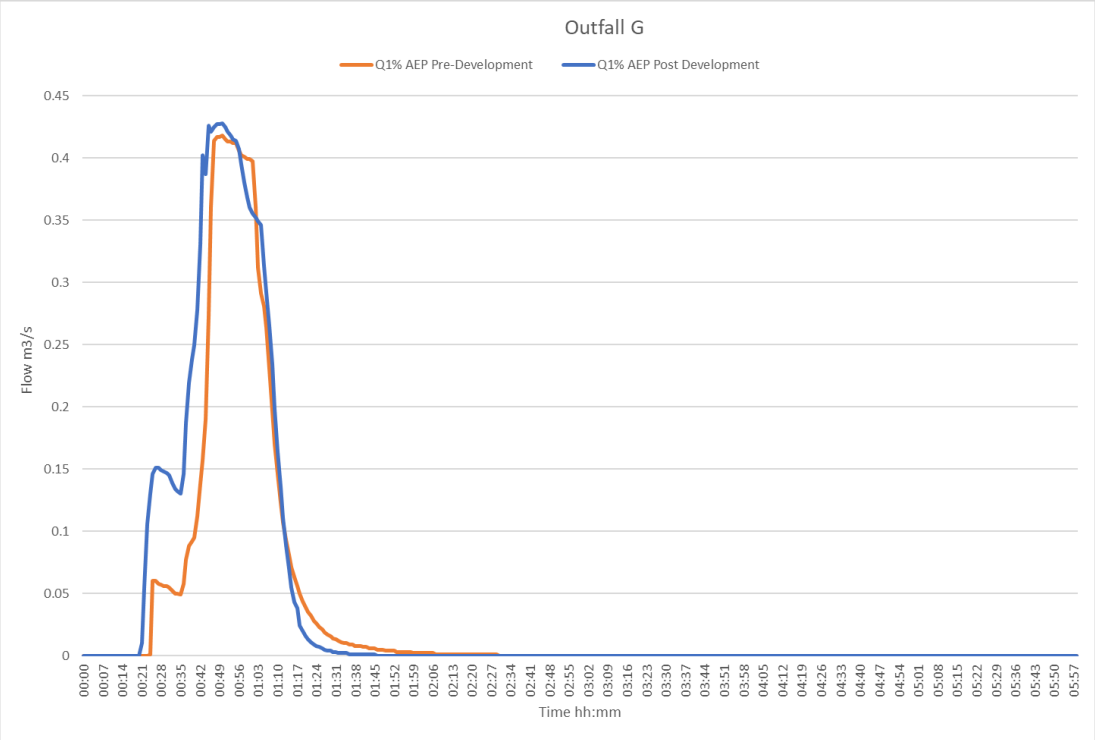


Figure E.13 Outfall G hydrograph discharge results for 1% AEP

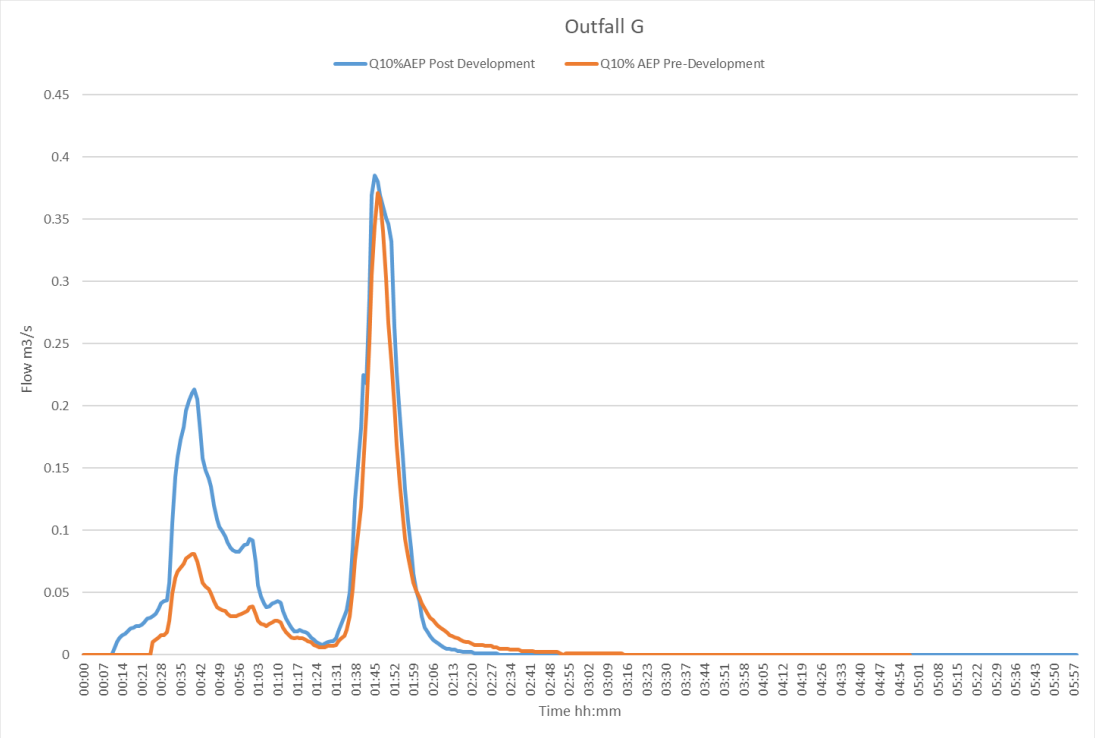


Figure E.14 Outfall G hydrograph discharge results for 10% AEP

OUTFALL H

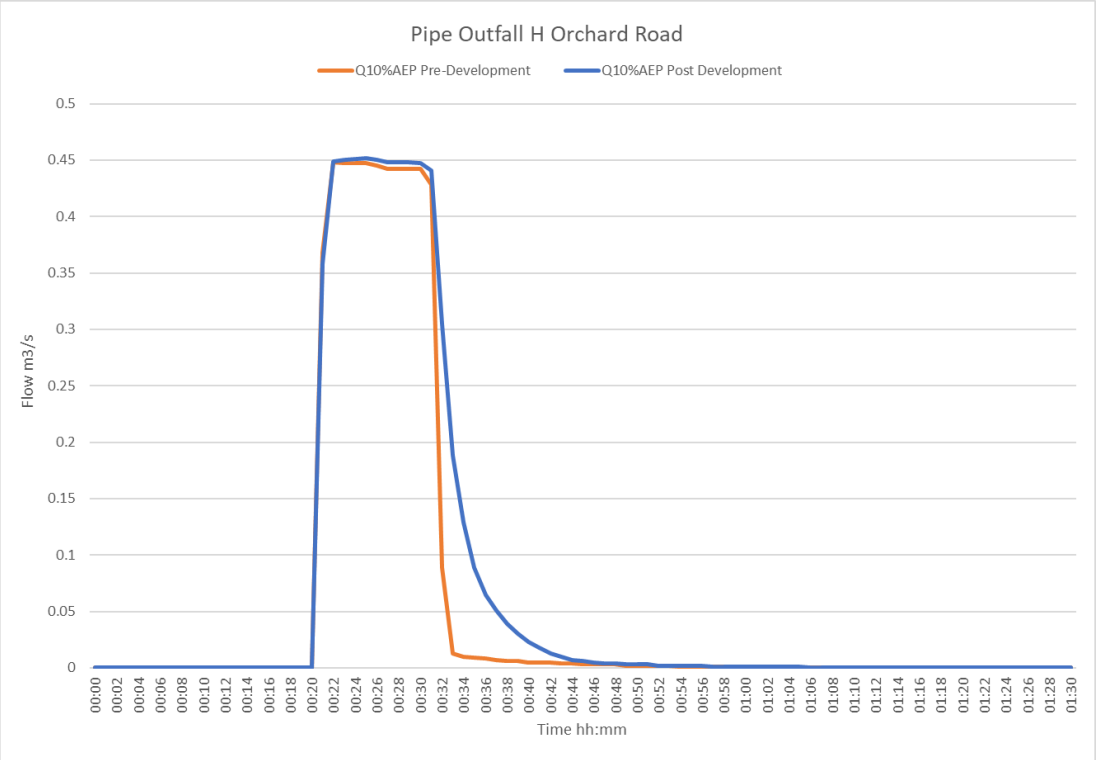


Figure E.15 Outfall H hydrograph discharge results for 10% AEP (within pipe)

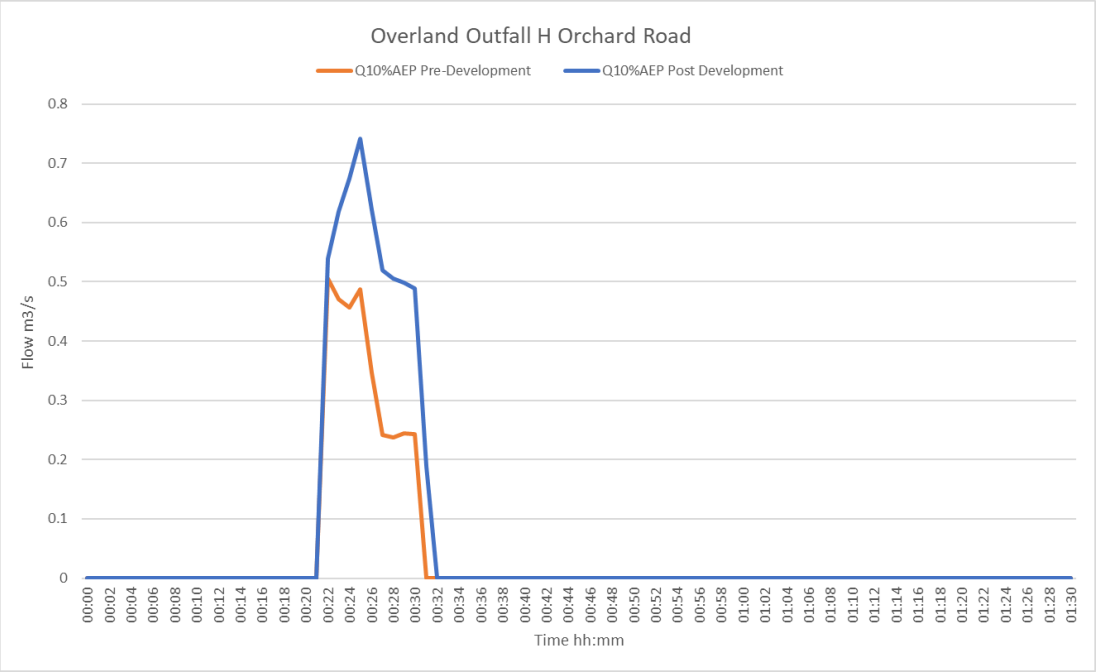


Figure E.16 Outfall H hydrograph discharge results for 10% AEP (overland flow)

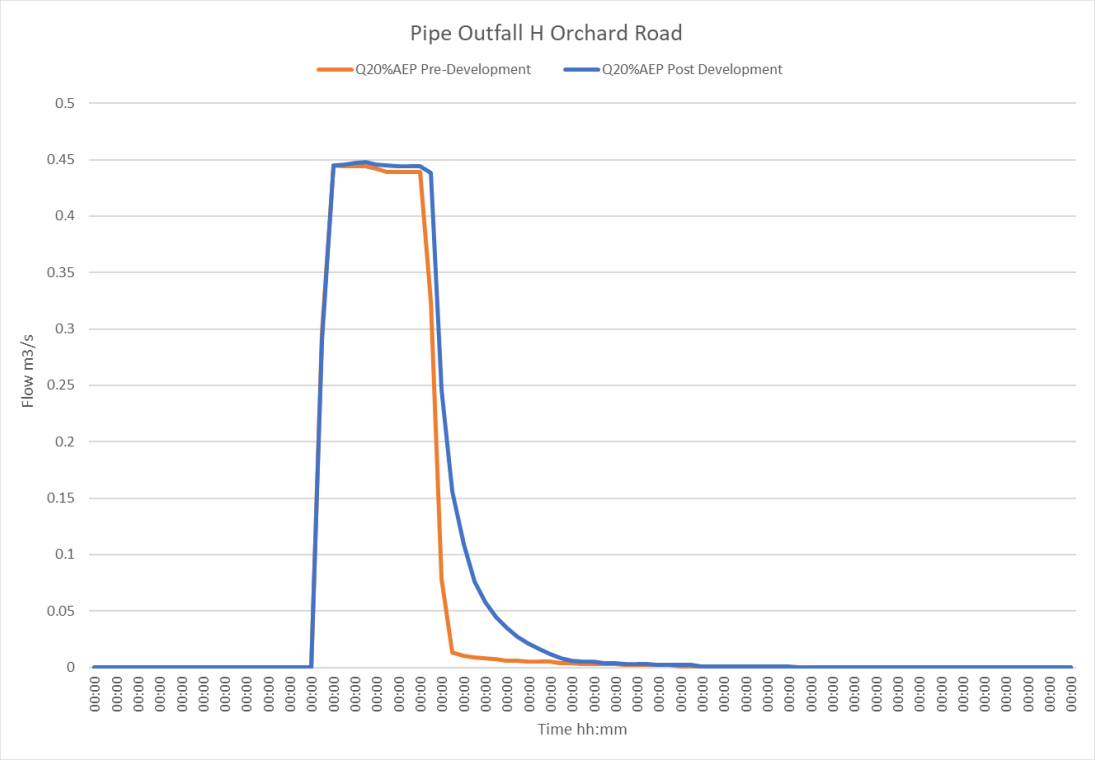


Figure E.17 Outfall H hydrograph discharge results for 20% AEP (within pipe)

