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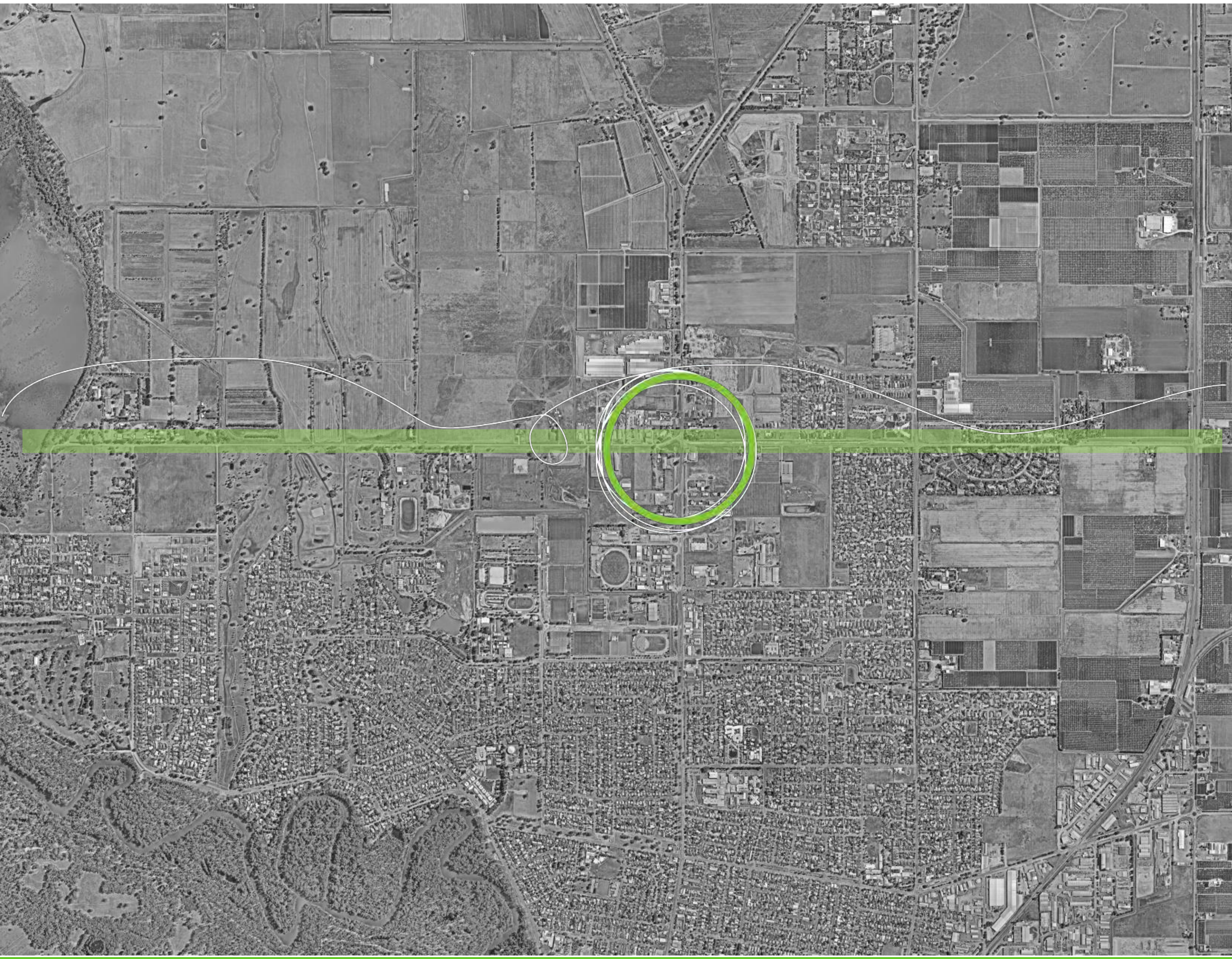

Wanganui Road & Ford Road, Shepparton
Feasibility Study
Design Report

draft

Client //	VicRoads & Greater Shepparton City Council
Office //	VIC
Reference //	V117720
Date //	09/02/18

Wanganui Road & Ford Road, Shepparton

Feasibility Study

Design Report

Issue: A-Dr2 09/02/18

Client: VicRoads & Greater Shepparton City Council
Reference: V117720
GTA Consultants Office: VIC

Quality Record

Issue	Date	Description	Prepared By	Checked By	Approved By	Signed
A-Dr	20/06/17	Draft	Alex Blackett & Ajanthan Pillai	Alex Blackett	Craig Gist	
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Executive Summary

Introduction

GTA Consultants has been commissioned by Greater Shepparton City Council and VicRoads to undertake a feasibility study to upgrade Wanganui Road and Ford Road, between Golf Drive and Grahamvale Road (approx. 5.9km length). These roads will enable Stage 1 of the Shepparton Bypass to connect with Goulburn Valley Highway and the Shepparton Alternate Route (Grahamvale Road).

As such, this feasibility study will be used to inform the development of a full business case and continued funding for Stage 1 of the Shepparton Bypass.

This report sets out the supporting investigations and discussions undertaken in developing the proposed alignment, impacts, layout and costings of the proposed upgrade to Wanganui Road and Ford Road as part of Stage 1 of the Shepparton Bypass. More specifically, the report includes the following, which is summarised hereafter:

- Key transport policies influencing the project and land uses in the area
- Existing and future known transport and land use conditions within the study area
- Broad design considerations and implications
- Consultation activities and considerations
- Proposed mid-block cross-sections and intersection layouts
- Environment and ecology, cultural and heritage, acoustic, landscape, flooding and pavement implications
- Concept design costings

Strategic Planning Context

A review of various state and local planning documents was undertaken. These documents highlight that Shepparton is situated at the intersection of Goulburn Valley Highway and Midland Highway, along the Newell Highway corridor, which makes it an important regional hub in Victoria's north, as well as being part of a key national freight route between Melbourne and Brisbane.

Historically, these traffic volumes have brought passer-by visitors and helped activate the city. However, as the city develops beyond the main street, the continuation and growth in this traffic through the centre is beginning to create some undesirable impacts. This includes impacts on road safety, amenity, congestion, travel time variability and reducing network resilience with only one proximate Goulburn River crossing.

Consequently, Greater Shepparton City Council and VicRoads have been investigating potential north-south and east-west road network upgrades and bypass routes to support development of Shepparton and Mooroopna and provide a safe and efficient network for the associated traffic volumes within and across the region.

The Shepparton Bypass is the key proposal in this regard, with an associated Public Acquisition Overlay (PAO) being in place since 2006 through Amendment C33. However, its overall cost means it will be delivered in stages, with funding already being allocated by the Victorian Government to get Stage 1 'shovel ready'.

In order to enable Stage 1 of the Shepparton Bypass to be a viable bypass to travelling through Shepparton, it has been recommended through the following previous strategies and resolutions that Wanganui Road and Ford Road be upgraded to connect it with Goulburn Valley Highway and the Shepparton Alternate Route (Grahamvale Road):

- Greater Shepparton 2030 Strategy 2006
- Greater Shepparton Freight and Land Use Study 2013
- Resolution on a staged approach to the realisation of the Bypass (May 2016).

Transport and Land Use Conditions

Shepparton North has been and is expected to continue to develop quickly, which is in turn seeing transport demands in the area increasing. Even now there are two residential growth areas, a major commercial development and industrial investigation area all expected to still be implemented along Wanganui Road and Ford Road.

In order to understand the impacts of the ongoing development, staging of the Shepparton Bypass and proposed road upgrades a strategic transport model has been developed for Shepparton. Table E.1 has been prepared to compare what the traffic volumes could be expected along Wanganui Road and Ford Road under the following scenarios:

- No road network improvements occur (i.e. Do Nothing)
- Only Stage 1 of the Shepparton Bypass is implemented
- Full Shepparton Bypass implemented.

TableE.1: Road Network Scenarios –Two-Way Daily Traffic Volumes

Scenario	Road Section Two-Way Daily All Vehicle Volumes (Heavy Vehicles)								
	Wanganui Road btw Bypass & GVH			Ford Road btw GVH & Verney Rd			Ford Road btw Verney Rd & Alt Route		
	2016	2031	2041	2016	2031	2041	2016	2031	2041
Do Nothing (BAU) [1]	2,200 (100)	2,600 (100)	2,900 (100)	3,000 (400)	4,100 (400)	5,100 (500)	2,300 (300)	2,800 (400)	3,500 (500)
Stage 1 only [1]	8,900 (1,100)	10,800 (1,300)	12,500 (1,500)	4,100 (600)	5,400 (700)	7,100 (800)	3,100 (500)	3,700 (700)	4,700 (700)
Full Shepparton Bypass [2]	*5,100 (800)*	*5,900 (900)*	*6,200 (1,000)*	*2,900 (500)*	*2,900 (500)*	*3,000 (1,000)*	*2,900 (500)*	*2,900 (500)*	*3,000 (1,000)*

[1] As presented in Table 8 of the 2016 AECOM report titled Shepparton Bypass Strategic Model Update
[2] As presented in Table 14 of the 2012 AECOM report titled Development of the Shepparton Bypass Strategic Transport Model

Based on Table E.1 it can be seen that even under the 'Do Nothing' scenario that traffic volumes continue to grow on Ford Road and require it to be upgraded regardless of whether the Shepparton Bypass is implemented or not. In terms of Wanganui Road, it will provide a key link between the Shepparton Bypass and Goulburn Valley Road, especially when only Stage 1 has been implemented. It is expected that its use will decline as subsequent stages of the Shepparton Bypass to the north are implemented.

Consultation

Consultation with various local stakeholders, industry and authorities was undertaken in mid to late 2017 to understand what desired outcomes, concerns and requirements have with the proposed upgrading of Wanganui Road and Ford Road.

The feedback received during this consultation has led to various subsequent studies and influenced the resulting proposed design.

In terms of additional studies, the following were undertaken:

- Environmental and Ecology
- Cultural and Heritage
- Acoustic Noise
- Landscape Masterplan
- Flooding
- Pavement Design

One key piece of feedback from local stakeholders was whether there is a more appropriate east-west alignment than Wanganui Road and Ford Road to connect Stage 1 of the Shepparton Bypass with Goulburn Valley Highway and Shepparton Alternate Route (Grahamvale Road). While this has already be considered and did not form part of this study, two alternative alignments were provided by local stakeholders as potential suggestions, which have been broadly considered and the following summary reasoning to use and upgrade Wanganui Road and Ford Road is provided:

- Upgrading of an existing road corridor provides a more feasible option to developing an entirely new road corridor, especially when only a small proportion of additional land is needed to be acquired (land, drainage and pavement substrate costs are significantly higher with a completely new road alignment).
- Background traffic growth due to the expected level of residential and commercial development in the area is expected to require Ford Road to be upgraded regardless of whether the Shepparton Bypass is implemented or not.
- The alignment results in a direct and efficient east-west link, which is considered to give the best funding probability for Stage 1 of the Shepparton Bypass.
- The Shepparton Bypass is a staged project, and the use of Ford Road as an east-west connection between the Shepparton Bypass and the Shepparton Alternate Route is expected to materially reduce as the other stages to the north of the Shepparton Bypass are completed.

Cross-Sections and Key Intersection Selection

After various iterations and discussions with VicRoads and Council, the resulting cost sections for Wanganui Road and Ford Road are as shown below.

Figure E.1: Wanganui Road – Mid-Block Cross-Section (33.6m)

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Figure E.2: Ford Road - Mid-Block Cross-Section (27.4m) west of Verney Road & east of 197 Ford Road

Figure E.3: Ford Road - Mid-Block Cross-Section (25.4m) between Verney Road & 197 Ford Road

The proposed cross-sections have considered each transport mode, as well as the need to minimise land acquisition in the most existing sensitive areas along the road corridor.

Along the road corridor there are also three key intersections. Their treatment type has been determined through a Safe Systems Assessment, which resulted in the following recommended arrangements:

- Goulburn Valley Highway / Wanganui Road / Ford Road = roundabout intersection with a pedestrian crossing approx. 100m east on Ford Road
- Ford Road / Verney Road = signalised intersection with pedestrian and cycling crossing facilities
- Ford Road / Grahamvale Road = roundabout intersection (with signals to shut down the intersection when the at grade rail crossing barrier arms are triggered).

Concept designs for the road corridor have been prepared and are included in Appendix C.

Concept Design Costings

The P90, P50 and TEI cost estimates for the proposed construction works to upgrade Wanganui Road and Ford Road as part of Stage 1 of the Shepparton Bypass are presented in Table E.2.

Table E.2: Road Construction Cost Estimates

Section	Total Estimated Investment (TEI)	P50 Estimate	P90 Estimate
Wanganui Road (Golf Drive to Goulburn Valley Highway)	$46.42M	$42.38M	$44.24M
Goulburn Valley Highway/ Whanganui Road/ Ford Road intersection	$8.93M	$8.12M	$8.51M
Ford Road (Goulburn Valley Highway to Grahamvale Road)	$45.29M	$41.40M	$43.16M
Total	$100.64M	$91.90M	$95.91M

It is noted that at this time a provisional allowance for landscaping works has been included in the above costing, which equates to approximately 10% of the total cost. We would expect that this cost is generally consistent with the level of landscaping proposed through the Landscape Masterplan discussed in Section 7.5.

An escalation rate of 4%p.a. has been assumed for the next five years in Table 8.2.

Table E.3: Cost Escalation Estimates

Financial Year	Escalation Index	Escalation amount (TEI)	Escalation amount (P50)	Escalation amount (P90)
2017/2018	0%	$100.64M	$91.90M	$95.91M
2018/2019	4%	$104.67M	$95.58M	$99.75M
2019/2020	4%	$108.85M	$99.40M	$103.74M
2020/2021	4%	$113.21M	$103.38M	$107.89M
2021/2022	4%	$117.73M	$107.51M	$112.20M

Full set out of the cost estimates is provided in Appendix F.

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1. Introduction

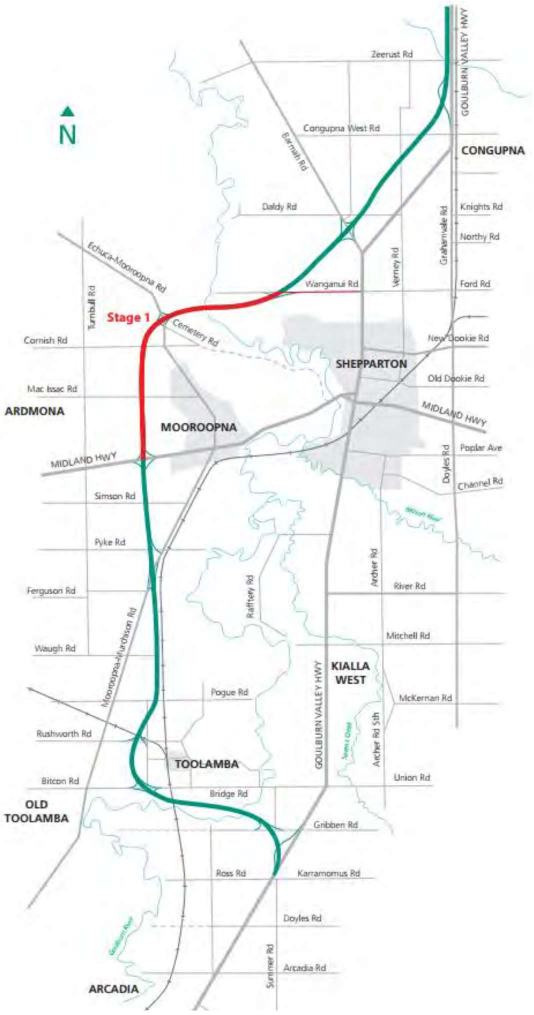
1.1 Background

As Greater Shepparton continues to grow, so too will the traffic volumes on the road network, both in terms of private and commercial vehicle movements within and across the region. Two major north-south and east-west arterial roads currently intersect within the centre of Shepparton, namely the Goulburn Valley Highway and the Midland Highway. These arterial roads attract significant traffic volumes through the city, making it an important regional hub in Victoria's north.

Historically, these traffic volumes brought passer-by visitors and helped activate the city. However, as the traffic volumes on these roads have continued to increase and the city develops beyond the main street, their travelling through the centre is beginning to create some undesirable impacts. This includes impacts on road safety, amenity, congestion, travel time variability and reducing network resilience with only one proximate Goulburn River crossing.

Consequently, Greater Shepparton City Council and VicRoads have been investigating potential north-south and east-west road network upgrades and bypass routes to support development of Shepparton and Mooroopna, and the associated traffic volumes within and across the region.

Figure 1.1: Shepparton Bypass



This has resulted in the identification and, in 2006, the approval of a Public Acquisition Overlay (PAO) on land associated with the preferred alignment for the Shepparton Bypass (refer to Amendment C33 to the Greater Shepparton Planning Scheme), as shown in Figure 1.1.

However, the full 36km long four lane Shepparton Bypass is estimated to cost in the order of $1.3 billion. As such, it is proposed to be delivered over a number of stages, both from an alignment and number of lanes perspective.

At this time, and as shown in Figure 1.1, the most critical and beneficial section of the Shepparton Bypass to the local community is considered to be between Midland Highway to the west of Mooroopna and Goulburn Valley Highway to the north of Shepparton – referred to as Stage 1, and comprising a carriageway with one lane in each direction.