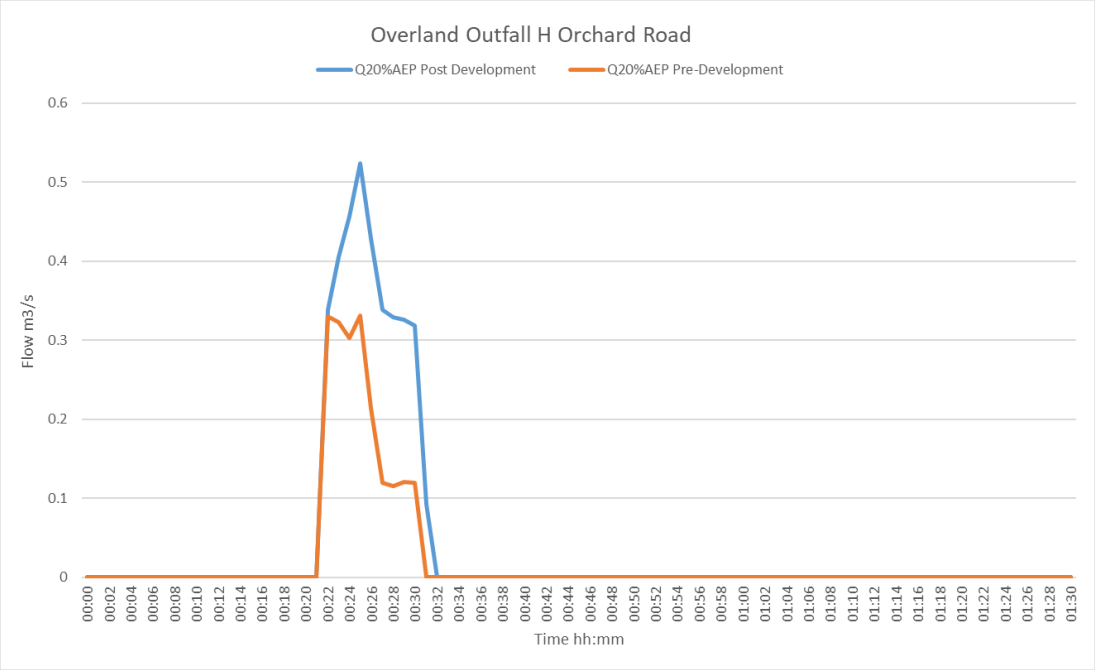


Figure E.18 Outfall H hydrograph discharge results for 20% AEP (overland flow)