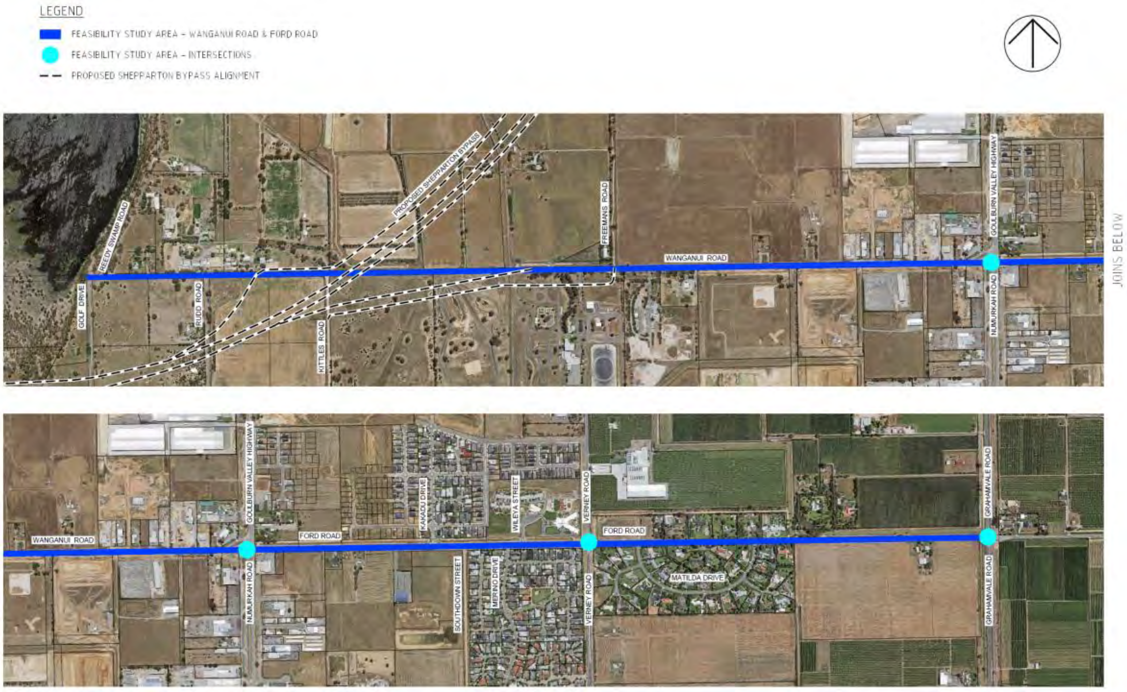
The key reasons for Stage 1 being the highest priority is because it provides an alternative route for traffic travelling through Shepparton between the north and west. It also provides a significantly improved level of network reliance through a second proximate river crossing to Shepparton, rather than approximately 35km to the north at Congupna / Wyuna.

1.2 Project Context

This project seeks to understand the feasibility of upgrading the existing local roads of Wanganui Road and Ford Road, between Golf Drive and Grahamvale Road (approx. 5.9km length). While these roads will not form part of the ultimate Shepparton Bypass alignment, they will enable Stage 1 to connect with Goulburn Valley Highway and the Shepparton Alternate Route (Grahamvale Road), as shown in Figure 1.2.

Following the implementation of subsequent stages of the Shepparton Bypass, it is expected that Wanganui Road will continue to provide a key connection to Goulburn Valley Highway and commercial developments in North Shepparton. While Ford Road, regardless of whether the Shepparton Bypass is implemented or not, needs to be upgraded to support abutting residential growth areas and their associated access to the broader arterial road network.

Figure 1.2: Wanganui Road and Ford Road Upgrade Extents



In this regard, Wanganui Road and Ford Road are proposed to be upgraded to an arterial road level and provide a suitable cross-section and intersection arrangements for the forecasted traffic volumes and vehicle mix. In combination with Stage 1 of the Shepparton Bypass, they will be expected to form a viable alternative route to passing through Shepparton and Mooroopna, especially those that travel to and from the west and north.

It is also understood that there is expected to be significant development to the north and south of Wanganui Road and Ford Road in the coming years. As a result, intersections, property access arrangements and crossing facilities need to be carefully considered and provided.

Upgrading the local road corridor to support all these changes represents a significant change to the current semi-rural environment. In order to determine its feasibility, consideration has also been given to its general constructability and identification of various likely impacts.

On this basis, GTA Consultants, as well as other specialist sub-consultants, have been commissioned by Greater Shepparton City Council and VicRoads to undertake this feasibility study to inform the development of a full business case and continued funding for Stage 1 of the Shepparton Bypass.

1.3 Report Purpose

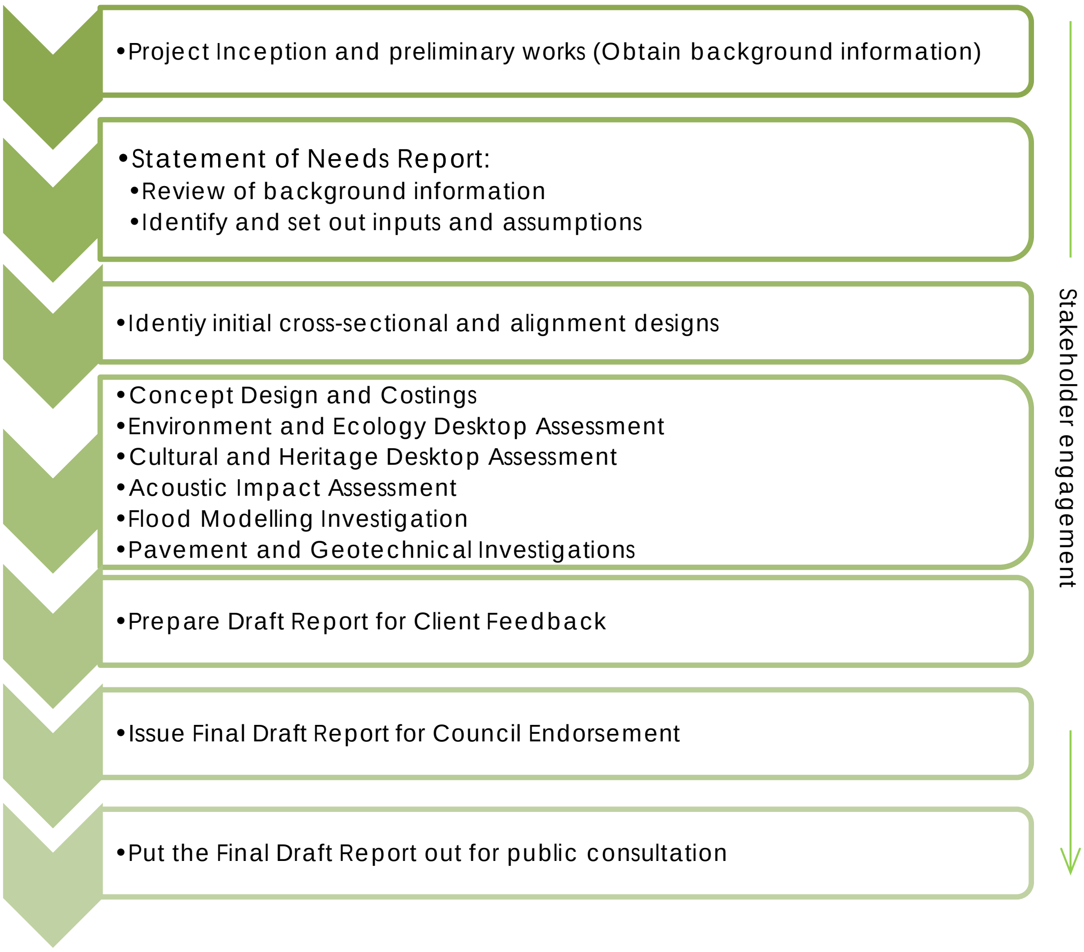
This report sets out the supporting investigations and discussions undertaken in developing the proposed alignment, impacts, layout and costings of the proposed upgrade to Wanganui Road and Ford Road as part of Stage 1 of the Shepparton Bypass. More specifically, the report includes the following:

- Key transport policies influencing the project and land uses in the area
- Existing and future known transport and land use conditions within the study area
- Broad design considerations and implications
- Consultation activities and considerations
- Proposed mid-block cross-sections and intersection layouts
- Environment and ecology, cultural and heritage, acoustic, flooding and pavement implications
- Concept design costings

1.4 Scope & Methodology

The scope and methodology for the overall project is shown graphically in Figure 1.3, with the draft report stage shown in bold.

Figure 1.3: Project Methodology



2. Strategic Planning Context

2.1 State Government

2.1.1 Transport Integration Act

The Transport Integration Act is the primary transport statute for Victoria, and has caused significant change to the way in which transport and land use authorities make decisions and work together. The Act enshrines a triple bottom line approach to decision making about transport and land use matters.

The Act requires that all transport agencies work together to achieve an integrated and sustainable transport system, and that land use agencies such as the DEDJTR take account of transport issues in land use decisions. The Act has been effective to date in changing the focus of organisations that traditionally only considered a single transport mode.

The Act:

- *Unifies all elements of the transport portfolio to ensure that transport agencies work together towards the common goal of an integrated transport system*
- *Provides a framework for integrated and sustainable transport policy and operations*
- *Recognises that the transport system should be conceived and planned as a single system performing multiple tasks rather than separate transport modes*
- *Integrates land use and transport planning and decision-making by extending the framework to land use agencies whose decisions can significantly impact on transport ("interface bodies")*
- *Re-constitutes transport agencies and aligns their charters to make them consistent with the framework.*

The Act forms an overarching legislative framework for transport related state planning policy decisions and has been integrated within the Victorian Planning Provisions (VPP).

2.1.2 Victoria Road Safety Strategy: The Way Forward

Victoria road safety strategy: The Way Forward 2013-2022 sets out the Victorian Government's commitment to deliver a safer road system for all road users and to make a substantial step towards their vision of "*ZERO deaths and ZERO serious injuries on our roads*", by setting a target over the next 10 years of a 30% reduction in the number of fatal and serious injuries on the road network.

A key point of difference with this road safety strategy to previous ones is that they are looking to tackle the 'hidden road toll' of serious injury. Reductions in this type of injury have historically not been as high as fatalities, yet also have significant impacts on the community. Moreover, there is a commitment to distinguish between crashes resulting in quadriplegia, brain injury and other serious injuries, to help understand where and if reductions are occurring with the most severe of serious injuries.

In order to achieve this, the strategy sets out an action plan for key areas, such as speed, trucks, drink driving and drug driving. It also looks at specific roads users, such as the most vulnerable (pedestrians, cyclists and motorcyclists) and inexperienced (young and unlicensed drivers).

2.2 VicRoads

2.2.1 Road Safety Strategy: Road Safety Step Up

The VicRoads Road Safety Strategy: Road Safety Step Up, outlines an organisation wide strategy and actions to change and strengthen their commitment, capability and culture to achieve the following goal for the road network.

"Our goal is for Victoria to achieve the safest levels of road use in the world by 2022 and ultimately achieve no serious road trauma in the long term."

In order to achieve the safest levels of road use in the world, it would require our current population based road fatality rate to reduce by 30% to be equal with Iceland and Sweden. However, it should be noted that these and other jurisdictions can be expected to continue to reduce their current road based fatality rate over the next 10 years as well, so the actual reduction required to achieve this goal will likely be in the order of 50%.

The strategy indicates that the goal will be achieved through the incorporation of the Safe System approach and principles with the four interconnected cornerstones of safe travel working effectively together – safer people, safer vehicles, safer roads and safer speeds.

2.2.2 SmartRoads

SmartRoads is a VicRoads policy which sets strategic 'modal' priorities on the road network at different times of the day and underpins many of the strategies significant to the operational directions that support broader strategies around land use and transport.

"There is no single solution to managing congestion on our roads. Sustainable management of congestion will require an integrated approach involving better management of the existing network, building new infrastructure, visionary land use planning, encouraging sustainable transport modes, and changes in behaviour by individuals, businesses and a level of government."

All road users will continue to have access to all roads. However, certain routes will be managed to work better for cars while others for freight, public transport, cyclists and pedestrians during the various peak and off-peak periods. In this regard, the following is noted by VicRoads for the various modes assigned to arterial roads across the network that form part of the Network Operating Plans:

- *Facilitate good pedestrian access into and within activity centres in periods of high demand*
- *Prioritise trams and buses on key public transport routes that link activity centres during morning and afternoon peak periods*
- *Encourage cars to use alternative routes around activity centres to reduce the level of 'through' traffic*
- *Encourage bicycles through further developing the bicycle network*
- *Prioritise trucks on important transport routes that link freight hubs and at times that reduce conflict with other transport modes*

The above modal aspirations are targeted towards achieving a more efficient transport network. Consideration of this and what the priorities will be for the upgrade of Wanganui Road, Ford Road and intersecting arterial roads will ideally be decided on to help inform the road corridor design and intersection layouts.

2.2.3 Moving More with Less

The VicRoads Freight Strategy, Moving More with Less, sets out the approach on how the growing freight demand that is required to support the growing economy. The key outcome from this is that truck productivity must be improved to better manage its impact on road infrastructure.

This has resulted in VicRoads adopting a more general approach to the access arrangements of the High Performance Freight Vehicles (HPFVs), which are the largest permit freight vehicles on the road. The key policy features of the new approach to HPFVs includes the following:

- *Place downward pressure on the number of trucks on Victorian roads by facilitating the use of more efficient HPFV configurations.*
- *Limit the use of HPFVs to appropriately designed roads, such as high-standard duplicated highways and roads with generous geometric design.*
- *Work with local governments to determine 'last mile' access.*
- *Ensure that trucks are safe and operate on the right roads through the Performance Based Standards (PBS) Scheme and the Intelligent Access Program.*
- *Separately addresses volume-limited and mass-limited fright because of their different impact on the infrastructure, which allows more road network access to be made available to volume-limited HPFVs that do not exceed regulation B double mass limits.*
- *Gives industry more flexibility to select the most suitable vehicle configuration, which makes HPFV operation viable in applications where it was not viable before.*
- *Recognises the different road and traffic conditions in county Victoria and metropolitan Melbourne, which gives rise to opportunities for greater volumetric capacity in applications that predominantly occur outside of metropolitan Melbourne.*

Given the above, it is expected that upgrading Wanganui Road and Ford Road will be a critical component of the Shepparton freight network, supporting the following freight activities:

- Connection with proposed Shepparton Bypass at its western end
- Connection with the regional freight network
- Form part of the 'last mile' access to local freight generating land uses.

2.2.4 Tree Policy

VicRoads has developed a tree policy in 2016 that aims to support active transport and healthier environments while facilitating a safe and efficient road network by promoting trees in the road reserve under certain conditions. The associated developed guidelines on where tree planting is supported has been done based on the application of the following policies:

- Safe System
- Road Network Efficiency
- Sustainable Transport
- Maintenance Responsibility and Cost
- Environmental Sustainability
- Community Wellbeing

A summary of the conditions where tree planting is considered appropriate is set out below:

- ≤ 50km/h road environments: minimum lateral distance of 1.0m from face of kerb
- 60km/h road environments: minimum lateral distance of 1.0-1.2m from face of kerb
- 70 and 80km/h road environments: minimum lateral distances align with clear zone requirements, or more ideally reduce speed limit or locate approved safety treatments in front of them
- ≥ 90km/h road environments: unprotected trees are considered to be unacceptable

2.3 Greater Shepparton City Council

2.3.1 Municipal Strategic Statement

The Municipal Strategic Statement (MSS) for Greater Shepparton City Council is outlined in Clauses 21.01 to 21.07 of the Greater Shepparton Planning Scheme. The MSS outlines the strategic visions for the municipality with regards to the following:

- Municipal Profile
- Key Influences and Issues
- Vision, Sustainability Principles and Strategic Directions
- Settlement
- Environment
- Economic Development
- Infrastructure

The key visions most relevant to this project are reproduced as follows:

- Clause 21.01 – Economy:
  The region has a strong and vigorous rural economy based on irrigated and dry land agriculture. A major strength of the economy is in the value-adding manufacturing and processing of agricultural produce. It has a supporting service industrial base, notably Shepparton's role as a transport hub with a high level of freight movement and volume. A commitment to construct the Goulburn Valley Highway Shepparton Bypass, and the implementation of the Goulburn Valley Link freight logistics centre at Mooroopna, are key projects support this advantage.
- Clause 21.07-1 – Infrastructure, Transport:
  The development and maintenance of safe and efficient traffic and transport systems throughout the municipality is a priority. Key initiatives requiring implementation include:
  - The development of a second river crossing.
  - The development of an integrated road network for general road users which seeks to minimise intrusion to the local road networks and the central Shepparton area.
  - The development of the Goulburn Valley Highway Shepparton Bypass.
  - Linkages between the Goulburn Valley Highway Bypass and the surrounding arterial road network in order to reduce traffic intrusion to the central shopping area.
  - An integrated transport network to better link road and rail freight which will work to reduce freight traffic intrusion to the central Shepparton and Mooroopna areas.
  - Road widening where required, particularly in areas where traffic is likely to increase as a result of the Goulburn Valley highway Shepparton Bypass.
  - The planning of freeways and highways and the planning and control of land use and development in the areas through which they pass should be coordinated and integrated especially on the Goulburn Valley Highway.
- Clause 21.07-2 – Infrastructure, Urban and Rural Services:
  Goulburn Murray Water is responsible for the supply and distribution of irrigation water for rural use and the long term operational goal for the organisation is to continue to deliver water as efficiently as possible with the minimum amount of cost. Automation of channel structures has been introduced to the channel network system and replacement of open channels with pipelines will be ongoing.

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- Clause 21.07-3 Infrastructure – Urban Stormwater Management:
  The following is an overview of the urban stormwater management issues for communities throughout Greater Shepparton:
  - Council is committed to progressing principles of environmental sustainability, and effective stormwater management forms a key component of this objective.
  - The Greater Shepparton Stormwater Management Plan (2003) (GSSMP) identified the municipality's waterways as being valuable assets, providing important ecological habitats, attractive recreational areas and in some instances, contain sites of cultural significance and serve to enhance property values.
  - However, urban areas within the municipality can have an impact on water quality and the values of the waterways. The GSSMP is relevant to the urban areas including residential areas, industrial and commercial land use activities, and open space areas.
  - Utilising existing irrigation drainage infrastructure for urban development should be considered secondary to the implementation of urban stormwater drainage systems.
- Clause 21.07-4 – Infrastructure, Strategic Work Program:
  Develop a statutory plan for the Shepparton Alternate Route.

2.3.2 Movement and Place Strategy

The Greater Shepparton Movement and Place Strategy (MAPS) aims to provide a comprehensive understanding of the existing and future transport requirements for Greater Shepparton. The strategy takes a holistic approach to the provision of an improved transport system for various modes including walking, cycling, public transport, driving and freight movement.

Through the associated *Vision and Direction Paper*, it provides a long-term vision and objectives of the MAPS based on community and stakeholder feedback, and analysis of data and trends related to transport in Shepparton. The vision is embodied by the following three themes:

i Vibrant Centres and Liveable Neighbourhoods:
This theme focuses on movement within and around local neighbourhoods and centres within Shepparton.

ii Sustainable Local Connections:
This theme explores movement between Greater Shepparton's neighbourhoods and to its key destinations.

iii Effective Broader Connections:
This theme addresses Greater Shepparton's outward transport connections to the wider region and State.

At the Ordinary Council Meeting held in April 2017, Council resolved to endorse the Greater Shepparton Movement and Place Strategy – Vision and Direction Paper as the basis for the Draft Greater Shepparton Movement and Place Strategy.

It is expected that the Draft Greater Shepparton Movement and Place Strategy report will be completed and presented to the Council by mid 2018.

2.3.3 Freight & Land Use Study

The Greater Shepparton Freight and Land Use Study was prepared by AECOM in 2013. Its purpose was to identify and assess the interrelated industry, freight and land use trends for the City of Greater Shepparton.

The study identified the following current trends and issues:

- Majority of the freight related land uses are currently located to the east and northeast of the Shepparton CBD with other aligned businesses providing agglomeration benefits.
- The existing location of freight related land uses and interaction with arterial road network results in east-west freight movement travelling through the CBD.
- The current design of the Shepparton Alternative Route (north-south alignment) is not suitable for the freight task it attracts.
- The east-west freight movements through the CBD causes significant amenity issues to local businesses and the community, as well as resulting in a constrained and congested road network that impacts freight operators and generators.
- The freight task in the region is growing at a faster rate than the economic and population growth. It is forecasted to keep growing and be predominately road based given there is a lack of feasible rail options, which will further increase congestion and other undesirable impacts on the Shepparton Alternative Route and east west demand through central Shepparton.
- There is enough industrial land supply in the east and northeast of the Shepparton CBD to meet anticipated demand for the next 20 years, so is not expected that the freight related land uses will relocate in the short to medium-term and any new / upgraded east-west connections should ideally provide a bypass function of the CBD.

In terms of how these current trends and issues are best responded to, the study sets out the following strategic priority actions:

- Objectives:
  - Ensure the City is well placed to accommodate increased freight demand whilst minimising impacts on the community.
  - Safeguard strategically important freight transport corridors and links to facilitate delivery of future infrastructure projects.
- Roads:
  - Determine a road user hierarchy that supports a fully developed Shepparton Bypass so that investment occurs in concert with and supports council's strategic objectives.
  - Identify a package of road upgrades and new linkages for a scenario where Shepparton Bypass is partially/fully developed and where the Shepparton Bypass is not developed so that alternate strategies can be pursued and that also work toward a long term build out.
  - Identify routes that are suitable for high productivity vehicles (including potentially trialling B-triples) so that there is a clear strategy for managing movement by these vehicles.
  - Deliver truck calming measures once satisfactory arrangements for trucks have been provided and that will allow amenity benefits to be obtained throughout Shepparton to take account of new transport connections.

- Rail:
  - Investigate ways in which rail can support local services as part of their logistics chain and that will enable the potential for rail to be established and appropriate interfacing responses to be identified.
  - Continue to lobby for the Melbourne-Brisbane inland route via Shepparton.
- Land use:
  - Unlock the potential for the development of Shepparton Bypass and provide incentives that encourage freight generators and logistics industry operators to (re)locate to this site rather than at other sites within Shepparton and in so doing, alleviate congestion to the west of the CBD. It lists the main freight stakeholders and players in the Goulburn Valley region, and what their infrastructure wants are around Shepparton, as well as looking at piecing all the infrastructure plans together.

2.3.4 Cycling Strategy

The Greater Shepparton Cycling Strategy was prepared by GTA Consultants in 2012. The aim of the Strategy is to increase cycling participation in Shepparton, in an effort to, amongst other aspirations, achieve the various health, pollution, congestion and economic benefits cycling can bring.

In preparing the Strategy, a review of the existing commuter and recreational facilities has been completed, and the development of an overall facility blue-print and urban design framework to encourage cycling for all purposes – commuter, recreation, sports and tourism. The design basis for facilities was built around what is required to create an environment whereby people perceive cycling to be a feasible alternative for a variety of common trips and for all abilities.

The key outputs from the strategy were network plans and actions, including the following, which are recommended to be considered as part of this project:

- Off-road shared path is proposed along Ford Road between Goulburn Valley Highway and Grahamvale Road
- Intersecting shared paths with Ford Road at the following locations:
  - Goulburn Valley Highway (east side to the north and west side to the south)
  - Western side of Verney Road
  - Western side of Grahamvale Road
  - Along one side of the collector roads from the residential growth areas.
- On-road bicycle lanes on Goulburn Valley Highway and Verney Road

2.3.5 Urban Forest Strategy (2017-2037)

The Urban Forest Strategy provides a framework for existing tree management, technical guidelines and precinct plans. There are currently 6,000 vacant sites across Shepparton, Mooroopna and Tatura where trees have died or been removed.

The Urban Forest Strategy sets a vision, objectives, targets and a series of actions for Council to adopt and adhere to over the coming decades, to help make Greater Shepparton an attractive, vibrant and liveable region with well-connected green spaces that are valued by the community.

Key actions for the Council to complete by 2037 include:

- Increase urban forest canopy cover in each town to 40%
- Reduce the number of vacant street tree sites to zero
- Improve urban forest diversity by age and useful life expectancy
- Increase the number of biodiversity links through each towns street and road network
- Include urban trees in all major Council infrastructure projects at planning, design and implementation phase
- Ensure best practice urban tree management is being delivered across all Council programs

The upgrade of Wanganui Road and Ford Road provides an opportunity to help complete these actions, and are expected to be adopted as part of the Landscape Masterplan being prepared separately to this feasibility Study.

2.4 Previous Bypass Studies

2.4.1 North Shepparton Arterial (East-West Link) Initial Feasibility Study

The North Shepparton Arterial (East-West Link) Initial Feasibility Study was prepared by AECOM in 2012. The purpose of the study was to document and report on the critical issues influencing the feasibility of the project and needing further detailed investigation as part of subsequent planning and design stages for the upgrade of Wanganui Road and Ford Road in North Shepparton, between the proposed Shepparton Bypass and the existing Shepparton Alternate Route.

The study included consideration of the following aspects at the planning level:

- Land Use Planning
- Transport Planning
- Traffic Engineering
- Environment and Ecology
- Cultural Heritage

The key findings from the study where the following:

- Alignment and Land Use:
  Utilising the recommended alignment along Wanganui Road and Ford Road, as it uses already encumbered land and minimises land acquisition, consideration was given to what impacts would result from widening the road to the north or south. It was indicated that widening to the north was the preferred option as it resulted in few impacts and potential improvements to some properties.
- Engineering:
  The cross-section is expected to consist of the following elements:
  - Two separate carriageways, with two lanes in each direction, plus outer sealed shoulders and a 7m wide median (can vary due to existing corridor constraints).
  - Access arrangements to abutting properties to be consistent with VicRoads AMP4 standard.
  - Catering for longitudinal pedestrian and cycling movements may be warranted, with the provision of a Shared User Path to be considered.

  More detailed analysis is required to determine the following:

  - Scope for service roads
  - Minimising the number of direct access points

- Facilitating controlled access at key locations
- Providing well-spaced intersections
- Catering for future traffic demands (including the Shepparton Bypass, Midland Highway / Doyles Road intersection and other significant connections).
- Catering for pedestrian and cyclist crossing movements through formalised and informal crossings.

Services and infrastructure of relevance include:

- Undergrounding, relocating or removing the open irrigation channel alongside Wanganui Road and Ford Road will require consideration.
- As the overhead electrical power poles fall within the clear zone they will likely require relocation and/or removal.
- Potential impact on the various underground services known to cross the road including local water, power and telecommunications connections.

- Flora and Fauna:
  Relevant authority is required under Victoria's Native Vegetation Framework to demonstrate the three-step process to avoid, minimise and offset any vegetation clearing. In order to fully understand the legislative implications of the proposed development, it is recommended a detailed flora and fauna study including vegetation quality assessment be conducted.
- Cultural Heritage:
  It is concluded that a mandatory cultural heritage management plan will be required (pursuant to s.46(a) of the Aboriginal Heritage Act 2006) for any road construction works involving the upgrading, realignment or duplication of the Wanganui Road and Ford Road corridor.

2.4.2 Shepparton Alternate Route Issues Study

The Shepparton Alternate Route Preliminary Issues Report was prepared by AECOM in 2013. The purpose of the study was to undertake a desktop review of the issues, opportunities and constraints associated with the proposed duplication and upgrading of the Shepparton Alternate Route, which comprises sections of Grahamvale Road, Doyles Road and River Road.

The desktop review included consideration of the following aspects at the planning level:

- Land Use Planning
- Access
- Land contamination
- Flora and fauna
- European and Aboriginal Cultural Heritage

The key findings from the desktop review most applicable to this project were the following:

- With the proposed duplication and upgrading of the Shepparton Alternate Route, traffic volumes are expected to increase along this route from 6,300 vehicles (1,700 heavy) to 10,100 vehicles (2,400 heavy) per day, of which, 2,100 vehicles (300 heavy) per day will come from traffic that would otherwise travel through central Shepparton via the Goulburn Valley Highway.
- The rail corridor restricts widening along the east side, so any widening of the existing road corridor will have to occur along the west side.
- Short-term minor road and property access will be maintained, but longer-term these will be provided through service road arrangements. Only major new roads will be permitted to intersect with the Shepparton Alternate Route.

- There is considered to be a low likelihood of contaminated land based on historical land uses along the existing corridor, except within the rail corridor and properties between the rail corridor and the Midland Highway.
- The land within the existing road corridor and adjacent to the corridor is generally considered to be devoid of native vegetation, except for the former Broadcast Australia site in the vicinity of the Knights Road / Grahamvale Road intersection, but further specialist investigations are required.
- The desktop review identified areas of Aboriginal cultural heritage sensitivity, so further specialist investigations are required.

2.4.3 Shepparton Bypass Strategic Model Update

The Shepparton Bypass Strategic Model Update was prepared by AECOM in 2016. The key activities and findings associated with this project were the following:

- An update to the Greater Shepparton strategic transport model prepared in 2012 to assess the traffic and economic impacts of a number of Shepparton Bypass options.
- The original strategic transport model was updated to allow for the percentage differences in the Victoria in Future (VIF) 2011 data compared to the 2014 VIF data.
- Use the updated model to investigate travel demand and economic performance of a number of variations and staging of the preferred alignment (includes the upgraded Wanganui Road and Ford Road corridor as the first Stage).
- The economic evaluation indicated that each of the variations associated with the preferred alignment do not achieve a benefit cost ratio greater than 1.0.

It is noted that the economic evaluation of the preferred alignment is focused on the travel time savings achieved through the infrastructure proposal itself and does not include any wider potential benefits, such as savings to upgrades of existing infrastructure, and improved amenity and retail viability within the town centre. This is discussed further in Section 8.5.

2.5 Proximate Growth Areas

2.5.1 Shepparton North East Precinct

The Shepparton North East Precinct Structure Plan is currently being prepared by the Victorian Planning Authority (VPA), in consultation with Greater Shepparton City Council and various other Government agencies and is expected to be exhibited in March 2018.

The Precinct Structure Plan will guide the development and implementation of the proposed residential neighbourhood bounded by Ford Road to the north, Grahamvale Road to the east, and existing residential land to the south and Verney Road to the west, as shown in Figure 2.1.

The intent of the Shepparton North East Precinct Structure Plan is to develop a new neighbourhood with up to 1,500 dwellings accommodating some 4,000 people that seamlessly integrates with the surrounding urban framework of Shepparton, while providing employment opportunities and improving community facilities and local parks.

Figure 2.1: Shepparton North East Precinct

Source: Victorian Planning Authority

A Traffic Impact Assessment Report (TIAR) was prepared in support of the Shepparton North East Precinct Structure Plan by TrafficWorks in 2014, which confirmed the internal road network layout and intersection arrangements with the abutting roads.

Most critical to this project are the following traffic implications of the development proposal:

- Traffic count data collated in the report indicates that in 2010, Ford Road between Merino Drive and Verney Road, carried 2,746 vehicles per day, of which 10% were heavy vehicles, and 357 and 288 vehicles movements in the AM and PM peak hours, respectively.
- There is a proposed access point to Ford Road, via a connector road. The resulting intersection is proposed to be a give way controlled T-intersection with a 35m left turn auxiliary lane treatment on Ford Road.
- Traffic generated by the development is expected to travel to and from the site as follows:
  - East along Ford Road and north along Grahamvale Road: 5%, or 654 movements per day
  - East along Ford Road and continue past Grahamvale Road: 5%, or 654 movements per day
  - North along Verney Road (and potentially west along Ford Road): 3%, or 39 movements per day
  - West along Ford Road and north along Goulburn Valley Highway: 2%, or 26 movements per day

2.5.2 Shepparton North Growth Corridor

The Shepparton North Growth Corridor is located in the rectangular land bounded by Ford Road to the south, Verney Road to the east and Goulburn Valley Highway to the west, as shown in Figure 2.2. The Growth Corridor was included in the Planning Scheme in 2003, and when fully developed, has the potential yield to accommodate in the order of 1,042 dwellings and 2,700 – 2,750 people.

The Growth Corridor has been rezoned, and at this stage only the central third has not been developed.

There are already a number of access points to the Shepparton North Growth Corridor along the abutting roads, including a give-way controlled T-intersection with a 35m left turn auxiliary lane treatment on Ford Road with Kakadu Drive.

Figure 2.2: Shepparton North Growth Corridor

Source: http://greatershepparton.com.au/assets/files/documents/planning/shepp-north-south/Shepparton_North_Growth_Corridor_Outline_Development_Plan.pdf

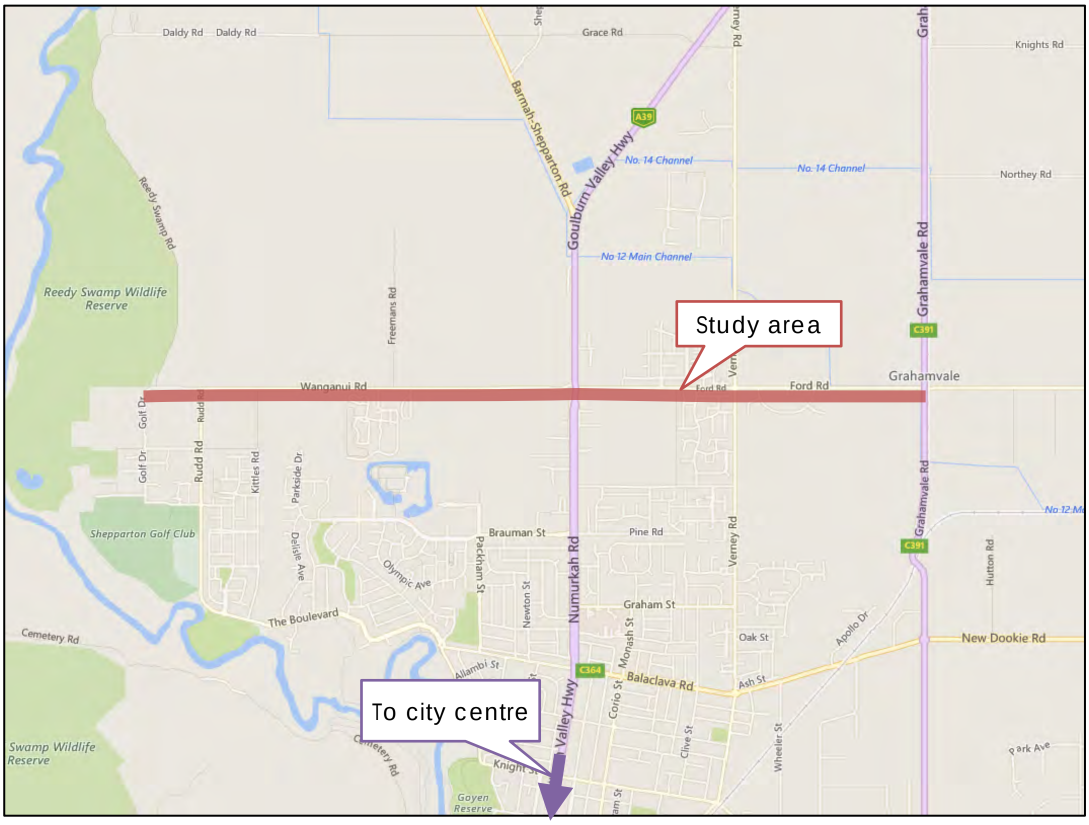
3. Baseline Conditions

3.1 Study Area

The study area for this project is the 5.9km section of the proposed link between Stage 1 of the Shepparton Bypass and Alternate Route that utilises the following road sections, as illustrated in Figure 3.1.