OUTFALL I

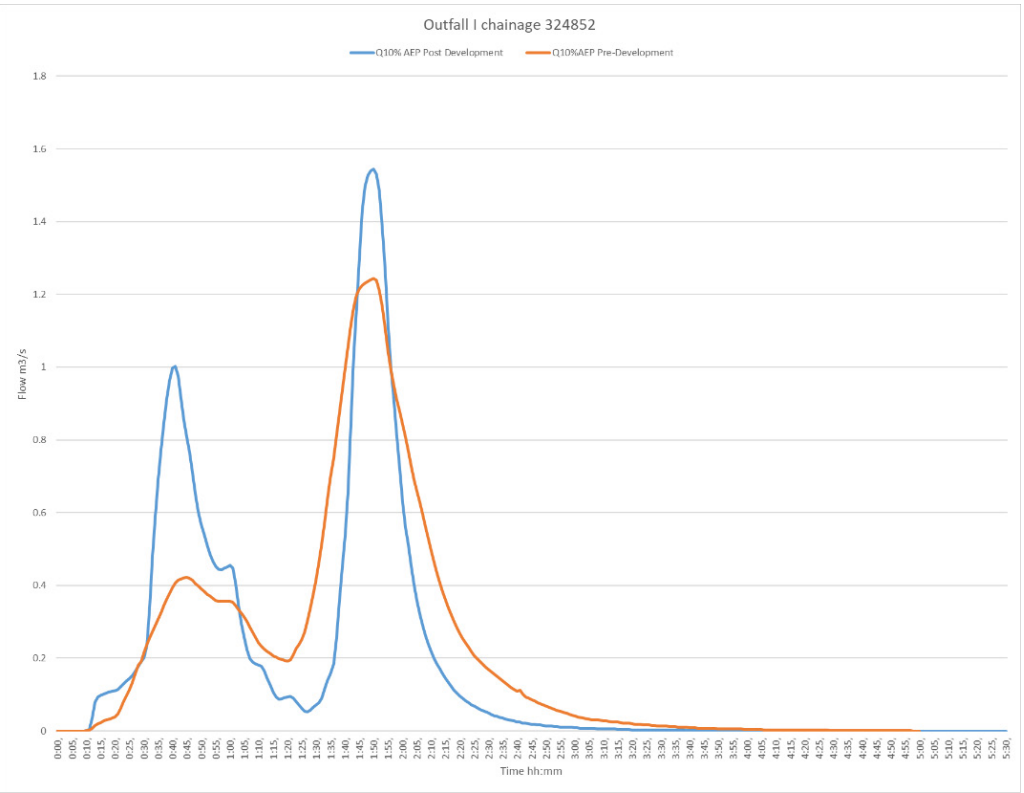


Figure E.19 Outfall I hydrograph discharge results for 10% AEP

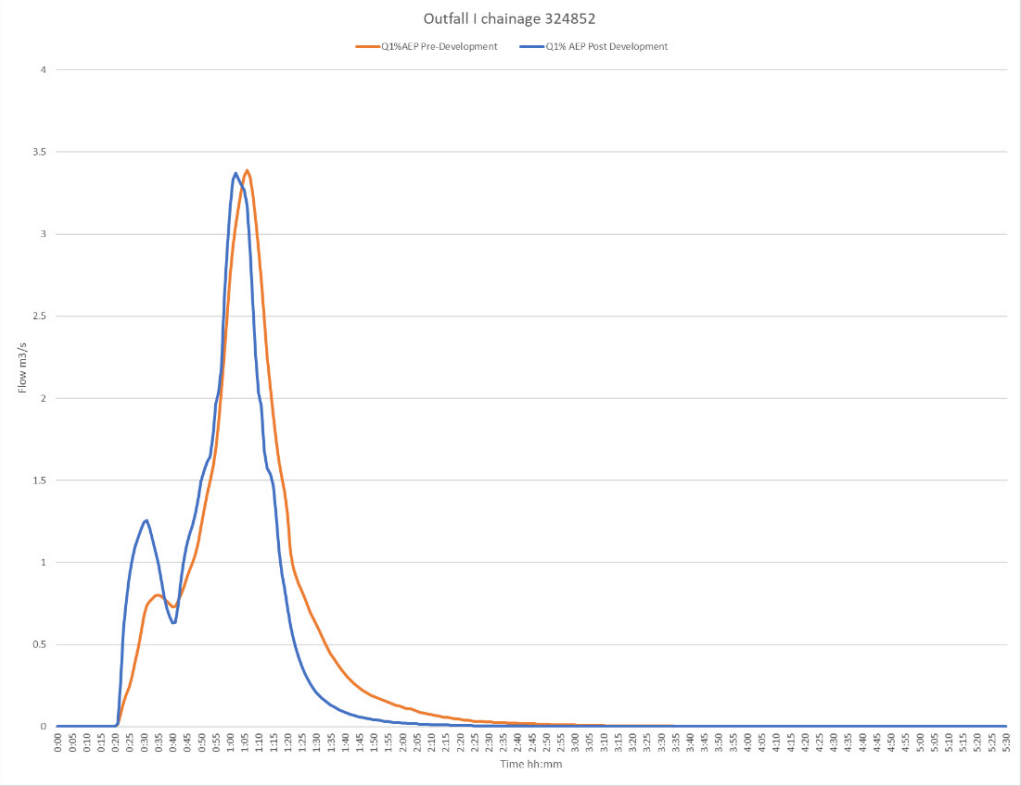


Figure E.20 Outfall I hydrograph discharge results for 1% AEP

OUTFALL J

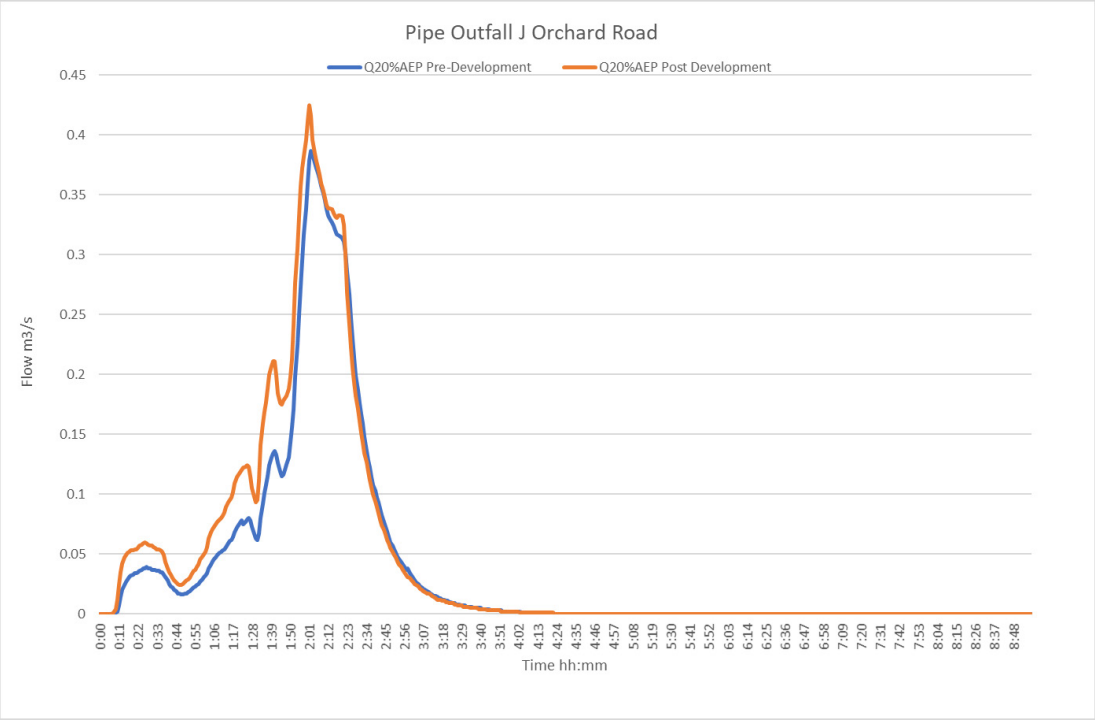


Figure E.21 Outfall J hydrograph discharge results for 20% AEP

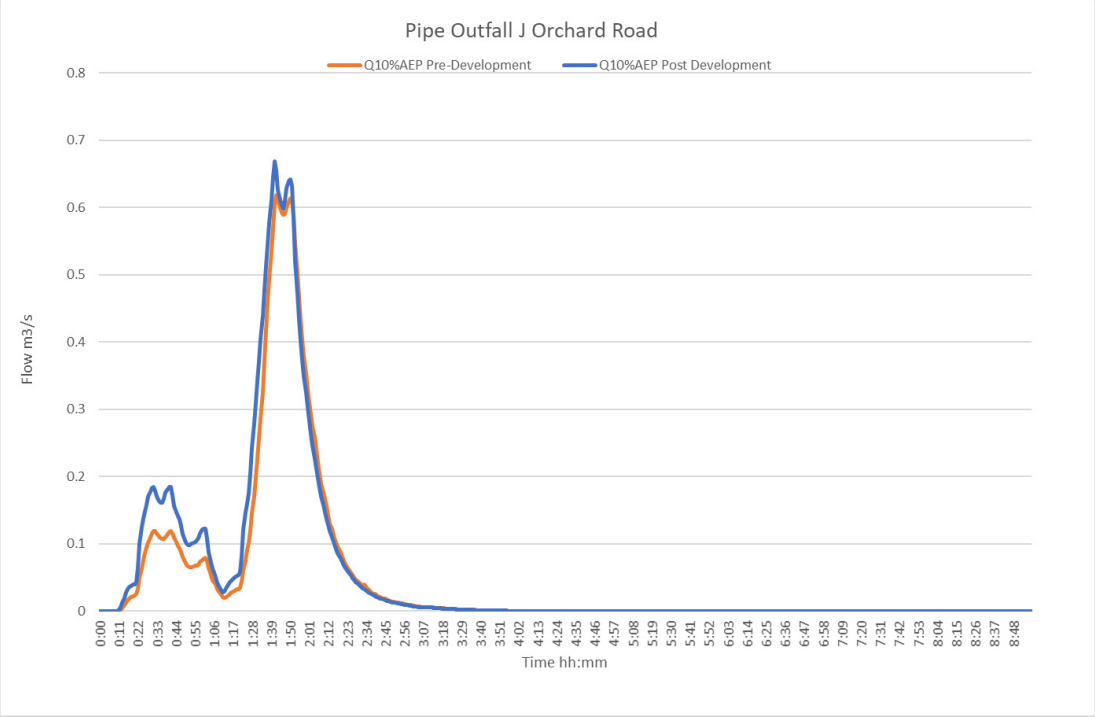


Figure E.22 Outfall J hydrograph discharge results for 10% AEP

OUTFALL K

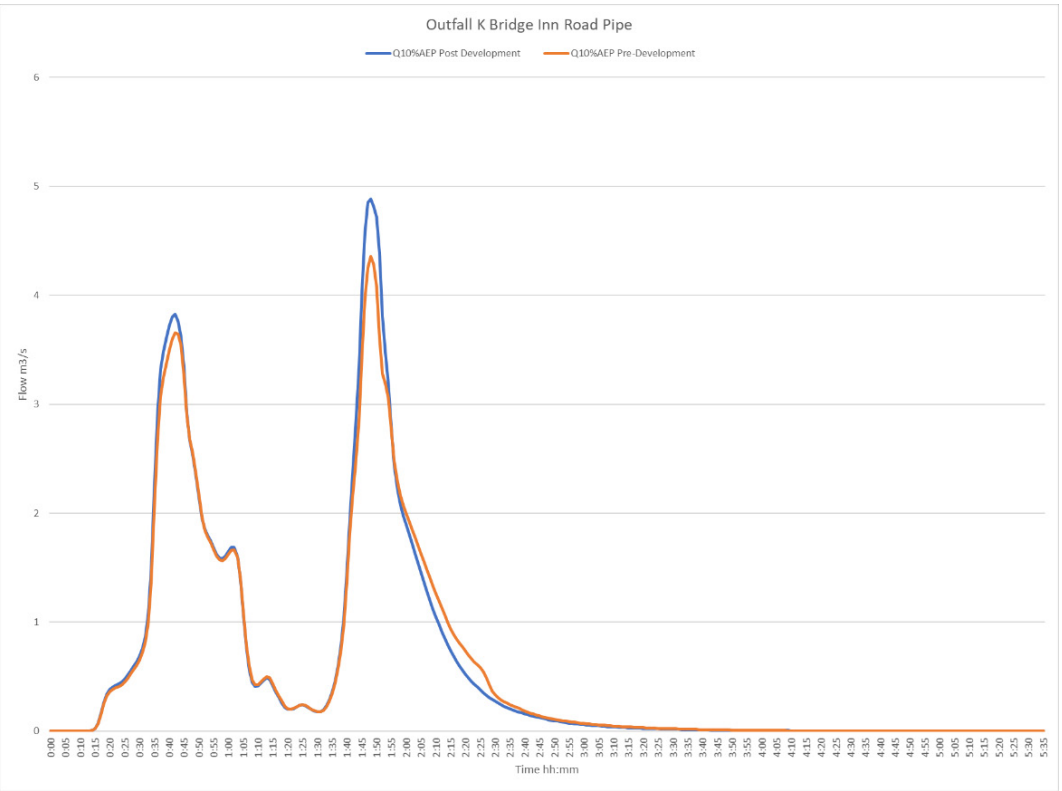


Figure E.23 Outfall K hydrograph discharge results for 10% AEP

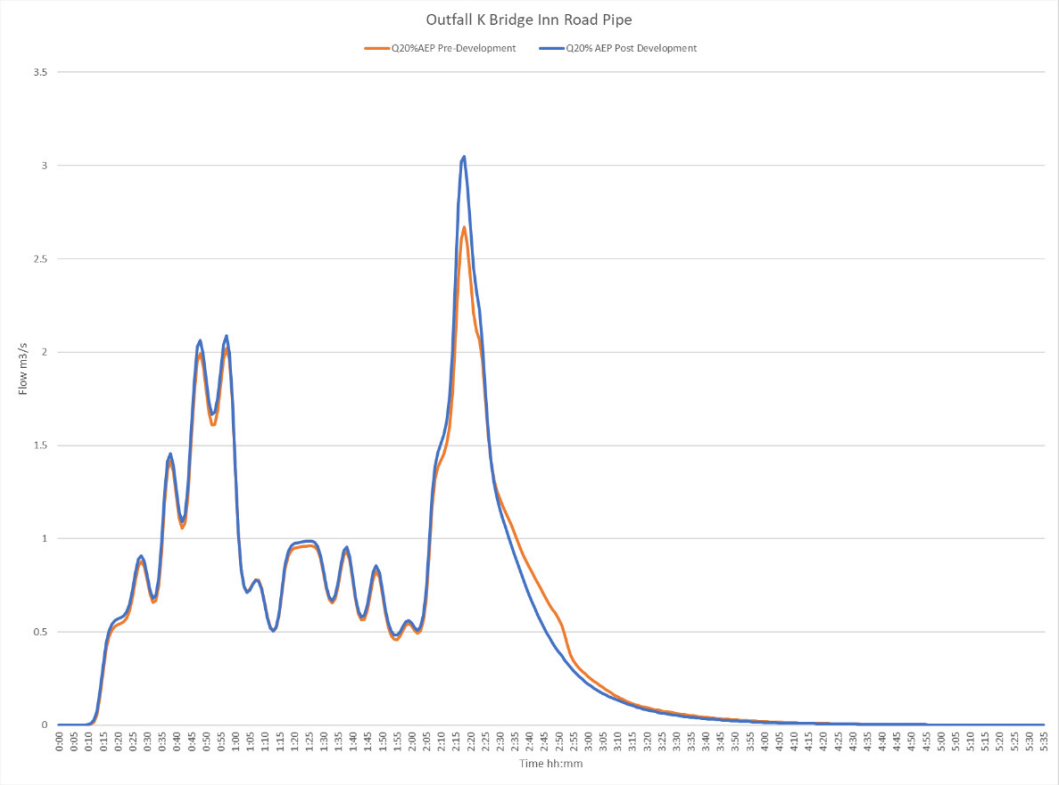


Figure E.24 Outfall K hydrograph discharge results for 20% AEP

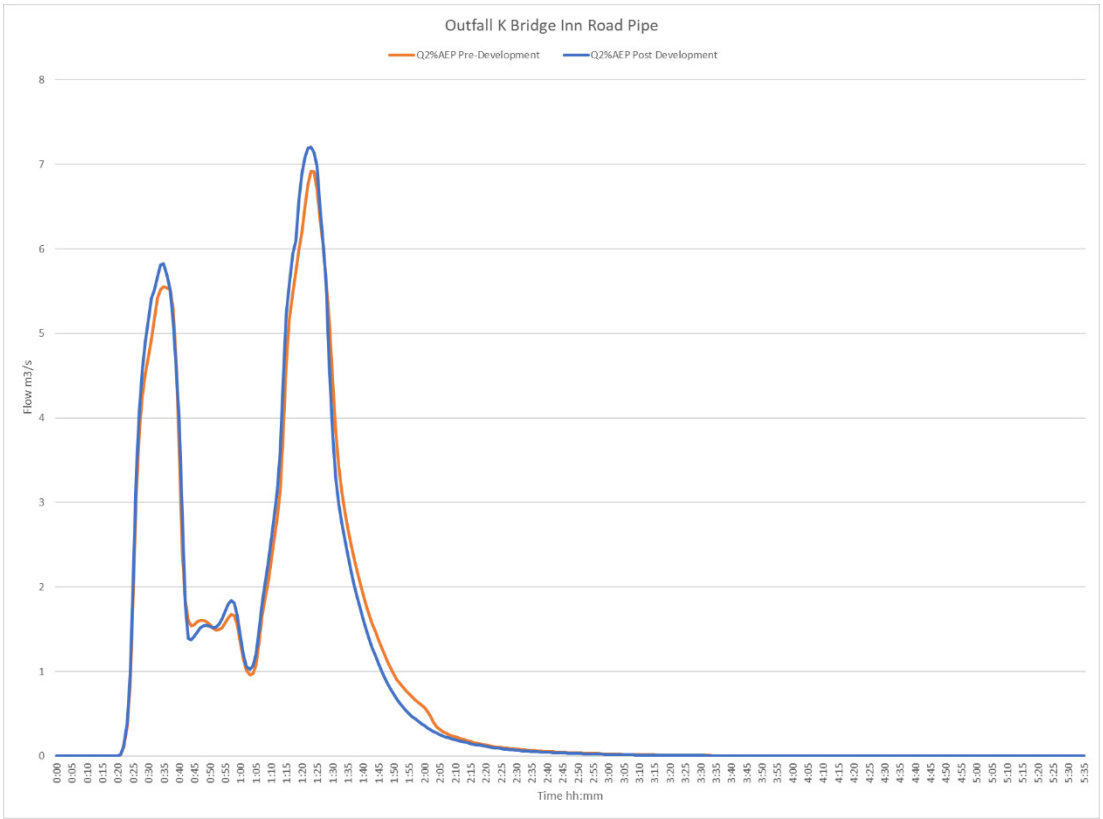


Figure E.25 Outfall K hydrograph discharge results for 2% AEP

APPENDIX F

SURFACE WATER RISK REGISTER

Major Road Projects Victoria

Project name: **Yan Yean Road Stage 2 EES Environmental Risk Register - Draft Post Environmental Risk Workshop & Specialist Input**

Version: 5

Date: 26/06/2020

Author: Sabrina Chapman

Contributors: Matt Knight, Tori Harvey, Paige Krygger, Louie D'Amore, Will Parker, Clinton Kenna, Arvind Deivasigamani, Louise McGinley, Sarah Sawyer, Sam Vertucci, Cameron Ryder, Rachael Mino, Samantha Fidge, Ellen Buswell, George Bazeley, Marianne Stoettrup