- Wanganui Road, between Golf Drive and Goulburn Valley Highway (3.25km)
- Ford Road, between Goulburn Valley Highway and Shepparton Alternate Route (2.65km)

Figure 3.1: Study Area



Source: Bing Maps.

3.2 Road Network

3.2.1 Roads

Wanganui Road

Wanganui Road is 3.25km long and extends between Goulburn Valley Highway to the east and Golf Drive to the west. Its entire length forms part of the study area and currently functions as a local council road. A Public Acquisition Overlay has been applied to a portion of Wanganui Road to help facilitate the Shepparton Bypass. It is located within a Road Zone (Category 2) in the Greater Shepparton Planning Scheme, which reflects that it has or is expected to have a high transport function, i.e. connect the Shepparton Bypass with Goulburn Valley Highway.

Wanganui Road is a two-way semi-rural road aligned in an east-west direction and configured with a two-lane, 8.0 metre wide carriageway set within a 20 metre wide road reserve (approx.).

Wanganui Road carries approximately 2,200 vehicles per day[1] and has a speed limit of 80kmh along its entire length. There are two minor roadways and 26 property access points that intersect Wanganui Road, many of which are unsealed. The only intersecting road along its length that provides wider network connectivity is Rudd Road, noting that this road also provides access into the residential area to the south west. As such, the majority of the traffic that currently uses Wanganui Road accesses it from Goulburn Valley Highway at its eastern end.

Ford Road

Ford Road is 5.35km long and extends between Goulburn Valley Highway to the west and Lemons North Road to the east. Only the 2.65km section between Goulburn Valley Highway and Grahamvale Road (western portion) forms part of the study area. Ford Road is designated as a local council road, but is a B-Double route. Moreover, between Verney Road and Grahamvale Road, Ford Road is located within a Road Zone (Category 2) in the Greater Shepparton Planning Scheme, which reflects that it has or is expected to have a high transport function, i.e. connect abutting growth areas with the Shepparton Alternate Route and Goulburn Valley Highway.

Ford Road is currently a two-way semi-rural road aligned in an east-west direction and configured with a two-lane, 9.0m wide carriageway set within a 20m wide road reserve (approx.). It has a 60km/h speed limit and carries approximately 3,000 vehicles per day[1].

There are five minor roadways and 22 property access points that intersect with Ford Road, with a mix of sealed and unsealed crossings. The main intersecting road along its length that provides broader network connectivity is Verney Road, but other roads are expected to as well as part of the adjacent growth areas and residential developments.

Intersecting Roads

There are four major intersecting roads along Wanganui Road and Ford Road within the study area. These include the following (in order of network hierarchy):

- Goulburn Valley Highway:
  A major arterial route that connects the Goulburn Valley Highway to the south through central Shepparton and continues north to the Murray Valley Highway. It provides a major freight link and forms part of the B-Double road network. This road intersects the study area at the staggered cross intersection between and where the east-west roads change names from Wanganui Road to Ford Road.
- Grahamvale Road:
  An arterial road that forms the eastern boundary of the study area. This road forms part of the road network on which A-Doubles are permitted. This road intersects with Ford Road as a staggered cross intersection with Ford Road, and has the rail corridor along its eastern side in this area.
- Verney Road:
  A local road that runs parallel to, but half way between (approx.), Goulburn Valley Highway and Grahamvale Road. The intersection with Ford Road is currently a single-lane roundabout.
- Rudd Road:
  A local road that intersects with Wanganui Road towards its western end. It provides a

1 Based on the peak hour traffic counts organised by GTA in 2016 at the Goulburn Valley Highway / Wanganui Road / Ford Road intersection, and assuming a peak-to-daily ratio of 8% for arterial roads and 10% for local roads.

connection to residential areas to the south and a circuitous route option to the Shepparton CBD.

Intersections

As indicated above, there are various roads intersecting Wanganui Road and Ford Road within the study area. However, there are two arterial road intersections, namely:

- Goulburn Valley Highway / Wanganui Road / Ford Road intersection
- Grahamvale Road / Ford Road intersection

The current layouts of these unsignalised intersections are shown in Figure 3.2 and Figure 3.3. It is noted that both are off-set (staggered) cross intersections, and that the Shepparton Rail Line is located on the east side of Grahamvale Road.

Figure 3.2: Intersection with Goulburn Valley Highway

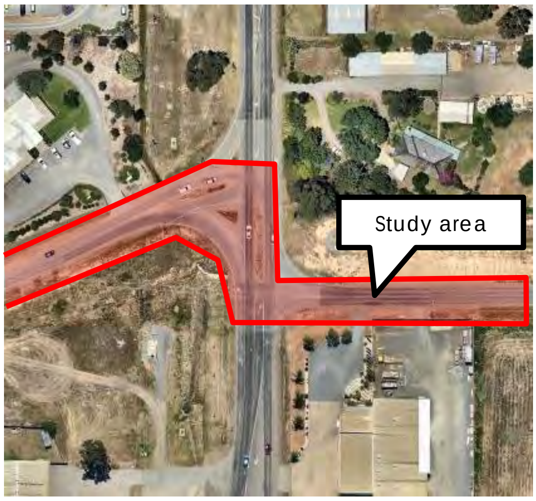
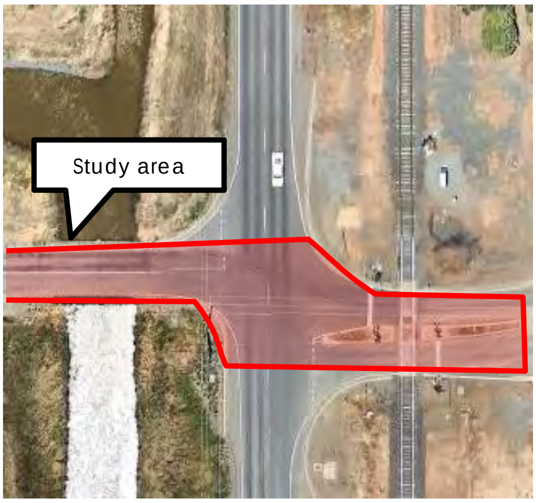


Figure 3.3: Intersection with Grahamvale Road



3.2.2 Freight

VicRoads, in consultation with local authorities, sets out the routes and heavy vehicle dimension limits across the road network. This is due to the impact and influence that heavy vehicles have on roads, namely in terms of pavement and road geometry, but also due to local community amenity, and the orderly operation of the network.

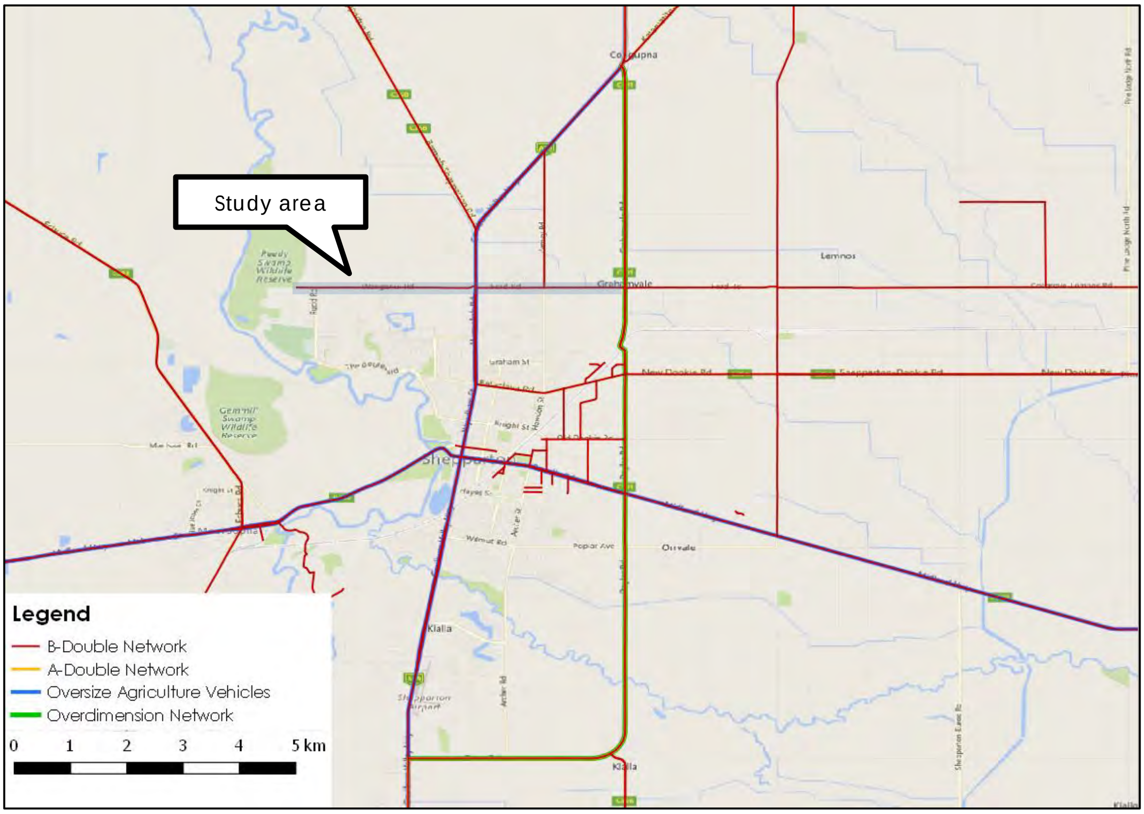
Heavy vehicle access permits for vehicles over 4.5 gross tonnes are now being assessed and managed through a new National Heavy Vehicle Regulator (https://www.nhvr.gov.au/), which is based in Queensland.

Based on the heavy vehicle network maps available on VicRoads' website, the following approved heavy vehicle routes exist within and proximate to the study area:

- B-Double routes along Wanganui Road, Ford Road, Goulburn Valley Highway, Grahamvale Road and Verney Road to the north of Ford Road
- A-Double route along Grahamvale Road
- Oversize agricultural vehicle route along Goulburn Valley Highway
- Over dimensional network route along Grahamvale Road

These local heavy vehicle routes and others within and proximate to the study area are shown in Figure 3.4.

Figure 3.4: Heavy Vehicle Network in Shepparton



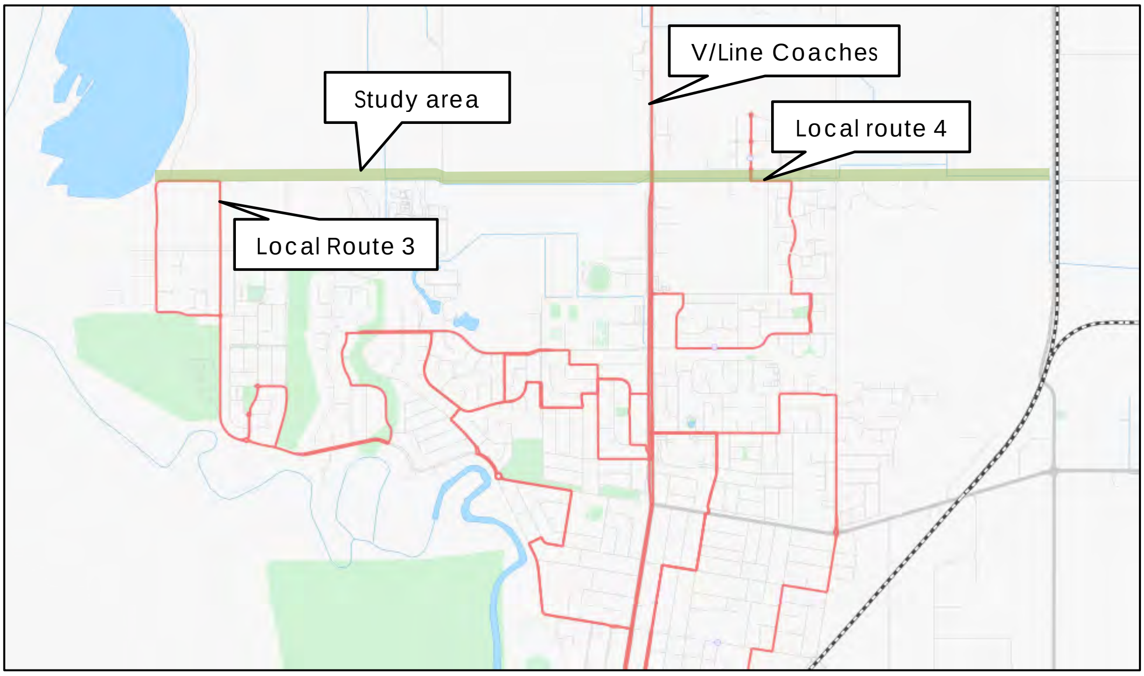
3.2.3 Public Transport

The local bus network intersects the study area in two locations. Additionally, V/Line coaches utilise Goulburn Valley Highway to reach destinations north of Shepparton. The routes and their interaction with the study area are outlined in Table 3.1 and Figure 3.5.

Table 3.1: Local Buses That Utilise Roads within the Study Area

Service	Route Nos	Route Description	Significant Destinations on Route	Frequency On/Off Peak
Bus	3	Wanganui Road between Rudd Road and Golf Drive	Goulburn Ovens TAFE	1 hour
Bus	4	Ford Road between Merino Drive and Kakadu Drive	Residential estates north and south of Ford Road	1 hour

Figure 3.5: Bus Routes Within Study Area



Source: OpenStreetMaps

3.2.4 Active Transport

Pedestrian Infrastructure

Most of the study corridor has little or no designated pedestrian infrastructure, except as follows:

- Pedestrian path along Ford Road between Kakadu Drive and Verney Road that connects the two residential estates.
- Pedestrian refuges located on each approach of the roundabout at the Verney Road / Ford Road intersection.

There is also no public seating or lighting along the length of the study area. However, there are footpaths on both sides of the roads within the proximate residential areas and the main roads to the south towards the Shepparton CBD.

Cycling Infrastructure

Most of the study area has no designated cycling infrastructure. However, there are currently the following facilities in the area:

- Dedicated bicycle lanes in both directions on Goulburn Valley Highway to the south of Wanganui Road and Ford Road.
- Dedicated bicycle lanes in both directions on Verney Road to the south of Ford Road.

It is noted that Ford Road is frequently used by road cyclists, as part of their early morning training routes. These occur both informally, and formally through the local Shepparton Bicycle User Group (BUG).

3.2.5 Crash History

Crash data for the ten-year period 28/02/2007 to 28/02/2017 has been provided by VicRoads for the length of the study area and an additional 200 metres along each intersecting road.

A total of 24 crashes were recorded within the study area over the 10 year period, as shown in Figure 3.6.

Figure 3.6: Crash Locations and History

Of these 24 recorded crashes, one was a fatality and eight resulted in serious injuries. Also, almost half of the crashes were recorded at two intersections within the study area, as follows:

i Ford Road / Verney Road:

- Six recorded crashes, five of which occurred within the most recent 5-year period.
- Four of the six crashes were "cross-traffic" (DCA# 110) incidents.

ii Ford Road / Grahamvale Road:

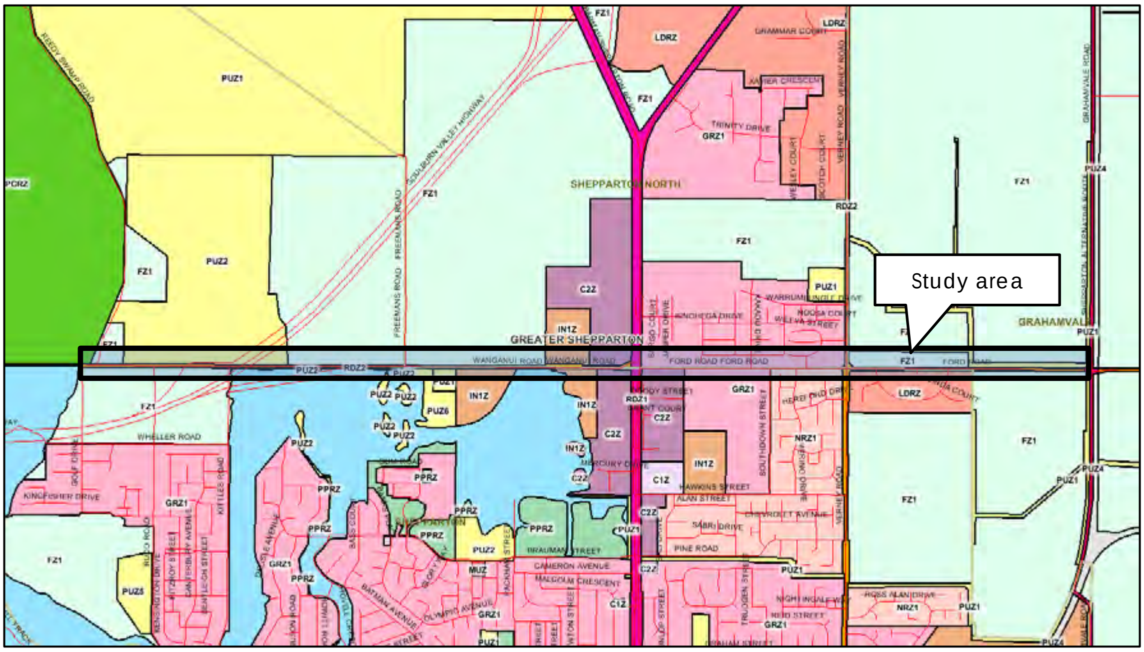
- Five recorded crashes including one fatality.
- Four incidents within the most recent 5-year period.
- Four of the five crashes were "cross-traffic" (DCA# 110) incidents.

3.3 Land Uses

3.3.1 Existing

The abutting land uses along the study area vary, with the majority being residential zones between Goulburn Valley Highway and Verney Road, with farm and rural zones beyond that, as shown in Figure 3.7.

Figure 3.7: Land Zoning within the Subject Area



Source: Land Channel Website

3.3.2 Future Known

Growth Areas

As indicated in Section 2.5, there are two growth areas with frontages to Ford Road, including two give-way controlled T-intersections. These two growth areas are noted as follows:

- The Shepparton North East Precinct Structure Plan is located at the eastern end of the study area and to the south of Ford Road. It is proposed to accommodate up to 1,500 dwellings and some 4,000 people.
- The Shepparton North Growth Corridor is located in the rectangular land bounded by Ford Road to the south, Verney Road to the east, and Goulburn Valley Highway to the north and west. It has the potential to accommodate in the order of 1,042 dwellings and 2,700 – 2,750 people, with only the central third not currently been developed.

38-60 Ford Road & 40-42 Southdown Street

A residential subdivision of 53 dwellings is currently in planning stages for the area bounded by Ford Road to the north and Southdown Street to the east, consisting of land at 38-60 Ford Road and 40-42 Southdown Street. This area is proposed to initially include 107 dwellings, with access to the site expected to occur via Ford Road and Southdown Street.

221-229 Numurkah Road (Goulburn Valley Highway)

A request for a combined planning scheme amendment and planning permit application (Amendment C193) was lodged for the land situated on the southeast corner of the Goulburn Valley Highway / Ford Road intersection. The combined amendment seeks to rezone land to accommodate a mixed-use development, consisting of a supermarket, specialty retail stores, medical centre, community centre, childcare centre and a number of pad sites / developable areas that will be confirmed through subsequent planning applications.

It is understood that Council has recently resolved to split Amendment C193, by adopting Amendment C193: Part 1 to provide a regional drainage solution, and will further consider Amendment C193: Part 2 relating to the mixed-use development in mid-2018.

If Amendment C193: Part 2 is approved, access to the site is expected to occur via Ford Road and the Goulburn Valley Highway service road, noting that a contribution would be made to improving the Goulburn Valley Highway / Ford Road / Wanganui Road intersection due to the likely impact of additional traffic on its operation and safety.

3.3.3 Future Unknown

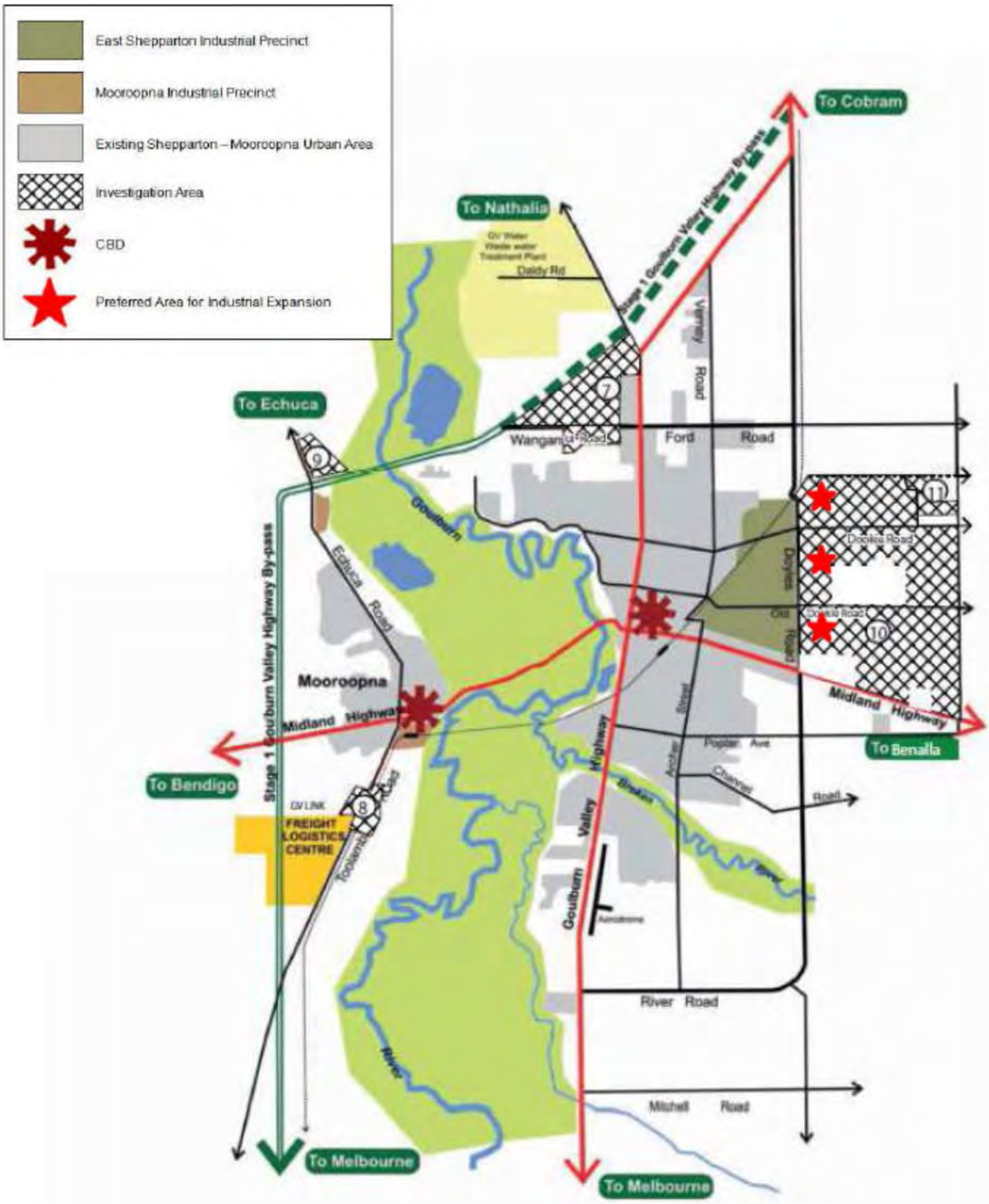
While there is potential for any number of land use development scenarios in the area over the next 20+ years, it is understood that there is a current intention to investigate the potential for industrial land to be accommodated within the triangular parcel of land broadly bounded by the following:

- Proposed Shepparton Bypass to the north
- Goulburn Valley Highway to the east
- Wanganui Road to the south (with additional land owned by Council to the south)

The area of potential industrial land being investigated is outlined in Clause 21.06 of the Greater Shepparton Planning Scheme, and referred to as Investigation Area 7 – Wanganui Road, Shepparton North.

A copy of the image from Clause 21.06 of the Greater Shepparton Planning Scheme outlining the Shepparton Industrial Framework Plan is provided in Figure 3.8.

Figure 3.8: Clause 21.06 of the Planning Scheme – Shepparton Industrial Framework Plan



At this time, the triangular area of potential industrial land referred to as Investigation Area 7 in the Shepparton Industrial Framework Plan has not been investigated. It is expected that flood modelling and mitigation measures will need to be developed to identify what the developable potential for industrial purposes will be given it is currently located within a flood plain.

Once the usable land extent has been identified, then a feasibility assessment can be undertaken to understand the suitability of it as an industrial precinct and what supporting infrastructure is needed, such as the internal road network and access arrangements to the surrounding network (i.e. Wanganui Road and Goulburn Valley Highway).

This will all need to be completed and presented as part of a planning scheme amendment to rezone the land from the current Farm Zoning (and potentially at the same time a planning permit application to develop the land), which will be heard at a Panel Hearing and ultimately require approval from the Planning Minister.

Until such time, the triangular area of potential industrial land is not able to be considered as part of this feasibility study. However, given the strategic nature of the proposed road network upgrades in the area, low traffic generation characteristics of industrial land uses and time horizon over which the land could be expected to be developed, it is not considered to be detrimental to this study. Some mitigating road works may be required over and above what is proposed as part of the current upgrade works, but this is as per any other potential development site in the area not fully considered at this time.

3.4 Traffic Volumes

A strategic transport model has been developed for the City of Greater Shepparton. The model was developed to help inform analysis and decision making around potential bypass route options and staging, including one that utilises Wanganui Road and Ford Road, which was the focus of the update of the model and analysis in 2016, as described in Section 2.4.1.

As such, the transport model is available to be used to understand what the traffic volumes are likely to be on roads along, within and intersecting the study area in the future.

In this regard, the Shepparton Strategic Transport Model has been interrogated to identify the current and future traffic volumes along and intersecting with Wanganui Road and Ford Road, which are set out below.

Mid-Block Traffic Volumes

The mid-block traffic volumes should the Stage 1 of the Shepparton Bypass be implemented for / expected along Wanganui Road, Ford Road and Goulburn Valley Highway in 2016, 2021, 2031 and 2041are set out in Table 3.2.

Table 3.2: Current and Future Mid-Block Traffic Volumes *with* Stage 1 Bypass

Road	Two-Way Daily All Vehicle Volumes (Heavy Vehicles)			
	2016	2021	2031	2041
Wanganui Rd btw Freemans Rd and Goulburn Valley Hwy	2,200 (80)	9,500 (1,130)	10,600 (1,250)	12,300 (1,420)
Ford Rd btw Goulburn Valley Hwy and Verney Rd	3,000 (380)	4,500 (540)	4,100 (430)	7,000 (760)
Goulburn Valley Hwy btw Ford Rd and Barmah-Shepparton Rd	11,800 (900)	13,200 (1,000)	20,500 (1,240)	17,500 (1,410)
Goulburn Valley Hwy btw Ford Rd and Pine Rd	15,700 (1,530)	17,000 (1,420)	21,200 (1,980)	23,200 (2,230)

It is noted that the 2016 traffic volumes presented in Table 3.2 are generally consistent with traffic survey results that GTA organised for the Goulburn Valley Highway / Wanganui Road / Ford Road intersection in 2016 (i.e. within 10%, which can relate to daily fluctuations).

Intersection Traffic Volumes

There are four intersections along the study area that traffic volumes are able to be identified through the strategic transport model. The intersection traffic volumes for 2041 should Stage 1 of the Shepparton Bypass be implemented are presented in Table 3.3.

Table 3.3: 2041 Intersection Traffic Volumes *with* Stage 1 Bypass

Intersection	2041 Vehicle Volumes Total (Heavy Vehicles)			
	AM	PM	Off Peak	Daily
Wanganui Rd / Rudd Rd	310 (12)	352 (13)	1,140 (74)	1,802 (99)
GV Hwy/ Ford Rd / Wanganui Rd	4,729 (370)	5,268 (363)	19,670 (2,131)	29,667 (2,864)
Verney Rd / Ford Rd	1,168 (103)	1,404 (101)	4,482 (571)	7,054 (775)
Grahamvale Rd / Ford Rd	1,786 (350)	2,072 (345)	6,745 (1,952)	10,603 (2,647)

Modelling Considerations

The following is noted regarding the strategic transport model:

- The transport infrastructure upgrades included in the 2041 model scenario only include the Stage 1 of the Shepparton Bypass, as shown in Figure 1.2. The full bypass and other proposed road network improvements, such as the duplication and upgrade of the Shepparton Alternate Route, are not included in the 2041 model scenario at this time.
- Future land uses along the study area in 2041 include the following, which is consistent with what is currently known to be proposed:
  - Residential Development North of Ford Road (between Goulburn Valley Highway and Verney Road)
  - Residential Development South of Ford Road (between Southdown Street and Verney Road)
  - Residential Development South of Ford Road (between Verney Road and Grahamvale Road)
  - Mixed Use Development South of Ford Road (between Goulburn Valley Highway and Southdown Street)

  It is noted that the triangular area of potential industrial land referred to as Investigation Area 7 in the Shepparton Industrial Framework Plan is not currently included within the strategic transport model. This is expected given it is only an investigation area at this time, for the reasons previously discussed. As mentioned, this is not considered to be detrimental to this study. Some mitigating road works may be required over and above what is proposed as part of the current upgrade works, but this is as per any other potential development site.
- The speed limits adopted for the various road sections in the Strategic Transport Model that form part of the Study Area are the following:
  - Wanganui Road = 100km/h
  - Ford Road = 80km/h

It is also noted that the speed limit for the roads within the city of Shepparton are 60km/h.

Potential Road Network Scenarios

It is noted that the above traffic volumes extracted from the strategic transport model are on the basis that all the anticipated known future land uses occur and that only Stage 1 of the Shepparton Bypass is implemented out to 2041. As such, it is considered to represent a worse case traffic volume scenario. Should other road infrastructure be implemented, such as other stages / full Shepparton Bypass, and duplication and upgrade of the Shepparton Alternate Route, then reduced traffic volumes on Wanganui Road and Ford Road would be expected.

As such, Table 3.4 has been prepared to compare what the traffic volumes could be expected along Wanganui Road and Ford Road under the following scenarios:

- No road network improvements occur (i.e. Do Nothing)
- Only Stage 1 of the Shepparton Bypass is implemented
- Full Shepparton Bypass implemented.

Table 3.4: Road Network Scenarios –Two-Way Daily Traffic Volumes

Scenario	Road Section Two-Way Daily All Vehicle Volumes (Heavy Vehicles)								
	Wanganui Road btw Bypass & GVH			Ford Road btw GVH & Verney Rd			Ford Road btw Verney Rd & Alt Route		
	2016	2031	2041	2016	2031	2041	2016	2031	2041
Do Nothing (BAU) [1]	2,200 (100)	2,600 (100)	2,900 (100)	3,000 (400)	4,100 (400)	5,100 (500)	2,300 (300)	2,800 (400)	3,500 (500)
Stage 1 only [1]	8,900 (1,100)	10,800 (1,300)	12,500 (1,500)	4,100 (600)	5,400 (700)	7,100 (800)	3,100 (500)	3,700 (700)	4,700 (700)
Full Shepparton Bypass [2]	*5,100 (800)*	*5,900 (900)*	*6,200 (1,000)*	*2,900 (500)*	*2,900 (500)*	*3,000 (1,000)*	*2,900 (500)*	*2,900 (500)*	*3,000 (1,000)*

[3] As presented in Table 8 of the 2016 AECOM report titled Shepparton Bypass Strategic Model Update
[4] As presented in Table 14 of the 2012 AECOM report titled Development of the Shepparton Bypass Strategic Transport Model

It is noted that the traffic volumes presented in Table 3.4 have been taken from two different reports (i.e. the 2012 and 2016 AECOM reports for the Shepparton Strategic Transport Model). With this it is noted that the full Shepparton Bypass was not included in the model update in 2016; only the 'Do Nothing' and 'Stage 1 Only' scenarios were completed. The full Shepparton Bypass was only completed as part of the 2012 modelling, along with the 'Do Nothing' and 'Stage 1 Only' scenarios.

When comparisons are made between the 2012 and 2016 model results for the 'Do Nothing' and 'Stage 1 Only' scenarios, they are lower in the 2012 results. However, what can also be deduced from the modelling completed in 2012 is that when the full Shepparton Bypass is implemented the traffic volumes along Ford Road decrease and essentially equal the 'Do Nothing' scenario (i.e. traffic growth relates to the additional development in the area), but Wanganui Road still remain generally consistent with the full Shepparton Bypass in place as it will be the main road link between the full Shepparton Bypass and the northern side of the city.

4. Design Implications

4.1 Introduction

This section of the report sets out the various transport planning and engineering implications to design the upgrade of Wanganui Road and Ford Road, as part of Stage 1 of the Shepparton Bypass. The various considerations and design implications in this section of the report generally follow the relevant sections and processes of Parts 4, 5 and 6 of the Austroads Guide to Traffic Management, with the dimensional aspects of the design treatments taken from the Austroads Guide to Road Design, Part 3: Geometric Design and other relevant Austroads Guides to Road Design and VicRoads Supplements.

4.2 Purpose & Function of Wanganui Road & Ford Road

Based on the background documents summarised in Section 2 of this report, the purpose of upgrading Wanganui Road and Ford Road to an arterial road level as part of Stage 1 of the Shepparton Bypass is to provide a viable alternative route for traffic movements through the Shepparton CBD, especially freight (i.e. those that currently travel between Mooroopna in the west, and north of Shepparton).

In order to achieve the above purpose, the upgrade of Wanganui Road and Ford Road will need to functionally achieve the following:

- Have a focus on the efficient and safe movement of people and freight, which is the role of an arterial road within the broader road network.
- Form part of the primary freight network as it will service regional movements and link strategic industrial areas.

Beyond these key functional requirements, the upgraded Wanganui Road and Ford Road will also need to consider the following:

- What other model priorities need to be supported along and intersecting the corridor (typically provided through VicRoads Network Operating Plans), such as public transport services.
- Have consideration and support for local pedestrian and bicycle movements along and across the corridor, such as envisaged in the Greater Shepparton Cycling Strategy.
- Support the existing (and potentially inform the future) adjacent land uses.

4.3 Access Management

4.3.1 Policy

Access management policy for arterial roads in Victoria is set by VicRoads. Historically, they applied what was set out in the VicRoads Access Management Policies document (most recent version was dated May 2006). However, with all road agencies across Australia working towards greater consistency, the Austroads Guides and Australian Standards have now generally been adopted, with supplements to these guides and standards developed by VicRoads to be read in conjunction with them, in order to clarify any aspects for specific application within Victoria.

In terms of access management, the Austroads Guide to Traffic Management – Part 5: Road Management is the most relevant. However, at this time, VicRoads has not developed a supplement to this guide. As such, the access management approaches set out in the Austroads Guide to Traffic Management – Part 5: Road Management should be what's applied in Victoria.