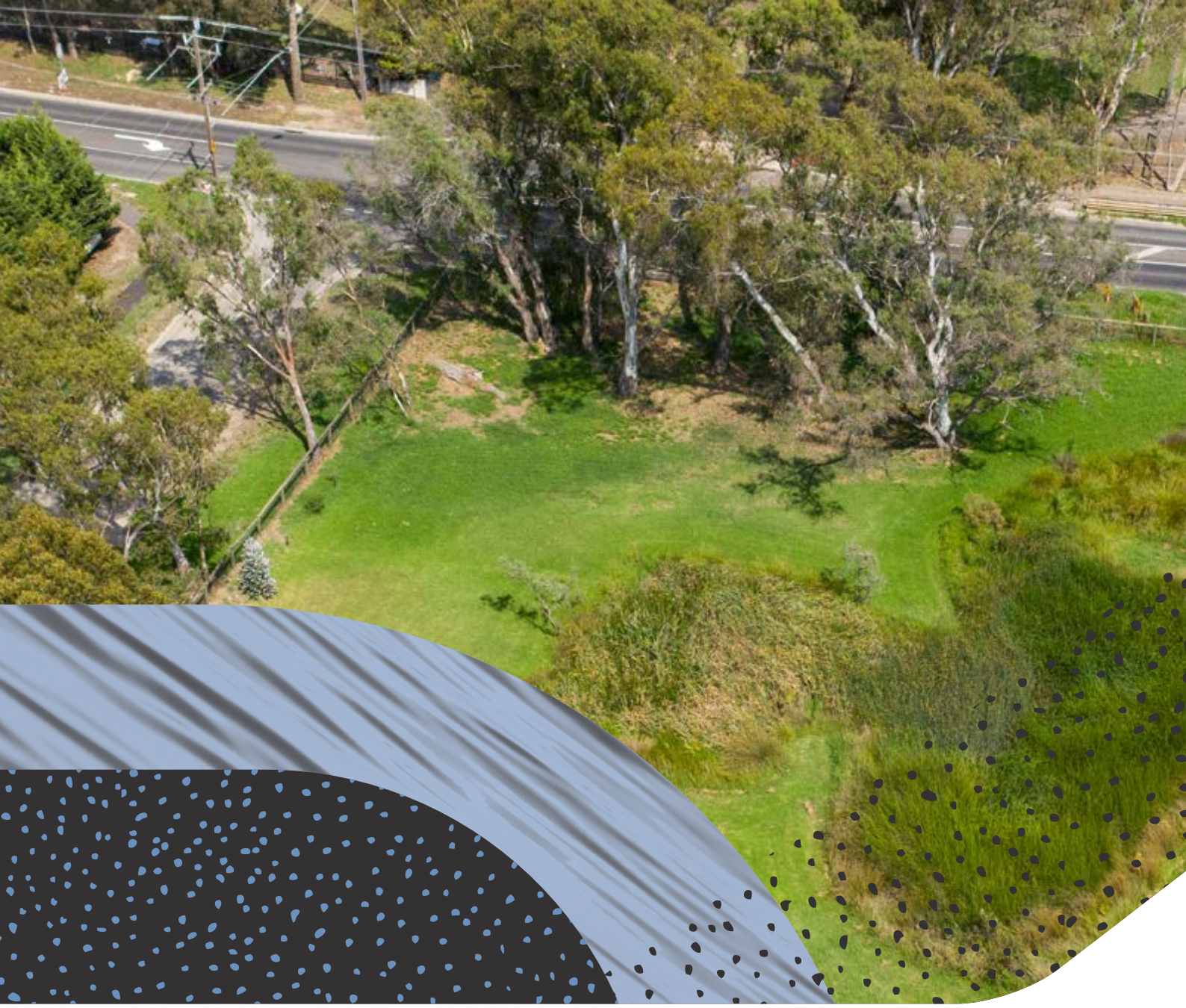
Review: Mat Peel

				Initial Risk					Residual Risk				
No	Aspect	Impact Pathway	Activity	Likelihood	Consequence	Inherent Risk Rating	Mitigation measures to inform Environmental Performance Requirement	EPR	Likelihood	Consequence	Residual Risk Rating	Rationale	Relevant impact assessment
15	Surface water	Potential changes to stormwater flows as a result of site works, and/or adverse impacts on water quality and beneficial uses including waterway health and listed Wetlands (if applicable)	Site establishment	Unlikely	Minor	Low	The Construction Environmental Management Plan will include processes and measures to manage surface water in accordance with the relevant water objectives set out in the Environment Reference Standard under the *Environment Protection Amendment Act 2018*, Melbourne Water Performance Criteria and other relevant statutory requirements. Mitigation measures to inform the Construction Environmental Management Plan will be established in accordance with Melbourne Water and Council requirements, contract specifications, EPA Publications 275, 480 and 960 and include: • Best practice sediment and erosion control • Maintenance of existing flow paths, drainage lines and floodplain storage, or in the case where existing flow paths will be modified, mitigate the effects of changes to flow where practicable • Water quality monitoring during construction and management of drainage infrastructure to be carried out in accordance with MRPV's Integrated Water Management Guideline (2019) • Stormwater or flood modelling mitigation solutions for temporary works as required • Flood emergency management including consideration of scheduling works • Maximise the visual and aesthetic amenity of waterways having regard to any relevant development plans in consultation with Melbourne Water • Refuelling in designated areas where hardstand is present and removal of impacted soils following minor spills.	EPR SW1	Unlikely	Minor	Low	The Surface Water Impact Assessment (WSP 2019) identified erosion from construction sites have the potential to contribute large sediment loads to downstream areas. Water supplies may be needed during construction for dust control and other such purposes. Depending on the quantities needed, there may be an impact on users of the water resource and aquatic fauna and flora. Regular site supervision and consultation with key stakeholders will ensure the Construction Environmental Management Plan (CEMP) is being fully implemented. In addition to this, reviews and improvements to the CEMP will be carried out when necessary to ensure Project compliance with listed published guidelines and Project specifications.	Technical Report L - *Surface water impact assessment*
35	Surface water	Potential changes to stormwater flows as a result of site works, reduction of flood conveyance or floodplain storage, and/or adverse impacts on water quality and beneficial uses including waterway health and listed Wetlands (if applicable)	Earthworks	Unlikely	Minor	Low	The Construction Environmental Management Plan will include processes and measures to manage surface water in accordance with the relevant water objectives set out in the Environment Reference Standard under the *Environment Protection Amendment Act 2018*, Melbourne Water Performance Criteria and other relevant statutory requirements. Mitigation measures to inform the Construction Environmental Management Plan will be established in accordance with Melbourne Water and Council requirements, contract specifications, EPA Publications 275, 480 and 960 and include: • Best practice sediment and erosion control • Maintenance of existing flow paths, drainage lines and floodplain storage, or in the case where existing flow paths will be modified, mitigate the effects of changes to flow where practicable • Water quality monitoring during construction and management of drainage infrastructure to be carried out in accordance with MRPV's Integrated Water Management Guideline (2019) • Stormwater or flood modelling mitigation solutions for temporary works as required • Flood emergency management including consideration of scheduling works • Maximise the visual and aesthetic amenity of waterways having regard to any relevant development plans in consultation with Melbourne Water • Refuelling in designated areas where hardstand is present and removal of impacted soils following minor spills.	EPR SW1	Unlikely	Minor	Low	The Surface Water Impact Assessment (WSP 2019) identified erosion from construction sites have the potential to contribute large sediment loads to downstream areas. Water supplies may be needed during construction for dust control and other such purposes. Depending on the quantities needed, there may be an impact on users of the water resource and aquatic fauna and flora. Regular site supervision and consultation with key stakeholders will ensure the Construction Environmental Management Plan (CEMP) is being fully implemented. In addition to this, reviews and improvements to the CEMP will be carried out when necessary to ensure Project compliance with listed published guidelines and Project specifications.	Technical Report L - *Surface water impact assessment*
55	Surface water	Potential changes to stormwater flows as a result of site works, reduction of flood conveyance or floodplain storage, and/or adverse impacts on water quality and beneficial uses including waterway health and listed Wetlands (if applicable)	Civils and structures	Unlikely	Minor	Low	The Construction Environmental Management Plan will include processes and measures to manage surface water in accordance with the relevant water objectives set out in the Environment Reference Standard under the *Environment Protection Amendment Act 2018*, Melbourne Water Performance Criteria and other relevant statutory requirements. Mitigation measures to inform the Construction Environmental Management Plan will be established in accordance with Melbourne Water and Council requirements, contract specifications, EPA Publications 275, 480 and 960 and include: • Best practice sediment and erosion control • Maintenance of existing flow paths, drainage lines and floodplain storage, or in the case where existing flow paths will be modified, mitigate the effects of changes to flow where practicable • Water quality monitoring during construction and management of drainage infrastructure to be carried out in accordance with MRPV's Integrated Water Management Guideline (2019) • Stormwater or flood modelling mitigation solutions for temporary works as required • Flood emergency management including consideration of scheduling works • Maximise the visual and aesthetic amenity of waterways having regard to any relevant development plans in consultation with Melbourne Water • Refuelling in designated areas where hardstand is present and removal of impacted soils following minor spills.	EPR SW1	Unlikely	Minor	Low	The Surface Water Impact Assessment (WSP 2019) identified erosion from construction sites have the potential to contribute large sediment loads to downstream areas. Water supplies may be needed during construction for dust control and other such purposes. Depending on the quantities needed, there may be an impact on users of the water resource and aquatic fauna and flora. Regular site supervision and consultation with key stakeholders will ensure the Construction Environmental Management Plan (CEMP) is being fully implemented. In addition to this, reviews and improvements to the CEMP will be carried out when necessary to ensure Project compliance with listed published guidelines and Project specifications.	Technical Report L - *Surface water impact assessment*
75	Surface water	Potential changes to stormwater flows as a result of site works, and/or adverse impacts on water quality and beneficial uses including waterway health and listed Wetlands (if applicable)	Reinstatement	Unlikely	Minor	Low	The Construction Environmental Management Plan will include processes and measures to manage surface water in accordance with the relevant water objectives set out in the Environment Reference Standard under the *Environment Protection Amendment Act 2018*, Melbourne Water Performance Criteria and other relevant statutory requirements. Mitigation measures to inform the Construction Environmental Management Plan will be established in accordance with Melbourne Water and Council requirements, contract specifications, EPA Publications 275, 480 and 960 and include: • Best practice sediment and erosion control • Maintenance of existing flow paths, drainage lines and floodplain storage, or in the case where existing flow paths will be modified, mitigate the effects of changes to flow where practicable • Water quality monitoring during construction and management of drainage infrastructure to be carried out in accordance with MRPV's Integrated Water Management Guideline (2019) • Stormwater or flood modelling mitigation solutions for temporary works as required • Flood emergency management including consideration of scheduling works • Maximise the visual and aesthetic amenity of waterways having regard to any relevant development plans in consultation with Melbourne Water • Refuelling in designated areas where hardstand is present and removal of impacted soils following minor spills.	EPR SW1	Unlikely	Minor	Low	The Surface Water Impact Assessment (WSP 2019) identified the placement of temporary works, stockpiles, equipment and plant can result in a reduction in flood conveyance or floodplain storage, potentially leading to increases to flood levels, flow velocities and flood frequency.	Technical Report L - *Surface water impact assessment*
95	Surface water	Potential changes to stormwater flows as a result of operation, and/or adverse impacts on water quality and beneficial uses including waterway health and listed Wetlands (if applicable), due to changes to ground levels, ground surface imperviousness or increases in stormwater pollutants	Operations	Possible	Moderate	Medium	To mitigate changes to the hydrologic and / or hydraulic regime of waterways and stormwater risks, the following will be completed: • Develop a detail drainage model based on the 3D road detail design to comply with AustRoads, Council and Melbourne Water guidelines. A spill risk assessment should be conducted for each outfall based on the likelihood of a spill, which is estimated based on the road characteristics (geometry) of the outfall catchment, and its proximity to the downstream water sensitive receptors (i.e. consequence of the spill). Outfalls with a high spill risk are to provide spill containment • Detailed design drainage works in accordance with Melbourne Water, Austroads and Council requirements • Discharge and runoff to meet the relevant water objectives set out in the Environment Reference Standard under the *Environment Protection Amendment Act 2018*, Melbourne Water Performance Criteria and other relevant statutory requirements • For outfalls to major main drains or waterways, Melbourne Water will be consulted to determine specific requirements • An assessment and provision of flood mitigation measures during detailed design where the works result in an increase to flood risk • Investigate and mitigate interfaces with private, Council and Melbourne Water drainage assets • Comply with Melbourne Water Stormwater Quality Performance Criteria Yan Yean Road Upgrade - Stage 2 publication and MRPV's Integrated Water Management Guideline (2019) • In accordance with Emergency Response Procedures, complete spills risk assessment during detail design and provide spill containment for high risk locations.	EPR SW2	Unlikely	Minor	Low	The Surface Water Impact Assessment (WSP 2019) identified erosion from construction sites to have the largest impact on sediment loads. The assessment also identified the need for water supplies for dust control and other such purposes. Depending on the quantities needed, there may be an impact on users of the water resource.	Technical Report L - *Surface water impact assessment*

115	Surface water	Potential changes to stormwater flows as a result of maintenance activities such as weed control spraying, and/or adverse impacts on water quality and beneficial uses including waterway health and listed Wetlands (if applicable)	Maintenance	Unlikely	Minor	Low	Any potential impacts during operation and maintenance will be managed in accordance with the Department of Transport's standards for managing declared roads in Victoria.	EPR EMF5	Unlikely	Minor	Low	The Surface Water Impact Assessment (WSP 2019) identified based on the 1% AEP plus climate change (largest required design flood event to be considered): • Flood risk at outfalls to Melbourne Water watercourses, Melbourne Water wetland and Yarrambat lake is minor and mitigation during detail design can manage this risk • No properties were at increased flood risk (based on the road design option modelled and proposed transverse crossings) • Flood impacts for a range of more frequent AEPs should be confirmed during detail design. The preliminary drainage impact assessment identified that proposed WSRD onsite treatment to include: • Upgrading drains at the base of proposed embankments to grassed swales and providing connections to the kerb and channel network • Provide bioretention upstream of Yarrambat Lake Best Practice Environmental Management Guidelines targets for urban stormwater are achieved at project level and upstream of sensitive receptors.	Technical Report L - *Surface water impact assessment*

APPENDIX G

EXTENDED PROJECT DESCRIPTION



PART 1 INTRODUCTORY CHAPTERS

5 Project Description

5.1 Introduction

This chapter describes the proposed design, construction and operation of the duplication of Yan Yean Road between Kurrak Road and Bridge Inn Road (the Project). The chapter should be read in conjunction with Attachment VI *Map Book*, which contains detailed plans and drawings of key elements of the Project.