4.3.2 Objectives

Based on Section 2.1.2 of the Austroads Guide to Traffic Management – Part 5: Road Management, the objectives of access management are the following:

- Achieve a level of interaction between the road and abutting land that is consistent with the function of the particular road
- Contributes to the best outcome for the community by protecting the level of traffic service on important through traffic routes while providing road users with safe and appropriate access to adjacent land
- Manage the type of development on particular roads so that vulnerable road users are not subjected to an unacceptable crash risk
- It is an integral element of the larger transport and land use planning framework and is influenced by broad planning policies and objectives.

4.3.3 Applications to Study Area

Table 2.1 from the Austroads Guide to Traffic Management Part 5: Road Management outlines different types of roads and the practices that best suit them depending on the purpose and function of the road.

Given the above purpose and function of the upgraded Wanganui Road and Ford Road, and that it will be located within an urban environment with frequent existing property access points, it is expected that the access management approach for its length will be consistent with Category 3A and/or 3B in Table 2.1 from Austroads Guide to Traffic Management Part 5: Road Management.

The access management details of these two categories is reproduced in Table 4.1

Table 4.1: Access Management – Extract from Table 2.1 of Austroads Guide to Traffic Management Part 5: Road Management

Category	Generic Description	Typical Road Type and Function	Specific Access Control Tools	Good Practice in Implementation
3A	Roads with frequent but regulated direct access and median control / protection of right turns	Mixed function urban or rural secondary arterial roads with medians, servicing both community and traffic roles	○ Median preventing right turns except at selected locations ○ Some median opening geometry allowing right turns in one direction only ○ Some median openings for U-turns only ○ Right turn bans may apply at specified times	○ As property driveways directly access the major road, use of median to ensure that, generally, only left turns are used to enter or exit driveways abutting properties ○ At lower major road speeds, angled median openings can be used to allow exiting right turns while preventing entering right turns. This may be appropriate, for example, where sight distance is restricted in one direction ○ At lower speeds, long deceleration lengths are not needed in right turn or U-turn slots indented in the median ○ Locate U-turn slots and apply time-specific right turn bans when the major road traffic volumes are heavy
3B	Roads with frequent but regulated access but no median and generally without right turn restrictions	Mixed function secondary urban arterial roads without medians, servicing both community and traffic roles. Primary and secondary rural arterial roads servicing inter-regional traffic movement and providing direct access to abutting properties	○ Signage and/or central line marking at specific, dangerous locations to disallow right turns or U-turns at all times or at specific times. ○ Control of driveway locations to meet safety objectives (sight distances, separation from intersections, etc.) ○ Minimisation of number of driveways by combining driveways of adjacent properties	○ While Category 3B roads generally have no medians, it may be appropriate to use line marking or even short lengths of raised median, with or without signage, to legally and perhaps physically prevent right turns over a limited length of road. This may be appropriate, for example, where sight distance is restricted. ○ Minimisation of driveway numbers and control of their locations reduces conflicts between the traffic and access functions

The specific determination of which Access Management Category should be applied to the upgraded Wanganui Road and Ford Road sections will be dependent on other considerations (as discussed further in Section 4.6.1), such as the posted speed limit, but it is expected that the Wanganui Road will have Category 3A access arrangements, and Ford Road Category 3B access arrangements.

4.4 Allocation of Space

Road space allocation is the management of the available space within the road reserve to balance the mobility, accessibility, safety and priority needs of the users.

Moreover, the allocation of space is generally considered based on the function of the corridor, what users are being accommodated and their respective priority. Each of these considerations, in regard to upgrading Wanganui Road and Ford Road as part of Stage 1 of the Shepparton Bypass, are discussed as follows:

- The function is to provide the efficient and safe movement of people and freight

- Users in order of priority being accommodated is freight, through traffic, public transport (bus services), pedestrians and cyclists.

In order to suitably allocate the road reserve to achieve the above, the following key cross-sectional elements are expected:

- Divided carriageway, through central line marking and/or raised central medians
- Auxiliary turn lanes for left and right turns at mid-block locations to and from major land uses and side streets
- Pedestrian and bicycle crossing facilities at major intersections and mid-block locations where long block lengths exist
- Pedestrian and bicycle paths along the length of the corridor and connecting with intersecting facilities
- No kerbside parking within main carriageway, but potentially within any future service roads that are provided
- Indented bus stops where only a single traffic lane in the associated direction is provided, with a kerbside stop if two traffic lanes are provided in the associated direction.

4.5 Speed Management

The speed limit for the upgraded Wanganui Road and Ford Road, as part of Stage 1 of the Shepparton Bypass, will have a direct impact on whether it achieves its purpose and function, in terms of providing an efficient and safe movement of people and freight to travelling through the town centre of Shepparton. This is because the higher the speed limit the quicker the people will travel along it, which makes it a more viable alternative route to travelling through town where it is congested. But when conflicts occur between vehicles at higher speed, higher severity injuries occur, which is a lower safety outcome.

As such, it is recommended that the speed limit along the route be at least the same or higher than other east-west routes of Shepparton, and where possible priority be given to the through movements along it.

Moreover, reference is made to a simplified speed limit system being adopted by VicRoads, as outlined in their recent Speed Limit Review document, the key findings of which are reproduced in Figure 4.1.

Figure 4.1: VicRoads Speed Limit Review – Simplified Speed Limit System

40 km/h	Areas with significant pedestrian activity like schools, urban activity hubs (like a busy restaurant strip) and residential areas. Where traffic is often travelling faster than the speed limit, VicRoads will look at physical measures like speed humps, slow points and road markings to encourage drivers to comply with the speed limit.
60 km/h	Undivided roads with little or no pedestrian activity and divided roads with a high number of access points.
80 km/h	Divided arterial roads with few access points and little or no pedestrian activity. On freeways in some circumstances, such as when there is no emergency lane and on undivided rural roads in circumstances such as where there is a history of crashes or sparse abutting development.
100 km/h	Freeways and rural roads. Some high standard freeways will be signposted at 110 km/h.

Based on the simplified speed limit system being adopted by VicRoads, as reproduced in Figure 4.1, it is expected that the upgraded Wanganui Road and Ford Road, as part of Stage 1 of the Shepparton Bypass will have the following speed limits:

- Ford Road = 60km/h, which is consistent with its existing speed limit and reflective of the residential land uses expected on either side of the road.
- Wanganui Road = 80km/h, which is also consistent with its existing speed limit, but on the basis that industrial land uses are ultimately expected along its length.

It is expected that as future development occurs along the length of the corridor the access arrangements will be modified to better support these speed limits and desired access management arrangements (i.e. consolidate property access points and minimise right-turn movements). However, given the existing closely spaces vehicle crossovers on the northern side of Wanganui Road over the initial 500m from Goulburn Valley Highway, it is recommended that a 60km/h speed zone be provided in the interim.

Moreover, with the beginning of the city of Shepparton extending further north as part of continued land development, it is recommended that the 60km/h speed zone be extended further north to align with the last residential dwelling at 400 Goulburn Highway (may move further north as the northern growth corridor develops).

4.6 Cross-Sectional Elements

Cross-sectional design considerations are included in the Austroads Guide to Road Design Part 3: Geometric Design. A number of key considerations will be made in order to determine the required cross-sectional elements and overall road reserve width. The relevant considerations will include:

- Road locale: it will be within an urban context by 2041
- Traffic volumes and heavy vehicle mix
- Property access arrangements
- Truck types accessing the road
- Public transport provisions
- Pedestrian and bicycle facilities
- Vegetation, landscaping and screening
- Clear zones

4.6.1 Property Access Arrangements

Given the upgraded roads will be located within an urban environment with frequent existing property access points, it is expected that the access management approach will be consistent with Category 3A for Wanganui Road and Category 3B for Ford Road, as set out in Table 2.1 from Austroads Guide to Traffic Management Part 5: Road Management.

Median Width

Wanganui Road

In terms of what width, the central raised median should be along Wanganui Road, based on the cross-sectional information presented in the Austroads Guide to Road Design, Part 3: Geometric Design, and the associated VicRoads Supplement for an 80km/h speed limit and adopting Category 3A access arrangements, it should ideally be 7m to shelter vehicles undertaking turning movements.

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While this has been adopted at this time, it is noted that there is potential to adopt a narrow median width given that the need to shelter right-turning vehicles is limited in this instance, given that right-turning vehicles will only be crossing one lane of traffic in each direction at all give-way controlled intersections. The need to shelter right turning vehicles is most beneficial when there are multiple through lanes in each direction and it becomes difficult for right-turning vehicles to pick a suitable gap in all traffic lanes, i.e. need to stage their right-turn movement.

Ford Road

In terms of Ford Road, based on the cross-sectional information presented in the Austroads Guide to Road Design, Part 3: Geometric Design, and the associated VicRoads Supplement for an 60km/h speed limit and adopting Category 3B access arrangements, it should ideally be 3.5m to enable it to function as a turning lane.

However, on approach to the major intersections with Goulburn Valley Highway, Verney Road and Grahamvale Road, raised median islands of 0.6m to help protect the right turns have also been included.

4.6.2 Through Traffic Lanes

Based on the Austroads Guide to Road Design, Part 3: Geometric Design, and the associated VicRoads Supplement, the through traffic lane widths should be 3.5m to 4m wide. Where there are multiple lanes a 3.5m lane width is proposed, and where there is only a single lane a 4m wide lane is proposed due to the use of the route by heavy vehicles.

In terms of the number of through traffic lanes that should be provided, reference is made to the Austroads Guide to Traffic Management, Part 2: Traffic Theory, and the associated VicRoads Supplement, which indicates that the theoretical mid-block capacity for an uninterrupted through traffic lane is 9,000 vehicles per day, or for one lane in each direction the two-way capacity is 18,000 vehicles per day.

On this basis, there is only a need for one through traffic lane in each direction as part of the upgrades of Wanganui Road and Ford Road, given the traffic volumes anticipated to be accommodated in 2041 is up to 12,300 vehicles per day.

However, this is on the basis that the mid-block through traffic have the following arrangements:

- No kerbside car parking facilities
- Deceleration lanes that support turning vehicles of a notable volume

It is noted that in Table 4.3 of the Austroads Guide to Road Design, Part 3: Geometric Design that there needs to be at least a width of 5.0m between kerbs and channels. As such, there needs to be an additional 1.0m wide off-set of the outside kerb and channel from the 4.0m wide traffic lane at the mid-block locations where there is only a single lane in each direction along Wanganui Road.

It is also noted that the traffic volume anticipated to be accommodated in 2041 on Ford Road is up to 7,100 vehicles per day, which is only just above the theoretical capacity of a connector road given in Clause 56.06 of the Greater Shepparton Planning Scheme. Moreover, connector roads typically have kerbside parking spaces disrupting the through traffic lanes. It is not proposed for kerbside parking to be provided along Ford Road, and as such, there is considered to be an ability to not provide deceleration lanes for left turns and still achieve the required through traffic lane capacity.

4.6.3 Turning Lanes

As indicated above, auxiliary deceleration turning lanes are required where there are notable turning traffic volumes to achieve the required mid-block through traffic lane capacities needed to support the future anticipated traffic volumes (except for left-turn lanes on Ford Road). The way that these auxiliary decelerations turning lanes achieve this is by enabling turning vehicles to complete the majority of their deceleration outside of, and hence not disrupting, the through traffic lane.

To support turning vehicle deceleration outside of the through traffic lane, full auxiliary deceleration turning lane treatments are proposed to be adopted at all intersections and major property access points (where operational and/or safety warrants are met) along the upgraded sections of Wanganui Road and Ford Road, as described in Section 5 of the Austroads Guide to Road Design, Part 4A: Unsignalised and signalised intersections, and based on a design speed that is 10km/h above the posted speed limit.

On this basis, the following turning lane lengths will be provided at all intersections and major property access points to support the turning movements along the updated road corridor:

- Wanganui Road = 125m (minimum of 90m)
- Ford Road = 75m (minimum of 55m)

4.6.4 Road Reserve / Border

The main function of the road reserve / urban border area within an urban environment is the following, as set out in the Austroads Guide to Road Design, Part 3: Geometric Design:

- Separated pedestrian and bicycle facilities
- Indented bus bays
- Transition between any level changes
- Accommodate public utilities
- Landscaping
- In some instances, noise attenuation treatments.

For the majority of arterial roads in an urban environment a road reserve / urban border width of 4.3m to 7.3m is considered sufficient based on guidance provided in the Austroads Guide to Road Design, Part 3: Geometric Design, and the associated VicRoads Supplement.

In terms of what width will be required along Wanganui Road and Ford Road as part of Stage 1 of the Shepparton Bypass, consideration needs to be given to each of the above functions (except for the transition between levels as the proximate area is very flat), noting that the pedestrian and bicycle facilities, and shallow rooted landscaping can be accommodated over the public utilities.

On the above basis, Table 4.2 has been prepared to outline what the requirements and associated reference is for each of the functions expected to be accommodated as part of the upgrading of Wanganui Road and Ford Road.

Table 4.2: Road Reserve / Border Area Functional Width Requirements

Functions	Width	Reference
Pedestrian & Bicycle Facilities	1.5m wide footpath on one side and 3m wide shared path on the other side of the road	Austroads Guide to Road Design, Part 6A: Pedestrian and Cyclist Paths
Indented bus bays	3.0m, only expected to be provided along Ford Road	Austroads Guide to Road Design, Part 3: Geometric Design
Public Utilities	4.3m to 5.6m (can include paths and landscaping) depending on whether you relocate any of the services under the adjacent left-turn deceleration lanes.	Refer to the summary of Service Authority requirements in Attachment 1 of this memorandum
Landscaping	Will be located over the remaining areas accommodating the public utilities, except if trees are desired	Landscape Architect input required. However, if trees planted reference should be made to the VicRoads Tree Policy
Noise attenuation treatments	Varies depending on treatment adopted, which typically consist of low noise pavements, earth mounds and and/or noise walls (usually made from timber, plastic, concrete or steel)	Acoustic Engineer input required. However, reference is expected to be made to VicRoads Noise Reduction Policy

4.7 Intersection Selection

The Austroads Guide to Traffic Management, Part 6: Intersections, Interchanges and Crossings sets out a selection process for the section of intersections types. Broadly, the associated process indicates that the selection of the most appropriate intersection type at a given location will likely relate to the following:

- Balancing of safety and mobility
- Capacity, delay and level of service, generally and for specific users
- Planning policy and objectives
- Traffic management strategies or objectives for the road network or corridor
- Compatibility with adjacent intersection treatments
- Topography at the site
- The natural and built environment
- Economic considerations.

However, at a road network functionality level, Table 2.3 in the Austroads Guide to Traffic Management, Part 6: Intersections, Interchanges and Crossings provides guidance on what the most appropriate intersection types are between given road types, which is reproduced in Figure 4.2.

Figure 4.2: Suitability of Types of Traffic Control to Different Road Types

	Primary Arterial	Secondary Arterial	Collector & Local Crossing Road	Local Street
Traffic Signals				
Primary arterial	A	A	O	X
Secondary arterial	A	A	O	X
Collector & local crossing road	O	O	X	X
Local street	X	X	X	X
Roundabouts				
Primary arterial	O	O	X	X
Secondary arterial	O	O	O	X
Collector & local crossing road	X	O	A	O
Local street	X	X	O	A
STOP or GIVE WAY signs				
Primary arterial urban/(rural)	X / (O)	X / (O)	A	A
Secondary arterial urban/(rural)	X / (O)	X / (O)	A	A
Collector & local crossing road	A	A	A	A
Local street	A	A	A	A
Legend: A = Most likely to be an appropriate treatment O = May be an appropriate treatment X = Usually an inappropriate treatment				

Source: Table 2.3 in the Austroads Guide to Traffic Management, Part 6: Intersections, Interchanges and Crossings

With consideration of the above, and that the majority of the intersections along Wanganui Road and Ford Road are with low traffic volume local roads, stop or give way controlled intersections are considered to be the most appropriate to be implemented.

However, there are the following intersections with higher order roads that roundabout or signalised intersection treatments will be required to achieve suitable operational and safety levels of service:

- Goulburn Valley Highway / Wanganui Road / Ford Road intersection
- Ford Road / Verney Road intersection
- Ford Road / Grahamvale Road intersection

In terms of how to decide on which intersection treatment will be most suitable for the above, Safe System Solutions was engaged to complete a Safe System Assessment (consistent with AP-R509-16 Austroads Safe System Assessment Framework) for each intersection. All VicRoads infrastructure projects are now required to consider adoption and implementation of the Safe System principles, as the industry transitions towards this new road safety philosophy.

A copy of the Safe System Assessment is provided in Appendix A, with the results for each of the above three intersections discussed hereafter.

4.7.1 Goulburn Valley Highway / Wanganui Road / Ford Road Intersection

The existing arrangements of the Goulburn Valley Highway / Wanganui Road / Ford Road intersection do not align well with the Safe System Principles. However, its conversion to a roundabout or signalised intersection would greatly increase safety outcomes for almost all road users, except for potentially side swipe crashes types with a roundabout and rear-ends with signals.

In terms of which intersection treatment is better from a Safe Stys perspective between a roundabout or signalised intersection in the future with the Goulburn Valley Highway / Wanganui

Road / Ford Road intersection, it has been identified as being a roundabout, but only as long as pedestrian crossing numbers at the intersection remain very low.

Given the future potential for a pedestrian desire line to exist between the commercial development on the southeast and residential subdivision on the northeast of the intersection, it is proposed to provide a Signalised Pedestrian Crossing on Ford Road a suitable distance back from the roundabout treatment to support these crossing pedestrian volumes.