This Project description has been developed to provide an understanding of all components, processes and development stages of the Project to enable assessment of the Project's potential environmental effects. The description includes specific design elements to address the potential for the Project to generate adverse environmental effects and impacts.

5.2 Project overview

Yan Yean Road is a significant north-south arterial road servicing the Shire of Nillumbik and the City of Whittlesea, providing connectivity for the City of Whittlesea's growing suburbs of Doreen and Mernda to the townships of Plenty and Yarrambat. Yan Yean Road connects with major east-west arterials such as Bridge Inn Road, Kurrak Road and Diamond Creek Road and also provides a connection to employment and services in established neighbouring suburbs such as Greensborough and Diamond Creek.

Stage 1 of the Yan Yean Road upgrade (Diamond Creek Road to Kurrak Road) was completed in 2019, and construction on Stage 2 (the subject of this EES) is scheduled for completion by 2025.

The Project seeks to upgrade an existing road in hilly terrain, largely within the existing road reserve. The surrounding environment is characterised by low density residential and rural living areas such as farmland and agricultural areas, with the suburb of Doreen experiencing rapid change from rural living to higher density residential developments. The Project alignment and immediate surrounds intersect a range of land uses including residential, open space, rural living, commercial and education.

Key land uses along the alignment include Yarrambat Park and the Yarrambat Park Golf Course, Plenty Valley Christian College, Yarrambat Primary School, St Macarius Coptic Orthodox Church and the Doreen business precinct.

Terms used in this project description

Carriageway: lanes where traffic would be travelling, plus shoulders and auxiliary lanes

Cross section: shows the width of the road with the position and number of traffic lanes, medians, walking and cycling paths and footpaths

Cutting: ground excavation that is required to create a smooth base for construction of a road

Land parcel: the smallest unit of land able to be transferred within Victoria's cadastral system

Median: the area between two opposing carriageways

Mid-block: a section of road between key intersections

Outer edge / shoulder: the area next to a roadway that provides clearance between the roadway and roadside

Road reserve: all the area of land that is within the boundaries of a road

Roadside: any land that is within the boundaries of a road (other than the shoulders of the road) which is not a roadway or pathway

Roadway: the area of the public road that is open to or used by members of the public and is developed by a road authority for the driving or riding of motor vehicles

Signalised intersections: intersections controlled by traffic lights

The Project would duplicate a 5.5 kilometre section of Yan Yean Road between Kurrak Road and Bridge Inn Road, increasing the existing two lanes to four lanes (comprising two lanes in each direction). The design speed along Yan Yean Road within the extent of the project area is 70 kilometres per hour, with the exception of north of Bridge Inn Road where the design speed is 80 kilometres per hour. This is consistent with existing speed limits. The design for the Project assessed in this EES has 3.5-metre-wide lanes, with the majority of the Project using a central 2.2 metre-wide median. This design was adopted due to various constraints: road safety issues, steep and rolling terrain, high cut and fill batters and subsequent retaining walls at certain locations.

The design also seeks to limit impacts to existing properties, local accesses and trees along Yan Yean Road. The existing road alignment has been retained due to constraints around the topography and land uses adjacent to the road corridor. The exception is at the Bridge Inn Road intersection, which would be shifted to the north east to retain two River Red Gums (referred to as the Doreen River Red Gums) and two businesses. The project area is shown in Figure 5.1 and key components of the Project are shown in Figure 5.2.

The Project includes:

- Two new roundabouts: one at Heard Avenue and one at Youngs Road
- Five new signalised intersections at Bannons Lane, Jorgensen Avenue, North Oatlands Road, Orchard Road and Bridge Inn Road
- Upgrades to one existing signalised intersection at Ironbark Road, including an additional right-hand turning lane, slip lane and traffic island
- New street lighting at all intersections, road signage and landscaping
- A new walking and cycling path on the western side and a footpath on the eastern side of Yan Yean Road, linking Diamond Creek to Doreen and improving safety and connectivity for pedestrians and cyclists
- Continuous safety barriers running along the Project's length, proposed in the median and behind outer kerbs along the mid-block sections of the carriageways
- A wide median between Bannons Lane and Jorgensen Avenue to provide for additional landscaping opportunities and potential avoidance of existing biodiversity values and large trees.

Figure 5.1 Project area

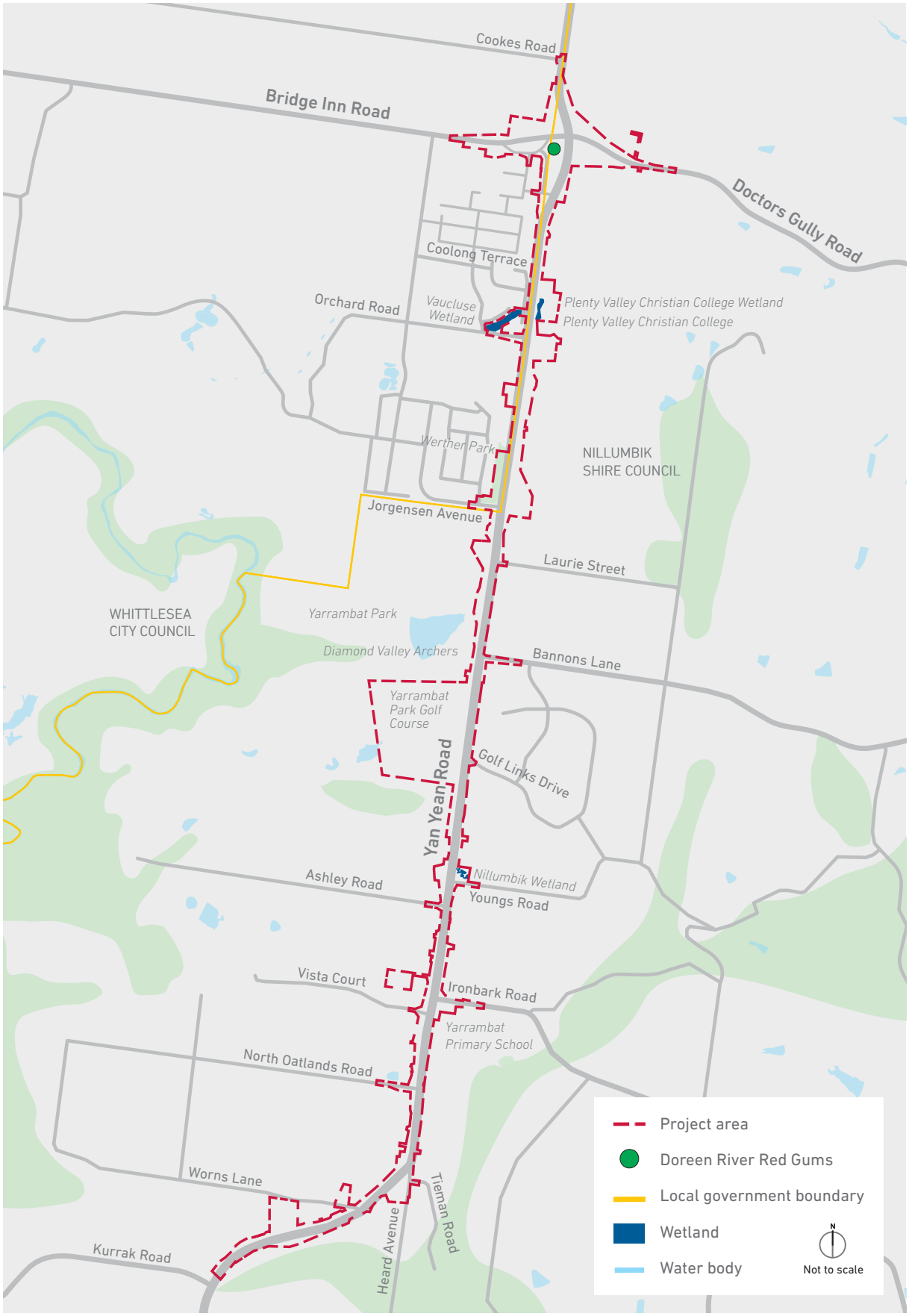
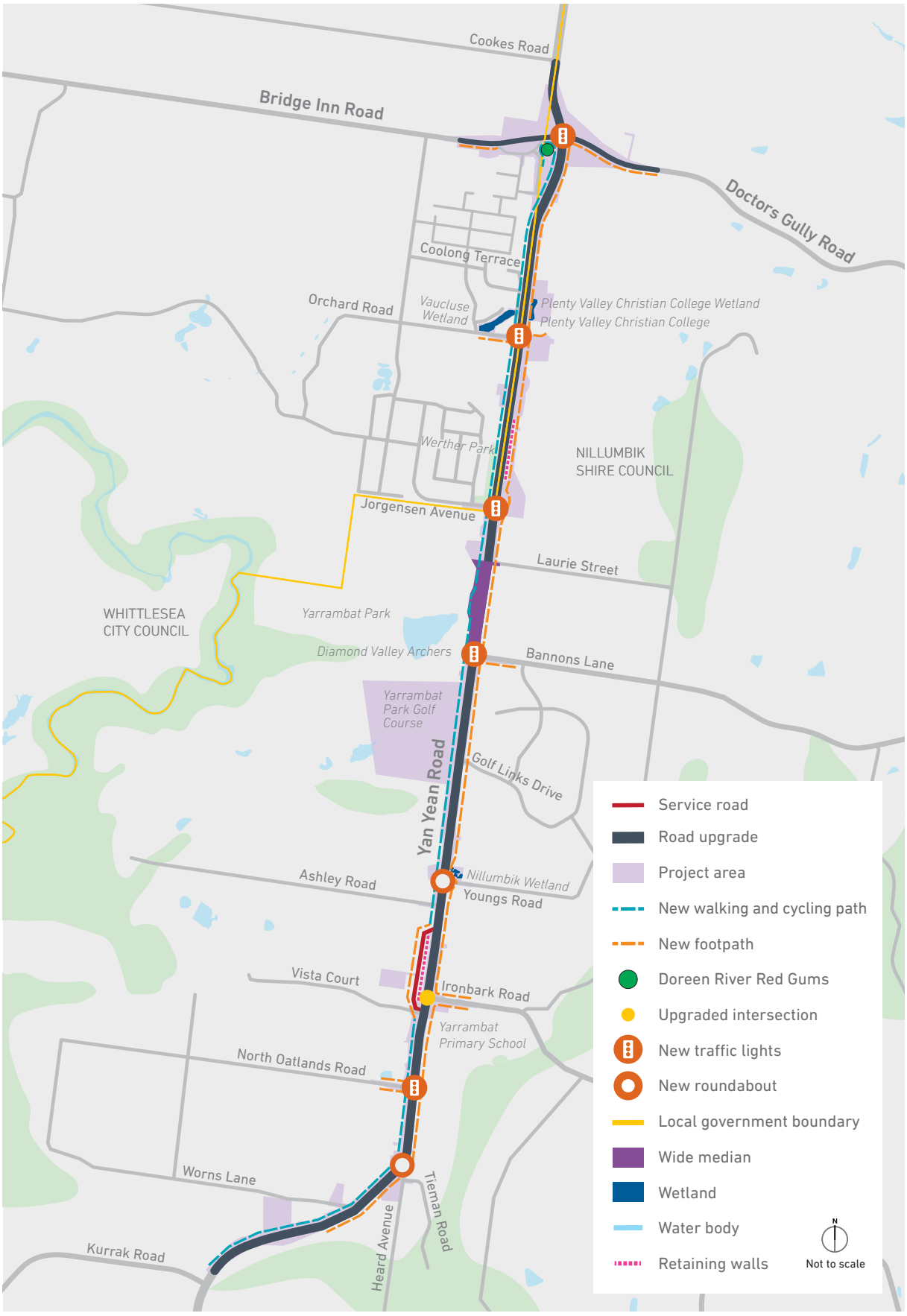


Figure 5.2 Key components of the Project



5.3 Project design

5.3.1 Road design

There are a number of elements to the road design of Yan Yean Road:

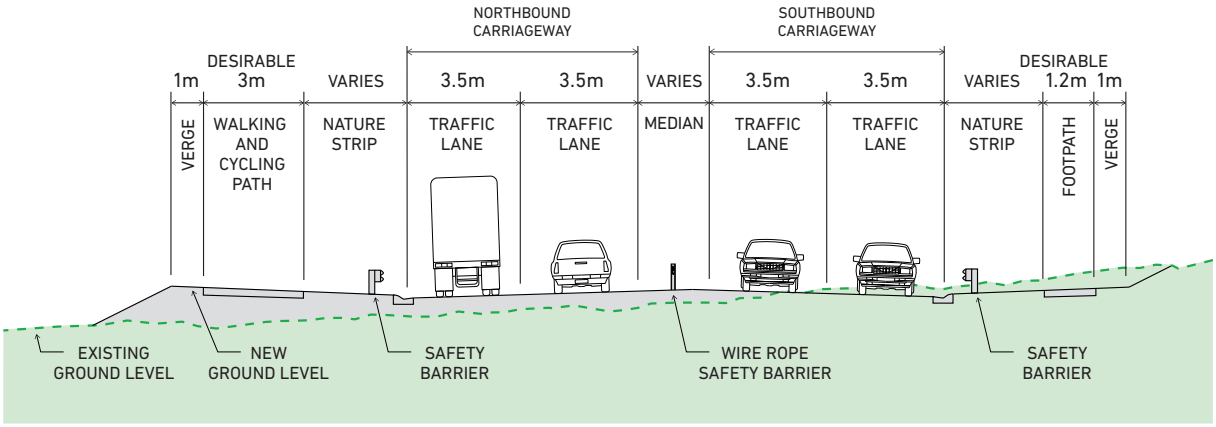
- Typical cross section
- Intersections
- Access
- Wide median
- Safety barriers
- Retaining walls
- Fencing
- Car parks
- Bus facilities.

Typical cross section

The following diagram indicates the typical cross section of the road design for the Project. At some locations along the alignment, such as intersections or roundabouts, this cross section would be slightly different and wider. Figure 5.3 shows the preferred mid-block cross section design, which allows for duplication with a 2.2 metre median with safety barriers.

The installation of safety barriers provides opportunities for tree planting in closer proximity to the road carriageway than would be otherwise permissible, in accordance with the Project's Landscape Strategy (Technical Report G). The total road reserve width along most of the proposed design is 24.2 metres increasing to 33 metres between Bannons Lane and Jorgensen Avenue to accommodate the widened median at this location. The current typical roadway width is eight metres.

Figure 5.3 Yan Yean Road preferred cross section design



For illustrative purposes only.

Intersection design

The scope of the Project includes modifications to a number of intersections. Signalised intersections are proposed to improve safety, provide U-turn opportunities and increase the capacity of existing intersections, and roundabouts are proposed to improve safety and provide larger U-turn opportunities. Intersection works include:

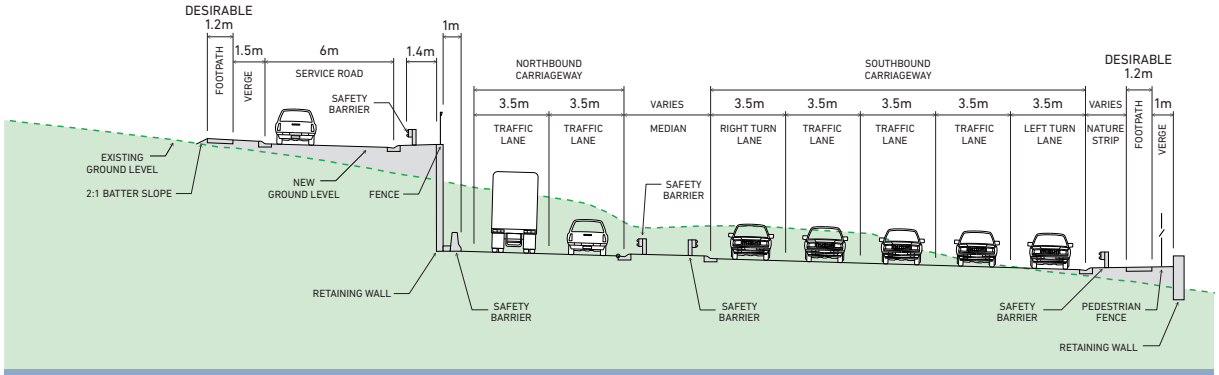
- Signalised intersections at North Oatlands Road, Ironbark Road (refer to Figure 5.4), Bannons Lane, Jorgensen Avenue, Orchard Road and Bridge Inn Road (refer to Figure 5.5)
- Roundabouts at Heard Avenue and Youngs Road
- Proposed left in / left out arrangements at all other intersections, including:
  - Yan Yean Road / Activity Way
  - Yan Yean Road / Laurie Street
  - Yan Yean Road / Golf Links Drive
  - Yan Yean Road / Ashley Road
  - Yan Yean Road / Service Road A exit (left out only)
  - Yan Yean Road / Vista Court
  - Yan Yean Road / Worns Lane
  - Yan Yean Road / 807 Yan Yean Road access
  - Yan Yean Road / Service Road B (between Kurrak Road and Worns Lane)
  - Residential properties and businesses along the alignment
- Auxiliary lanes provided for all left turns (and where applicable, right turns) from Yan Yean Road into key intersections to separate turning traffic from the main traffic flow to reduce collisions and improve the road capacity.

The project design at Bridge Inn Road would retain the two Doreen River Red Gums situated adjacent to the Bridge Inn Road and Yan Yean Road T-intersection and the General Store / former post office and Pet Supplies and Stockfeeds Store on the corner of Doctors Gully Road. It proposes shifting the whole intersection to the north-east corner of Yan Yean Road / Bridge Inn Road with two lanes in each direction.

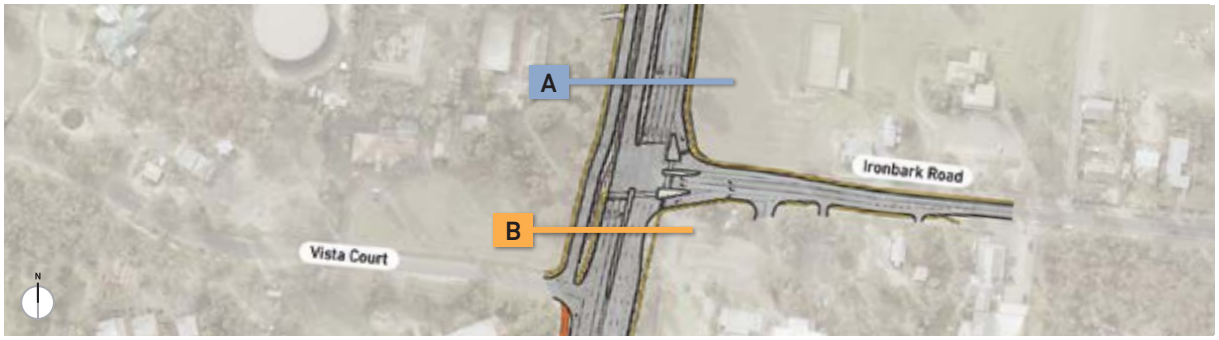
The design at Bridge Inn Road has been refined following community consultation and in response to additional arboriculture advice on the Doreen River Red Gums, which are situated south-west of the proposed intersection (refer to Figure 5.5).

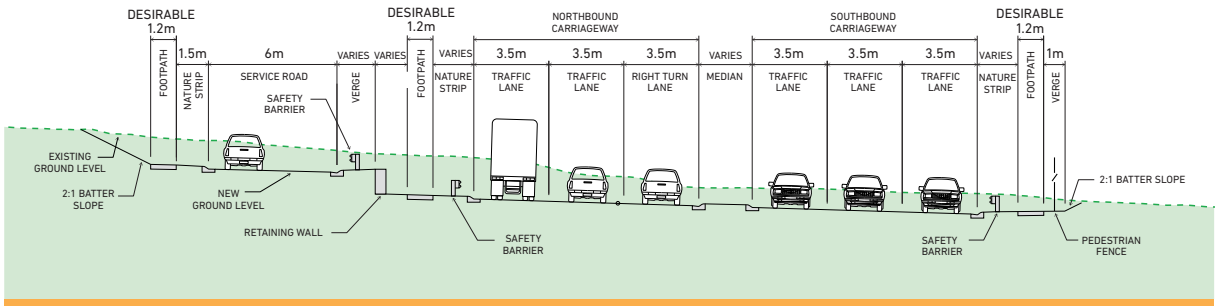
The project design at Bridge Inn Road would retain the two Doreen River Red Gums situated adjacent to the Bridge Inn Road – Yan Yean Road T-intersection and the General Store.

Figure 5.4 Typical signalised intersection cross section – Ironbark Road (northbound)



A: IRONBARK ROAD INTERSECTION DEPARTURE

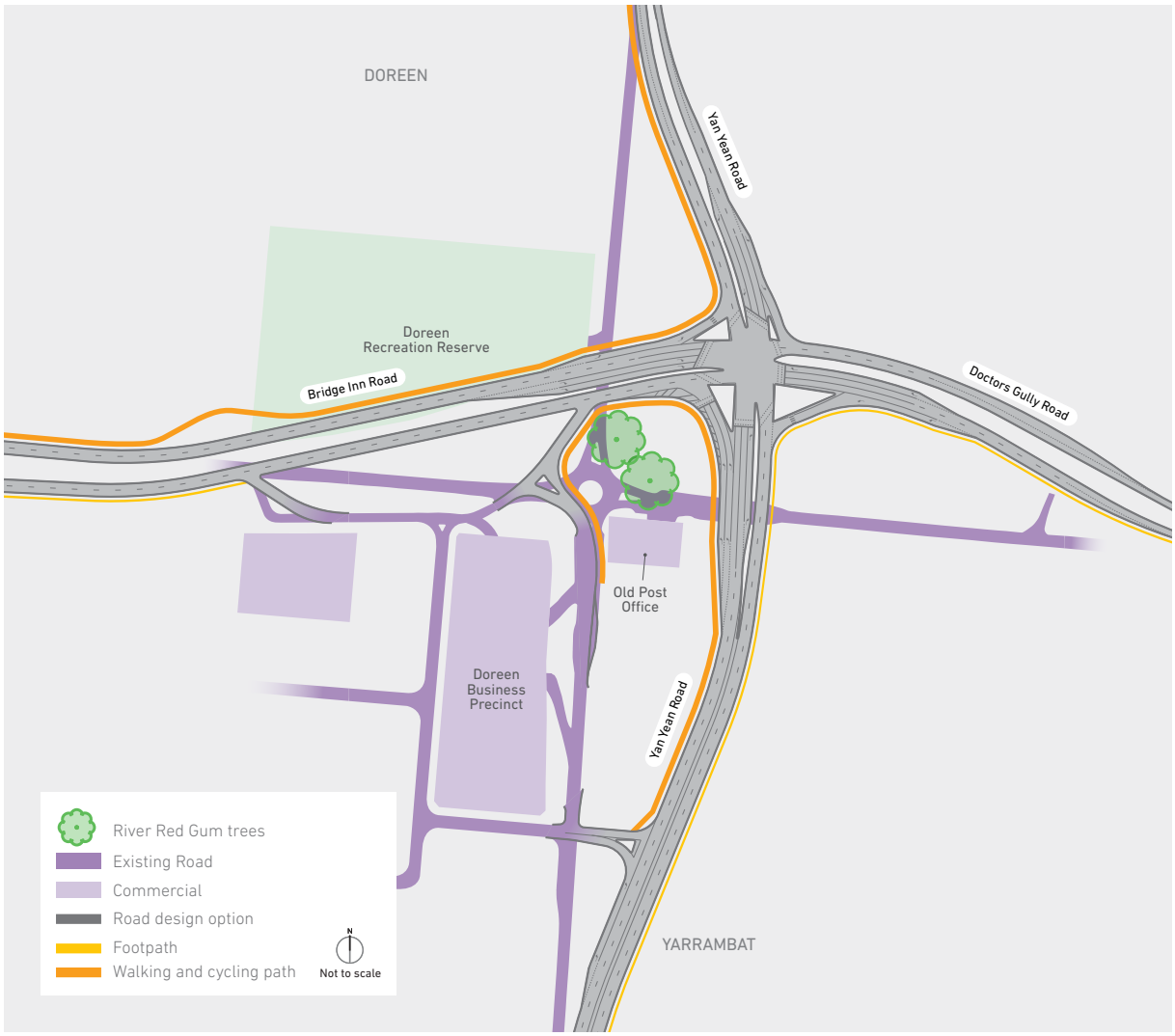




B: IRONBARK ROAD INTERSECTION APPROACH

For illustrative purposes only.