Should in the future additional significant traffic volumes emerge, especially as Shepparton continues to develop northward, then consideration should be given to converting the intersection to a fully signalised intersection.

4.7.2 Ford Road / Verney Road Intersection

The existing arrangements of the Ford Road / Verney Road intersection align fairly well with the Safe System Principles. However, it won't be sufficient to accommodate the future anticipated traffic volumes and needs to be upgraded.

In terms of which intersection treatment is more suitable from a Safe Systems perspective between an upgraded roundabout or signalised intersection in the future with the Ford Road / Verney Road intersection, it has been identified as being signals, namely due to the expectation of there being reasonable numbers of pedestrians and cyclists crossing at the intersection with shared paths on two approaches and schools in the area.

4.7.3 Ford Road / Grahamvale Road Intersection

The existing arrangements of the Ford Road / Grahamvale Road intersection do not align well with the Safe System Principles. However, its conversion to a roundabout or signalised intersection would greatly increase potential safety outcomes for almost all road users, except for side swipe crashes types with a roundabout and rear-ends with signals.

In terms of which intersection treatment is better from a Safe Systems perspective between a roundabout or signalised intersection in the future with the Ford Road / Grahamvale Road intersection, it has been identified as being a roundabout, namely due to Grahamvale Road having an 80km/h speed limit, which signalised intersections do not manage as well as roundabouts do.

However, the Ford Road / Grahamvale Road intersection is located adjacent to a rail line and has an at-grade level crossing on the eastern approach. As such, the roundabout will need to be able to be shut down on all approaches through signals that only operate when the level crossing barrier arms are triggered.

5. Consultation

5.1 Stakeholders

Consultation with key stakeholders has been undertaken as part of this feasibility study to understand what the key concerns and implications of upgrading Wanganui Road and Ford Road from a feasibility perspective.

To this end, the following stakeholders have been consulted with:

- Service and Asset Authorities
- Key landowners, residents, businesses and/or their representatives

In addition, it is noted that VicRoads and Greater Shepparton City Council have been involved throughout the project and consulted on a number of aspects of the proposal.

5.2 Activities

5.2.1 Service and Asset Authorities

In terms of the various service and asset authorities, they were predominately consulted via email and telephone. However, site visits and/or meetings were completed with the following:

- Goulburn-Murray Water
- Goulburn Valley Water
- Nextgen
- Greater Shepparton City Council Infrastructure Directorate
- Ausnet services (meeting at their office in Melbourne)

5.2.2 Landowners, Residents, Businesses and/or Representatives

With the key landowners, businesses and their representatives, the following consultation activities have been completed to date:

- Mail drop by Greater Shepparton City Council to all abutting land owners and occupiers informing them of the proposed upgrade of Wanganui Road and Ford Road, as well as how they could set up a time to discuss the project.
- Drop-in session for Ford Road on Wednesday 19 April at the Greater Shepparton City Council offices.
- Drop-in session for Wanganui Road on Wednesday 7 June at the Greater Shepparton City Council offices.

5.3 Outcomes

5.3.1 Service and Asset Authorities

There are various existing utility assets and services within the study area that will need to be maintained, as well as various others that will need to be accommodated, to which there are specific requirements in how they will be provided as part of the proposed upgrade of Wanganui Road and Ford Road.

These have been identified through consultation with each service authority as part of this project, from an approval process, design and construction planning perspectives.

A summary of the key service and asset authority requirements that affect the project feasibility is set out below, with a full summary provided in Appendix B for all service and asset authorities.

i Power: Responsible authority for power in the area is Powercor for 66kv assets and below, and Ausnet services for 110kv assets and above. In this regard, the following is noted:

- There are 33 electrical poles including 5 of them with pole mounted substations needing to be relocated along northern side of Wanganui Road. Moreover, Powercor has indicated that given they are 66kv lines they would prefer them to not be put underground, and the pole centres be located at least 3.3m from any property boundaries. As such, the power poles will not be able to be located within the proposed cross section (or able to remain in their current location) and an additional easement would be required to accommodate them. In this regard, it is recommended that the 33 relocated power poles be located along the southern side of Wanganui Road between Rudd Road and Goulburn Valley Highway by widening the current proposed cross-section by 3.3m (i.e. they would be located along the current property boundary). Clearance to the existing powerlines along the southern side will need to be confirmed with Powercor.
- There are 14 electrical poles including 2 of them with pole mounted substations needing to be relocated along northern side of Ford Road, between Verney Road and Grahamvale Road. However, given the lower speed limit, there is considered to be opportunity to include these relocated power poles in the proposed cross-section.
- There are three electrical poles needing to be relocated within the proposed intersection works at Goulburn Valley Highway / Ford Road / Wanganui Road.
- There is no major effect to Ausnet services assets across Wanganui Road.
- Undergrounding or relocation of these assets may require more than one year lead time.

ii Water and Sewers: Responsible authority for water and sewers is Goulburn Valley Water. They have indicated the following:

- The water assets along the northern side of Wanganui Road and Ford Road need to be relocated to avoid them being underneath the proposed road pavement.
- Sewer rising main from Goulburn Valley Highway to Freemans Road along the southern side of Wanganui Road needs to be protected or relocated. Most of the sewer rising main is located outside of the proposed carriageway. However, this needs to be confirmed through service proving.
- The sewer pump located within the vicinity of Goulburn Valley Highway / Ford Road / Wanganui Road intersection needs to be protected.
- Sewer rising main from Verney Road to Grahamvale Road along the southern side of Ford Road needs to be protected or relocated wherever the existing sewer rising main is within the proposed carriageway.

iii Gas: APA is the responsible authority for the gas main, and they have indicated the following:

- Gas main within the intersection of Goulburn Valley Highway / Ford Road / Wanganui Road needs to be protected or relocated.
- Gas main within the intersection of Ford Road/Verney Road needs to be protected or relocated.

iv Telecommunication: Telstra's communication cables run along the northern side of Wanganui Road and Ford Road, to which they indicated the following:

- Telstra assets within northern side of Wanganui Road need to be relocated.
- Telstra assets located within northern side of Ford Road need to be relocated.
- The junction box located along the southern side of Ford Road within the vicinity of the Goulburn Valley Highway / Ford Road / Wanganui Road intersection needs to be relocated.

v Irrigation Channel – Goulburn-Murry Water (G-MW) is the responsible authority, and they indicated the following:

- Smaller bridges across Wanganui Road need to be reconstructed to suit the proposed road works.
- Channel along the northern side of Ford Road needs to be protected and further consultation is required to decide what their requirements will be about managing the impact of the road construction works adjacent to their live channel.
- The existing bridge on Ford Road along the western side of Grahamvale Road (eastern end of the study area) needs to be reconstructed to suit road widening and heavy vehicle loadings.
- Some part of the proposed Ford Road alignment is within the G-MW property and agreement to acquire it needs to be obtained from them as early as possible.
- The existing Irrigation Channel adjacent to Northern side of Ford Road from Goulburn Valley Highway to Verney Road needs to be realigned and / or converted to underground pipe drain
- The live channel along the northern side of Ford Road from Matilda Drive to Grahamvale Road need to be protected for pavement subsurface moisture and proposed road widening within the G-MW land need to be discussed with them and agreed as early as possible.

vi Railway track: VicTrack is the responsible authority of the existing at-grade railway track along the eastern side of Grahamvale Road. The proposed traffic signal facilities will need to be incorporated with the rail signals.

vii Data: Nexgen's communication cable is located within the Powercor electrical pole in the vicinity of the Goulburn Valley Highway / Ford Road / Wanganui Road intersection, where it runs along the southern side of Ford Road up to Verney Road. The electrical pole relocation within the intersection will therefore also require this Nextgen cable to be relocated with the electrical poles.

5.3.2 Landowners and Representatives

From the consultation undertaken with local land owners, residents, businesses and their representatives, there was a range of opinions received, from those that believe the proposal is overdue, especially with some of the intersections, to those that do not want any changes to the existing road corridor.

However, the following key topics have emerged as being the most critical concerns raised by the local land owners, residents, businesses, and their representatives:

- Residential amenity impacts with the introduction of arterial roads, such as noise, vibration and pollution generated by the increased traffic volumes, especially by the heavy vehicles.
- Impact on current access arrangements to their properties and the broader area.
- Need for land take from the properties on the northern side of the road corridor.
- Potential impacts on safety with increased traffic volumes, especially heavy vehicles.
- The suitability of the associated alignment and use of Wanganui Road and Ford Road.

In terms of how each of the above key topics have been addressed as part of this feasibility study, the below is provided.

Residential Amenity Impacts

Traffic volumes in the area are increasing. This is mainly due to the increased level of development in North Shepparton, which has been significant, and has been shown through strategic transport modelling, that it will require Ford Road to be upgraded, regardless of whether the Shepparton Bypass is being implemented or not.

However, amenity impacts need to be considered, especially for the abutting residential areas, and where appropriate addressed. As part of this feasibility study the following activities and/or actions have been undertaken in this regard:

- Traffic surveys along Wanganui Road and Ford Road have been undertaken to understand what the current volumes and type of vehicles are using these roads. It is understood that additional surveys are proposed for later in the year to ensure any seasonal variation is being captured and considered as this project moves forward.
- Acoustic Noise Modelling has been completed to understand what the existing and future noise levels will be, whether they are considered acceptable (i.e. based on VicRoads Noise Targets Policy) and potential treatment options to mitigate the increased noise levels.
- Flood modelling has been undertaken for the floodway that intersects Wanganui Road between Kittles Road and Freemans Road, to understand what level the road needs to be to remain above a 1%AEP event, and what drainage infrastructure is needed to not cause up or downstream impacts.
- Development of a Landscape Masterplan for the entire length of the road corridor to identify an approach and potential treatments to achieve a high-quality urban environment that suits the different sections of the corridor and reflects Shepparton's identity.
- Inclusion of some amenity impact reduction design elements, such as low noise pavement treatments, no kerbside parking, and prioritising east-west movements to minimise the number of stoppings and startings.

Access Impacts

Generally speaking, current property access arrangements have been maintained, except on approaches to the proposed roundabout at the Goulburn Valley Highway / Wanganui Road intersection. In these locations raised central medians are proposed, which will restrict right-in / right-out movements. However, U-turn opportunities have been provided within reasonable distances.

It is noted that there is potential for a raised central median along Ford Road as well. This would be to enable trees to be planted in the centre of the road. This is only an option at this stage and affected properties will be consulted further should this option be taken further.

Land Take

In order to update the existing semi-rural road of Wanganui Road and Ford Road to accommodate the future anticipated traffic volumes, there will be a need to acquire some additional land. The amount of land needing to be acquired has been minimised as much as possible, through the development of various cross-sections and negotiations with VicRoads and Greater Shepparton City Council.

Ultimately, the resulting cross-sections developed for Wanganui Road and Ford Road are the narrowest considered to be appropriate for the long-term purpose of these roads. Elements of the cross-sections that have been applied to minimise their width include the following:

- No kerbside car parking
- Locating majority of services on the southern side of the carriageway and shared path on the northern side
- Localised widening at intersections to accommodate additional lanes, bending of path treatments and minimum off-sets
- Adoption of a 60km/h speed limit along Ford Road, which minimises the required central median width

Safety Impacts

As traffic volumes increase some crash types typically increase. However, given that the existing road environment and intersection arrangements along Wanganui Road and Ford Road are considered to be poor, the proposed upgrading of these roads and intersections is expected to achieve an overall improved safety outcome.

This is reflected in the Safe System Assessment provided in Appendix A, which essentially shows an improved alignment with the Safe System principles with the proposed intersection treatments for all road users.

Road Safety Audits are also required at each key design stage to help minimise the potential for crashes involving all users of the resulting road corridor. At the current feasibility stage of the project, the concept level designs have been audited and associated changes to the designs made, as discussed in Section 6.3.

Suitability of the Alignment

While the identification of the most suitable east-west road alignment to connect Stage 1 of the Shepparton Bypass with the Shepparton Alternate Route (Grahamvale Road) is outside the scope of this project, and has already been investigated and agreed to, some discussion is provided below regarding two alternative alignments that have been put forward by the community as part of the pre-draft consultation phase.

Submitters' Proposed Alignment 1: Through the North Growth Corridor

One alternative alignment to service east-west movements between Stage 1 of the Shepparton Bypass and Shepparton Alternate Route (Grahamvale Road), or at least a section of it, is to utilise the current central third of the Shepparton Northern Growth Corridor between the transmission easement and the G-MW Drain 4.

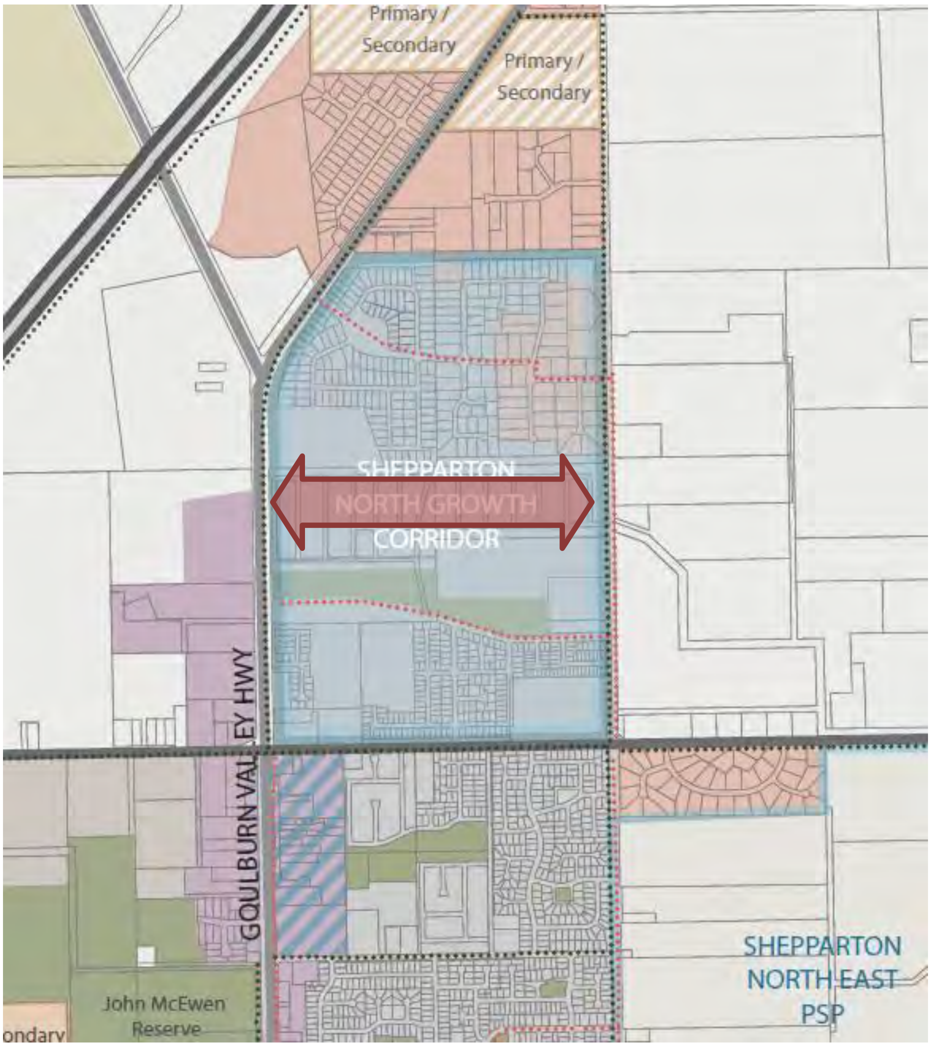
The alternative alignment would thus traverse land that has been identified as a strategic future residential growth corridor and zoned General Residential Zone, as discussed in Section 2.5.2 and 3.3.2, and shown in Figure 2.2.

Associated planning for this Growth Corridor has already been completed as part of Amendment C11 to the Greater Shepparton Planning Scheme in 2003. This included a suite of background reports assessing the development potential of the land and the quantum of infrastructure required to support it.

An Outline Development Plan (ODP) was prepared to guide the location of the future land uses in the Growth Corridor and intersections onto Goulburn Valley Highway, Ford Road, and Verney Road. A Development Contributions Plan (DCP) was prepared to apportion the costs to all development parcels within the Growth Corridor.

This alternative alignment is broadly shown in Figure 5.1, with issues in using it as an arterial road provided thereafter.

Figure 5.1: **Submitters'** Proposed Alignment 1



- The associated land has already been planned and designed for residential use, so at least high acquisition costs would be expected.
- The internal road layout and intersection locations, spacings and types to Goulburn Valley Highway, Ford Road and Verney Road were not developed on the basis of an arterial level road going through the middle of the Growth Corridor.
- There is proposed to be a retardation basins and public open space provided within the transmission easement to cater for all the residential development in the Growth Corridor to the south of the G-MW Drain 4 that will not be able to be provided.
- The proposed deviation would require an additional full-turning intersection onto the Goulburn Valley Highway, which is unlikely to be supported by VicRoads.
- Increased traffic volumes would occur along Verney Road, which is only a connector level road.
- It is assumed that Ford Road would remain as is, but this will not stop increasing vehicle volumes using it, especially given the Shepparton North East Precinct to the south east, as discussed in Section 2.5.1 and 3.3.2, and shown in Figure 2.1
- The resulting east-west alignment would not be a very efficient arrangement, which would reduce the funding probability for Stage 1 of the Shepparton Bypass.

Submitters' Proposed Alignment 2: Northeast of Ford Road / Verney Road Intersection

The other alternative alignment to service east-west movements between Stage 1 of the Shepparton Bypass and Shepparton Alternate Route (Grahamvale Road), or at least a section of it, is to extend a new road off the Ford Road / Verney Road intersection in a northeast direction out behind the existing residential dwellings and extending it out to Grahamvale Road.