Figure 5.5 Bridge Inn Road intersection design



For illustrative purposes only.

Access design

All existing accesses would be changed to left in / left out arrangements to allow for the installation of a centre median and safety barriers. U-turn lanes would be provided at the following locations to allow for the safe turning of vehicles wishing to travel in the opposite direction:

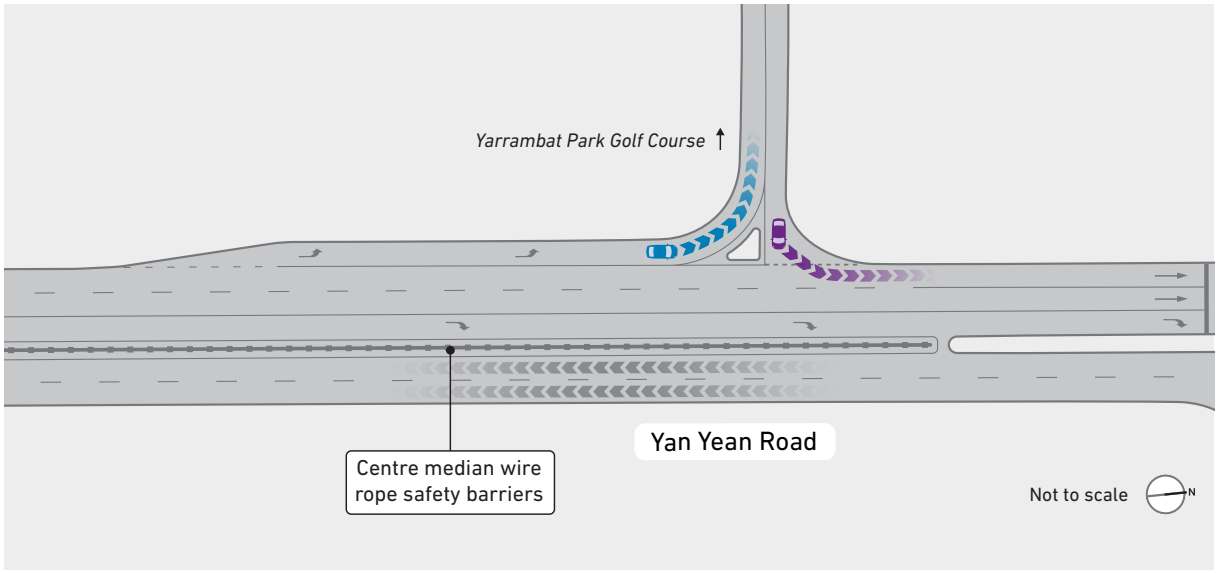
- Bridge Inn Road signalised intersection (cars only)
- Orchard Road signalised intersection (cars only)
- Jorgensen Avenue signalised intersection (cars only)
- Bannons Lane signalised intersection (cars only)
- Youngs Road roundabout (cars, cars with trailers / horse floats, semi-trailers and trucks)
- Ironbark Road signalised intersection (cars only)
- North Oatlands Road signalised intersection (cars only)
- Heard Avenue roundabout (cars, cars with trailers / horse floats, semi-trailers and trucks).

All existing Council approved property access and driveways are proposed to be maintained with minor tie-in works. Access for properties at the western side of Yan Yean Road from Vista Court to Ashley Road would be via a service road due to the steep grade and level differences between properties and Yan Yean Road (refer to Figure 5.4 and Attachment VI *Map Book*).

Access conditions at Yarrambat Primary School and Plenty Valley Christian College would be revised due to intersection upgrades impacting existing access and carpark arrangements.

The proposed design includes a left in / left out arrangement (refer to Figure 5.6) to the Yarrambat Park Golf Course.

Figure 5.6 Left in / left out arrangement – Access to Yarrambat Park Golf Course



For illustrative purposes only.

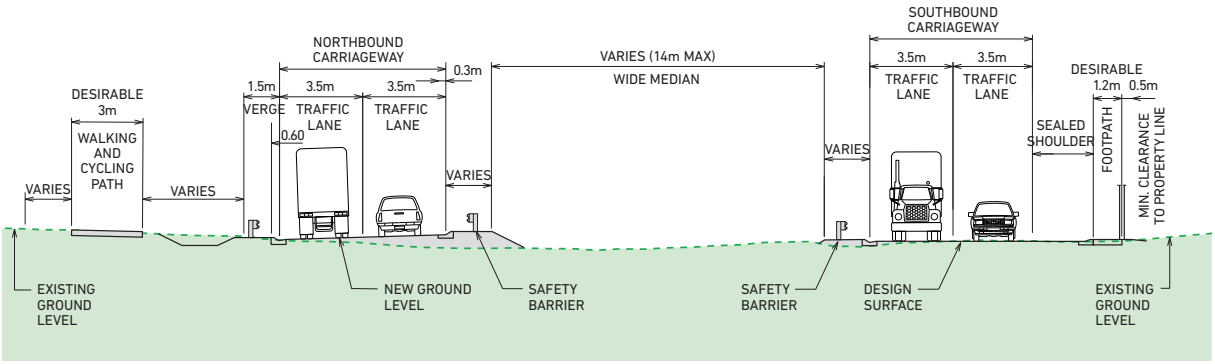
Wide median

A divided carriageway (boulevard design) increases the median width of Yan Yean Road from 2.2 metres to approximately 14 metres by realigning the northbound carriageway between Bannons Lane and Jorgensen Avenue (refer to Figure 5.7). The maximum road reserve width at this point would be approximately 33 metres, although the cross section would taper at either end to tie back into the standard cross section of 24.2 metres, as described above. A wider median at this location would provide for additional landscaping opportunities and potential avoidance of existing biodiversity values (including Matted Flax-lily) and large trees in accordance with the Project's Landscape Strategy (Technical Report G).

The southbound carriageway is aligned to follow the existing carriageway edge to retain the existing separation distance between driveways, residences and Yan Yean Road.

The wide median section of the road design tapers back to the standard cross section width at Bannons Lane. This allows the safe tapering of the road back to the standard road width while avoiding private land acquisition further south of the golf course.

Figure 5.7 Wide median cross section design



For illustrative purposes only.

Safety barrier design

Continuous safety barriers are proposed in the median and behind most outer kerbs (where there are not intersections). Safety barriers would be installed at various setbacks from the kerb ranging from 0.6 to 1 metre, depending on factors such as speed limit, topography and barrier type. Safety barriers require a cleared area behind them to maintain the integrity of their effectiveness. This includes clearance from walking and cycling paths, as well as footpaths. Proposed safety barriers include guardrail, wire rope and concrete barriers if deemed required.

Retaining walls design

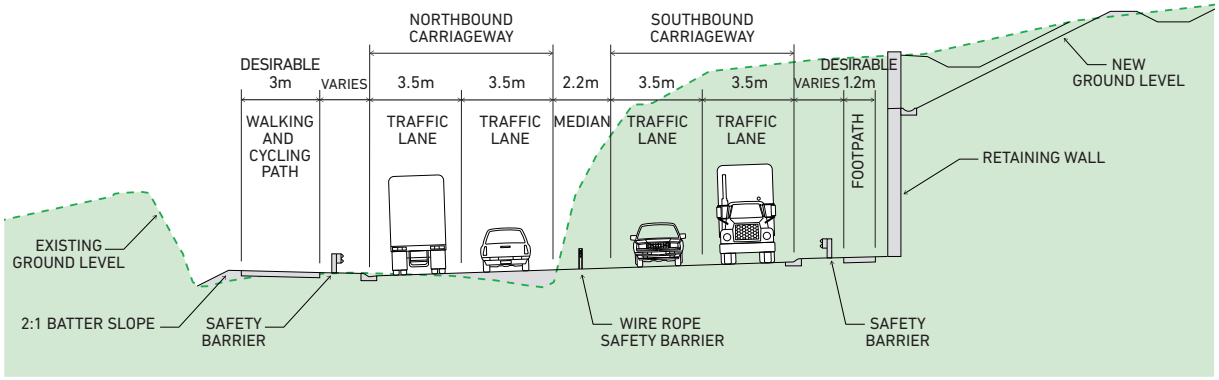
Retaining walls have been proposed at selected locations along Yan Yean Road to minimise the extent of land acquisition on adjacent properties, provide access to properties abutting Yan Yean Road, maximise the retention of existing trees and reduce the extent of cut earthworks. The design of retaining walls would be carried out in accordance with guidelines in the Project's Landscape Strategy (Technical Report G). Retaining walls are likely to be installed at the following locations (refer to Figure 5.8 and Figure 5.9):

- Between Service Road A and Yan Yean Road: a 270 metre long wall with an approximate maximum height of 3.6 metres. This retaining wall has been proposed to retain access to existing properties abutting Yan Yean Road and minimise impacts to existing trees
- At the north-east corner of Ironbark Road: a 230 metre long wall with an approximate maximum height of 2.4 metres. This retaining wall has been proposed to minimise the extent of land acquisition at the adjacent property
- North of North Oatlands Road along the western verge of Yan Yean Road: a 50 metre long wall with an approximate maximum height of 1.1 metres. This retaining wall has been proposed to minimise the extent of land acquisition at the adjacent property and minimise the impact to the existing driveway arrangement
- North of Jorgensen Avenue along the eastern verge of Yan Yean Road: a 220 metre long wall with an approximate maximum height of 8 metres. This retaining wall has been proposed to avoid impacting the existing telecommunication tower on the abutting property, maintain access to the adjacent property and telecommunication tower, maximise the retention of existing trees and reduce the extent of cut works.

Figure 5.8 Retaining wall locations

For illustrative purposes only.

Figure 5.9 Retaining wall cross section – north of Jorgensen Avenue intersection (northbound)



For illustrative purposes only.

Fencing design

The Project is required to ensure adequate safety measures are in place so that golf balls from Yarrambat Park Golf Course do not land on the walking and cycling path or road. This EES assumes that a 30-36 metre-high and 360 metre long fence along the edge of the golf course is included in the design to avoid golf ball collisions with pedestrians, cyclists or vehicles.

The proposed fence would incorporate elements to increase its visibility to Swift Parrot and other bird species. The alternative option to building a fence is to reconfigure golf course holes 1, 10 and 18 to increase their distance from the road and reduce the risk of golf balls landing on the new road and walking and cycling path to an acceptable level. This would not reduce the number of holes at the golf course.

A 1.8 metre timber paling fence has been designed to mitigate the risk of arrows from the Diamond Valley Archers facility affecting the road or walking and cycling path.

Plenty Valley Christian College and Yarrambat Primary School

Access to Plenty Valley Christian College and Yarrambat Primary School directly adjacent to the project area would be maintained during the Project's construction and operation. Some temporary arrangements may be required during construction to manage roadworks adjacent to the schools.

The Project would reconfigure and reinstate an existing car park at Plenty Valley Christian College. This includes a new access road to tie into the existing road. The dam at Plenty Valley Christian College would also require reconfiguration. This would be completed in collaboration with the school.

Land currently used by Yarrambat Primary School for informal car parking would require reconfiguration.

To facilitate these changes, partial land acquisition would be required along the frontage of both schools. This would be limited in extent and would not result in a long-term change to the existing land use; however, it would result in a permanent reduction in the land area on both school sites (refer to Attachment VI *Map Book*).

Bus facilities

Existing bus stops are proposed to be reinstated at the same location or within close proximity, in consultation with the Department of Transport and Public Transport Victoria. The project area allows for indentations around bus stops along the alignment if required.

5.3.2 Active transport design elements

Walking and cycling path and footpath

The design provides a walking and cycling path on the western side of Yan Yean Road in the following locations (refer to Figure 5.2):

- Adjacent to the northbound carriageway of Yan Yean Road from Kurrak Road to Bridge Inn Road, connecting to the existing walking and cycling path at both ends
- Adjacent to the eastbound carriageway of Bridge Inn Road, to be connected to existing walking and cycling paths.

Between Bannons Lane and Jorgensen Avenue, the walking and cycling path is realigned through Yarrambat Park and Shire of Nillumbik land to avoid the removal of more trees on the western side of Yan Yean Road. The walking and cycling path north of Jorgensen Avenue follows the existing footpath for the same purpose. The walking and cycling path would generally be three metres wide and would reduce slightly in width at various locations to allow the retention of trees.

In addition, a footpath, generally 1.2 metres wide, is proposed on the eastern side of Yan Yean Road in the following locations (refer to Figure 5.2):

- Adjacent to the southbound carriageway of Yan Yean Road from Bridge Inn Road to Kurrak Road to connect into the existing footpath
- Adjacent to the northbound carriageway of Yan Yean Road, along Service Road A from Vista Court to Ashley Road to connect to the proposed walking and cycling path extents
- Along Doctors Gully Road to Yan Yean Road to connect into the existing footpath.

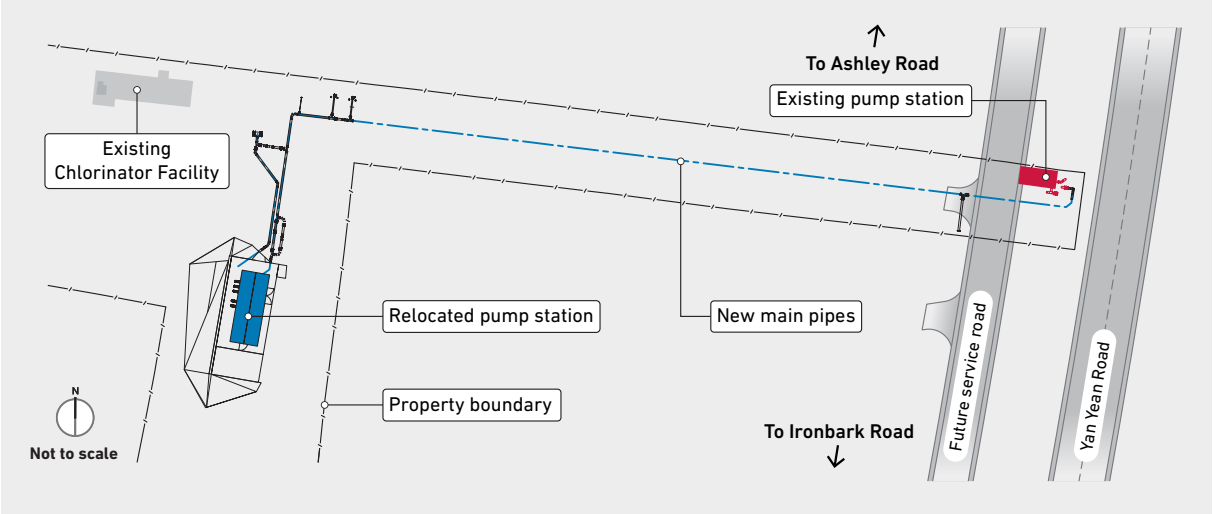
5.3.3 Utilities

New utility service upgrades, relocations and protection works may be required along the length of the Project. Where utility services cannot be avoided, protection / relocation / diversion works would occur adjacent to the proposed road pavement. Relocation of power lines along the alignment is anticipated to involve a combination of above ground and underground power. Works associated with existing water mains, sewer, gas and telecommunications assets may also require relocation and/or diversion adjacent to the road pavement. As such, a minimum allowance of five metres from the outermost construction extent (toe / top of batter, retaining wall, etc.) has been made to allow for potential utility upgrades and service relocations within the project area.

Relocation of Yarra Valley Water pump station

The project area includes a Yarra Valley Water pump station, near Ironbark Road on the western side of the existing Yan Yean Road, which the Project may be required to relocate. The tank may be re-located and new connecting infrastructure installed, all on existing Yarra Valley Water land. Refer to Figure 5.10 for the indicative relocation plan. MRPV continue to investigate design opportunities that could avoid the requirement to relocate the pump station.

Figure 5.10 Yarrambat pump station relocation indicative plan



For illustrative purposes only.

5.3.4 Drainage design

New drainage works, upgrades and relocations would occur along the length of the Project. Drainage along the alignment has been developed based on a flood model and expected outfall locations (which were determined by existing topography); however, the Project is also required to comply with water sensitive urban design (WSUD) requirements from Melbourne Water. This approach aims to make better use of stormwater in urban areas and reduce the harm it causes to the natural water cycle, rivers and creeks. Meeting Melbourne Water's requirements is likely to comprise grassed swale drains (where practicable), detention basins and water treatment basins.

The project area provides for a minimum 10 metres offset from the top of each drainage swale to allow for construction. In areas where drainage swales are not required, a minimum allowance of five metres from the outermost construction extent (toe / top of batter, retaining wall, etc.) has been provided in the project area to allow adequate construction space. The Project would coordinate closely with local schools to ensure the functionality of existing car parks and outdoor playing fields is maintained if these areas are impacted by drainage works.

Detention basin sites for surface water management have also been allowed for within the project area in proximity to Worns Lane, Heard Avenue, Youngs Road, Orchard Road (Melbourne Water wetland) and Bridge Inn Road.

5.3.5 Landscaping and urban design

A Landscape Strategy (Technical Report G) has been developed in consultation with Councils and other key stakeholders to ensure that the Project fits sensitively into the built, natural and cultural environment of Doreen and Yarrambat. The strategy would ensure that landscaping undertaken as part of the Project is well designed and contributes to the character and functioning of the Yan Yean Road corridor and the surrounding area, as well as to the accessibility and connectivity of people within the wider region and community. The Project would provide new and reinstated landscapes that are appropriate to the local conditions and consistent with the existing varied character of the area. Wherever possible, the Project would provide opportunities to increase canopy cover and improve amenity in the public realm.

The Landscape Strategy provides overarching principles to guide the Project landscape design, with a particular focus on minimising impacts on trees along the road corridor. Planting typologies have been considered to enhance the experience of drivers, pedestrians and cyclists, provide visual interest, screen infrastructure elements, improve habitat values and provide subtle wayfinding clues. Planting adjacent to the shared path would provide shelter and shade to improve user amenity. The activation of remnant open space would be explored to provide increased amenity to the local community where feasible.

5.3.6 Sustainability and climate change

MRPV is committed to delivering projects that optimise social, economic and environmental outcomes over the long term. To fulfil this commitment, MRPV would ensure:

- Sustainability risks and opportunities are identified and refined into project-appropriate performance objectives and requirements
- Delivery partners are monitored to ensure achievement of sustainability performance objectives and requirements
- Project sustainability performance is measured, verified and publicly reported on.

Key sustainability opportunities for the Project include:

- Ensuring the Project is resilient to the challenges of climate change by preparing and implementing a climate risk assessment and adaptation plan
- Optimising the use of recycled content in infrastructure materials
- Reducing greenhouse gas emissions, material lifecycle impacts and waste generation during the Project's construction and operation
- Protecting and enhancing the built, natural and cultural environment within and adjacent to the project area.

5.3.7 Land acquisition

The existing road corridor is not of sufficient width to accommodate the duplication and supporting infrastructure such as service roads, walking and cycling path and drainage. The Project would require the partial or full acquisition of 96 parcels of land. In most cases, partial acquisition of the land would be required along the frontages of landholdings.

This acquisition would be limited in extent and would not result in a long-term change in the existing land use, but it would result in a permanent reduction in the land area on those land parcels.

The land acquisition process would be undertaken in accordance with the *Land Acquisition and Compensation Act 1986* and would include consultation with affected landowners. Compensation would be provided for all land acquired for the Project. Refer to Attachment VI *Map Book* for the proposed Public Acquisition Overlay (PAO).

The landowner status of proposed land acquisition for the Project includes:

- Shire of Nillumbik: 24 land parcels
- City of Whittlesea: four land parcels
- Private: 60 land parcels
- Public Authorities / State: eight land parcels.

5.4 Project construction

5.4.1 Construction activities

Construction details would be subject to further refinement as the Project progresses; however, any changes to the activities and requirements outlined below would need to be in accordance with the Environmental Performance Requirements (EPRs) set out in Chapter 12 *Environmental Management Framework*.

Proposed construction activities would be standard road construction activities to be undertaken in accordance with the EPRs for the Project.

Site establishment would involve tree clearance and vegetation lopping and removal within the project area, establishment of construction site compounds, clearing and grubbing, temporary sediment and erosion control works, and establishment of environmental and traffic controls.

Earthworks would involve remediation of any existing contamination and removal of any hazardous material, as appropriate, protecting and relocating services, widening of existing rock cuttings (approximately 750 metres of existing cut along the Project would be widened by approximately 20 metres), new cuttings (approximately 1,300 metres of new rock cut would be required to a width of approximately five metres along the Project), and bulk earthworks and haulage. Some of the cutting locations would require retaining walls. Refer to Figure 5.8 for the location of proposed retaining walls in the Project and Figure 5.9 for a representative retaining wall cross section.

Civil and structure works would involve construction of infrastructure, including intersection upgrades, walking and cycling paths, retaining walls, drainage works and pavement works.

Reinstatement would involve implementing traffic management systems and landscaping in accordance with the Landscape Strategy (Technical Report G) for the Project.

5.4.2 Construction laydown areas

To minimise disruption at and around the Project site, one or more separate site compounds (or 'laydown areas') would be established for site offices, storage of materials and plant, amenities for workers, secure container storage, short-term storage for waste and potentially workforce parking. The laydown area(s) would be required to be in use for the full duration of Project construction.

Construction laydown areas have not yet been identified for the Project, other than those included in the project area. Following the engagement of a contractor, they would identify one or more sites that are suitable for this purpose on the basis of minimal environmental impact. Depending on the site(s) selected, a separate planning approval process may be required which would need to be informed by site investigation and consultation.

The project area has allowed for a site on the western side of Yan Yean Road in close proximity to the Yarrambat Horse and Pony Club, which is currently being used as laydown area by Yarra Valley Water. The Project may also utilise the existing Department of Transport owned land at 423-437 Yan Yean Road Yarrambat at the southern end of the project area. Vegetation removal would avoid the no-go zones identified in Attachment VI *Map Book*.

The laydown area(s) would be reinstated following works to their pre-Project condition, or as agreed with the landholder. The nature of reinstatement and any improvement works would be agreed with the landowner and any other relevant stakeholders, potentially Council and the Department of Transport.

5.4.3 Construction method

The construction methods adopted would seek to develop the Project in discrete stages to the extent practicable. This would assist with localising construction impacts for each stage of works. Maintaining traffic flow throughout the Project would be a key component of the construction methodology. Constructing new lanes 'offline' would be integral to maintaining traffic flow, including diverting traffic into new lanes as staged sections were completed. As traffic is diverted into newly constructed lanes, old lanes would be upgraded to assist in maintaining traffic flow.

Temporary road closures and diversions would be required for the construction of intersections. Road closures and diversions would be managed through community consultation and detailed traffic management plans.

Spoil is defined as waste soil or rock resulting from excavation activities. Spoil generated by construction activities would be managed in accordance with EPA requirements applicable at the time of construction.

The final spoil disposal strategy would be developed in accordance with EPA Victoria requirements, particularly in regard to managing any contamination entrained within the soil, and whether spoil would be stockpiled or taken immediately to landfill. Haulage routes would be constrained to arterial roads, including Yan Yean Road. Where roads other than Yan Yean Road or designated arterials are required to be used, this would be done in consultation with the Department of Transport and the relevant local authority, with appropriate notice given to any affected residents.

5.4.4 Working hours

Construction work for the Project would be undertaken in accordance with EPA requirements applicable at the time of construction. Standard construction work hours are:

- Monday to Friday, 7am to 6pm
- Saturday, 7am to 1pm.

Construction outside standard hours might occur at discrete stages to enable particular tasks to be undertaken more safely than could otherwise be achieved. Night works would also be required to minimise impacts on traffic or nearby stakeholders. Works proposed for outside standard hours would need to be approved in advance by MRPV, following consultation with all relevant stakeholders.

5.5 Project operation and maintenance

When complete, Yan Yean Road would be owned by the Department of Transport and operated in accordance with its environmental management approach. Ongoing monitoring and associated management and mitigation measures set out in the EPRs would be implemented during operation of the Project by the relevant organisation.

Maintenance of the infrastructure would be undertaken by Department of Transport, or local Councils for pathways and service roads, in accordance with the *Road Management Act 2004 – Code of Practice*.

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