This alternative alignment is broadly shown in Figure 5.2, with issues in using it as an arterial road provided thereafter.

Figure 5.2: **Submitters'** Proposed Alignment 2

- The Ford Road / Verney Road intersection is currently identified to be upgraded to a signalised intersection. This alignment would require the intersection design to be amended to be a five-way roundabout and involve land acquisition on at least two of the corners. In addition, this would be expected to result in a less safe pedestrian and bicycle arrangements.
- This alignment would require the construction a bridge over the Goulburn-Murray Water backbone channel or the realignment of the channel. This would substantially increase the cost of the road. The proposed alignment would also sever access to the channel from Verney Road for Goulburn-Murray Water staff for maintenance, this is unlikely to be supported by Goulburn-Murray Water.
- The proposed alignment would require the acquisition of a mature orchard and cool store operation. This would lead to substantial compensation for the owner of the land, which will involve significant cost to any realignment.
- The proposed alignment would impact on a number of existing residential properties, so only push the associated concerns north.
- The proposal would require a new intersection onto Grahamvale Road in close proximity to the existing Ford Road / Grahamvale Road intersection, which will not likely be supported by VicRoads.
- The resulting east-west alignment would not be a very efficient arrangement, which would reduce the funding probability for Stage 1 of the Shepparton Bypass.

In summary, the following points are raised as to why the current proposed alignment is considered to be the most appropriate:

- Upgrading of an existing road corridor provides a more feasible option to developing an entirely new road corridor, especially when only a small proportion of additional land is needed to be acquired (land, drainage and pavement substrate costs are significantly higher with a completely new road alignment).
- Background traffic growth due to the expected level of residential and commercial development in the area is expected to require Ford Road to be ungraded regardless of whether the Shepparton Bypass is implemented or not.
- The alignment results in a direct and efficient east-west link, which is considered to give the best funding probability for Stage 1 of the Shepparton Bypass.
- The Shepparton Bypass is a staged project, and the use of Ford Road as an east-west connection between the Shepparton Bypass and the Shepparton Alternate Route is expected to materially reduce as the other stages to the north of the Shepparton Bypass are completed.

6. Cross-Sections & Intersection Layouts

6.1 Cross Sections

Based on the design implications set out in Section 4, and the consultation outcomes in Section 5, the proposed mid-block cross sections for Wanganui Road and Ford Road are indicated below.

6.1.1 Wanganui Road

The proposed mid-block cross section for Wanganui Road is indicated in Figure 6.1, which requires the existing 20.0m wide road reserve to be widen by 13.6m and includes the following elements:

- Acquire the 13.6m additional road reserve width to the north.
- Northern border width of 7.0m that includes available width for services, 3.0m wide shared path and ability to accommodate a left-turn lane.
- Divided carriageway width of 17m that includes 5.0m wide traffic lanes in each direction and a 7.0m wide central raised median that can accommodate right-turn lanes (propose to maintain the majority of existing property access arrangements).
- Southern border width of 9.6m that includes available width for services (such as the 3.3m width for the 33 x 66kv relocated power lines), 1.5m wide footpath and ability to accommodate a left-turn lane.

Figure 6.1: Wanganui Road – Mid-Block Cross-Section (33.6m)

6.1.2 Ford Road

The proposed mid-block cross section for Ford Road is indicated in Figure 6.2, which requires the existing 20.0m wide road reserve to be widen by 7.4m and includes the following elements:

- Acquire the 7.4m additional road reserve width to the north.
- Northern border width of 8.0m that includes available width for services, 3.0m wide shared path and ability to accommodate a left-turn lane.
- Carriageway width of 12.1m that includes 4.0m wide traffic lanes in each direction and a 4.1m wide marked central median that can accommodate right-turn lanes.
- Southern border width of 7.3m that includes available width for services, 1.5m wide footpath and ability to accommodate a left-turn lane.

Figure 6.2: Ford Road - Mid-Block Cross-Section (27.4m)

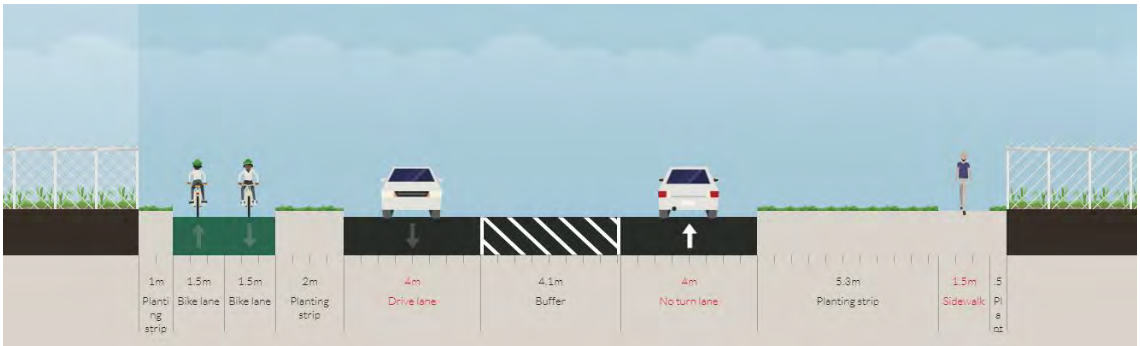
As previously mentioned, a Landscape Masterplan for the road corridor has been developed, and an option that has a raised central median to accommodate tree planting along Ford Road is being considered. The associated cross-section for this arrangement is shown in Figure 6.3.

Figure 6.3: Ford Road - Mid-Block Cross-Section (27.4m) with a raised central median

It is also noted that between Verney Road and 197 Ford Road, residential properties already exist abutting the current road reserve boundary. As such, to minimise the need to acquire additional land, a revised 25.4m (2.0m narrower) mid-block cross section has been developed and is indicated in Figure 6.4 which broadly consists of the following elements:

- Acquire the 5.4m additional road reserve width to the north.
- Northern border width of 6.0m that includes available width for services and 3.0m wide shared path (localised widening utilised where a left-turn lane is required).
- Carriageway width of 12.1m that includes 4.0m wide traffic lanes in each direction and a 4.1m wide marked central median that can accommodate right-turn lanes.
- Southern border width of 7.3m that includes available width for services, 1.5m wide footpath and ability to accommodate a left-turn lane.

Figure 6.4: Ford Road - Mid-Block Cross-Section (25.4m) between Verney Road & 197 Ford Road



Opportunity also exists for a raised central median arrangement for this revised cross-section.

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6.2 Intersections

As indicated in Section 4.7, the majority of the intersections along Wanganui Road and Ford Road are with low traffic volume local roads, so stop or give way controlled intersections are considered to be the most appropriate to be implemented, which from a design perspective are able to be easily accommodated given there is ability to accommodate left and right turn deceleration lanes in each direction.

However, the following intersections are with higher volume roads and are proposed to be the following intersection types, which is discussed in more detail thereafter:

- Goulburn Valley Highway / Wanganui Road / Ford Road = roundabout intersection
- Ford Road / Verney Road = signalised intersection
- Ford Road / Grahamvale Road = roundabout intersection (with signals to shut down the intersection when the at grade rail crossing barrier arms are triggered).

6.2.1 Goulburn Valley Highway / Wanganui Road / Ford Road Intersection

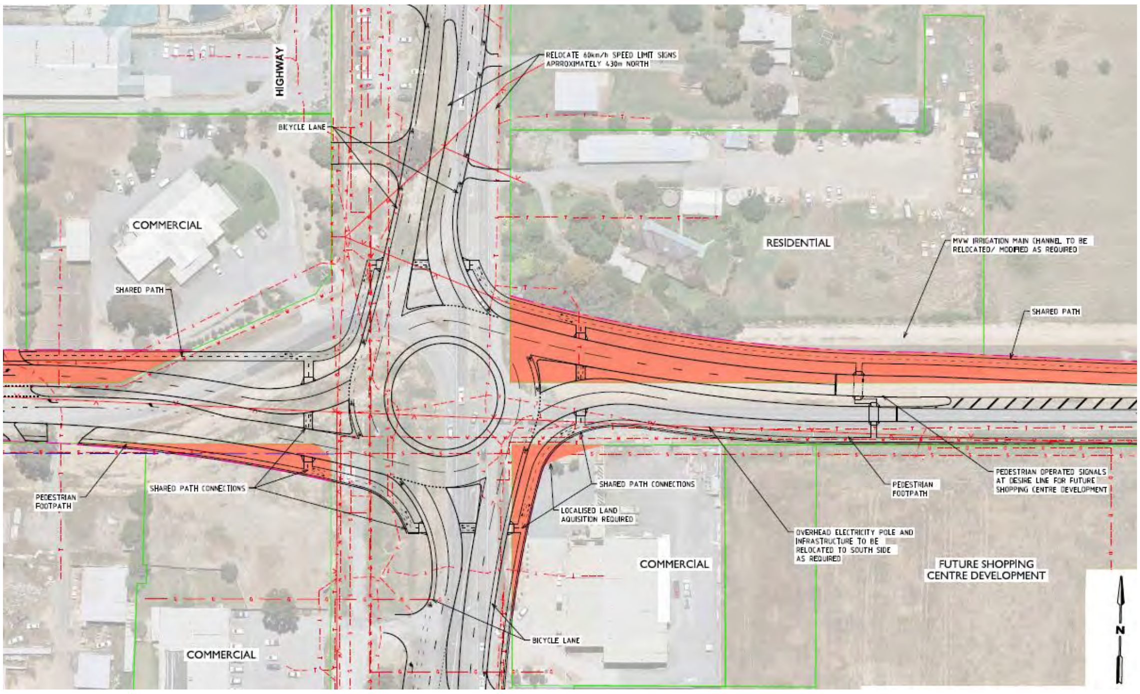
The Goulburn Valley Highway / Wanganui Road / Ford Road intersection will accommodate significant traffic volumes in the future with the implementation of Stage 1 of the Shepparton Bypass and proposed levels of development in the area. As such, and until more detailed traffic analysis is completed, the following facilities are proposed as part of the intersection layout:

- Dual lane roundabout based on a 70km/h speed environment (VicRoads requires designs to be based on a speed environment 10km/h above the posted speed limit)
- Continuation of the duplication of Goulburn Valley Highway north through the intersection
- Realignment of Wanganui Road and Ford Road to form a standard X-intersection
- Two through lanes on each approach and departure (noting the Wanganui Road and Ford Road approaches will taper back to one-lane in each direction a suitable distance from Goulburn Valley Highway)

On this basis, the concept level design layout for the Goulburn Valley Highway / Wanganui Road / Ford Road intersection is shown in Figure 6.5. Based on this layout the following is noted:

- Access to each of the properties on the corners of the intersection will be impacted, with only left-in / left-out access points possible to their fronting roads, except the property on the northeast corner due to the drain to the south (unless a bridge is provided).
- Land acquisition is required on each of the corners of the intersection, except the northwest.

Figure 6.5: Goulburn Valley Highway / Wanganui Road / Ford Road Intersection



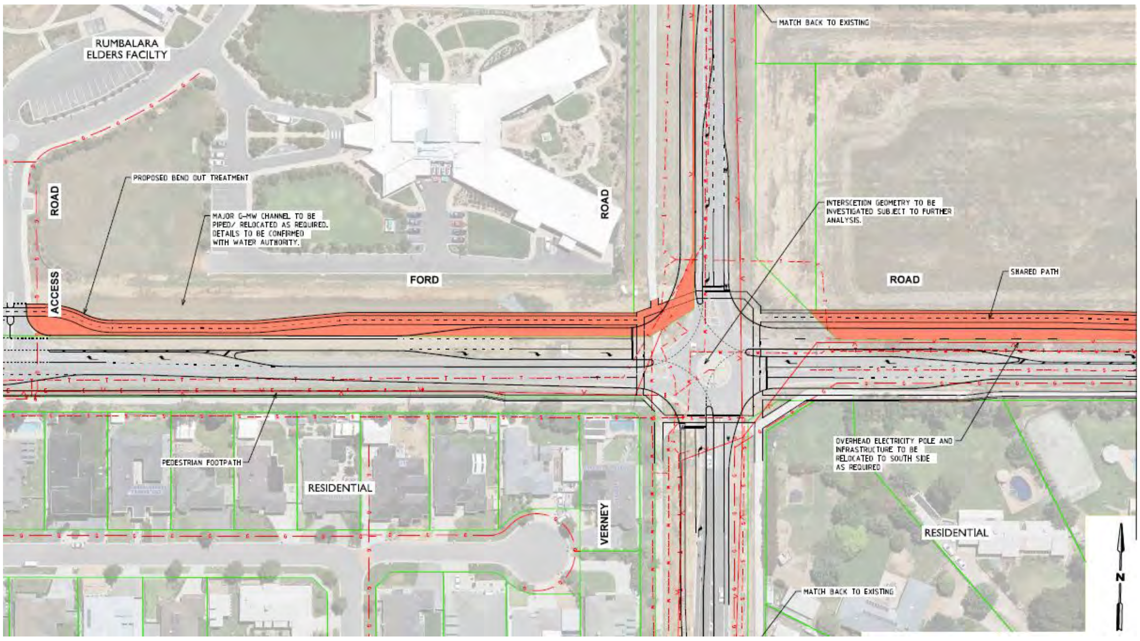
6.2.2 Ford Road / Verney Road intersection

The Ford Road / Verney Road intersection will accommodate moderate traffic volumes in the future (majority along Ford Road) with the implementation of Stage 1 of the Shepparton Bypass and proposed levels of development in the area. As such, the following facilities are proposed as part of the intersection layout:

- Two through lanes on Ford Road approaches and departures that taper back to one-lane in each direction a suitable distance from Verney Road
- Right-turn lane on each approach.

On this basis, the concept level design layout for the Ford Road / Verney Road intersection is shown in Figure 6.6, which is generally able to be accommodated with the mid-block proposed cross-section width and not impact proximate property access arrangements.

Figure 6.6: Ford Road / Verney Road Intersection



6.2.3 Ford Road / Grahamvale Road intersection

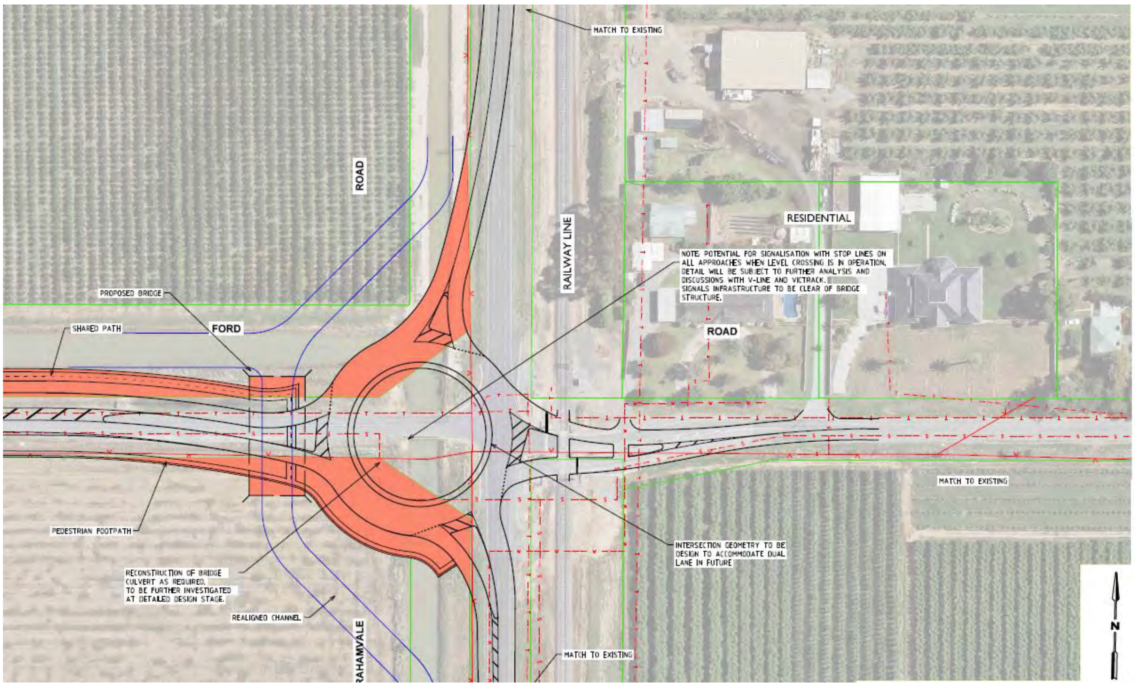
The Ford Road / Grahamvale Road intersection will accommodate significant traffic volumes in the future (with the exception of the east approach) with the implementation of Stage 1 of the Shepparton Bypass and proposed levels of development in the area. As such, the following facilities are proposed as part of the intersection layout:

- Single lane roundabout based on a 90km/h speed environment (VicRoads requires designs to be based on a speed environment 10km/h above the posted speed limit)
- Inclusion of signals to shut down the intersection when the at grade rail crossing barrier arms are triggered
- Realignment of the east and west approaches to form a standard X-intersection, but off-set north-south to achieve required deflections and speed management

On this basis, the concept level design layout for the Grahamvale Road / Ford Road intersection is shown in Figure 6.7. Based on this layout the following is noted:

- A significant bridge or culvert over and realignment of the open channel will be required to support the new Ford Road cross-section and roundabout treatment.
- The existing level crossing will need to be modified given the east approaches realignment and widening to better support heavy vehicles.

Figure 6.7: Grahamvale Road / Ford Road Intersection



6.3 Concept Designs

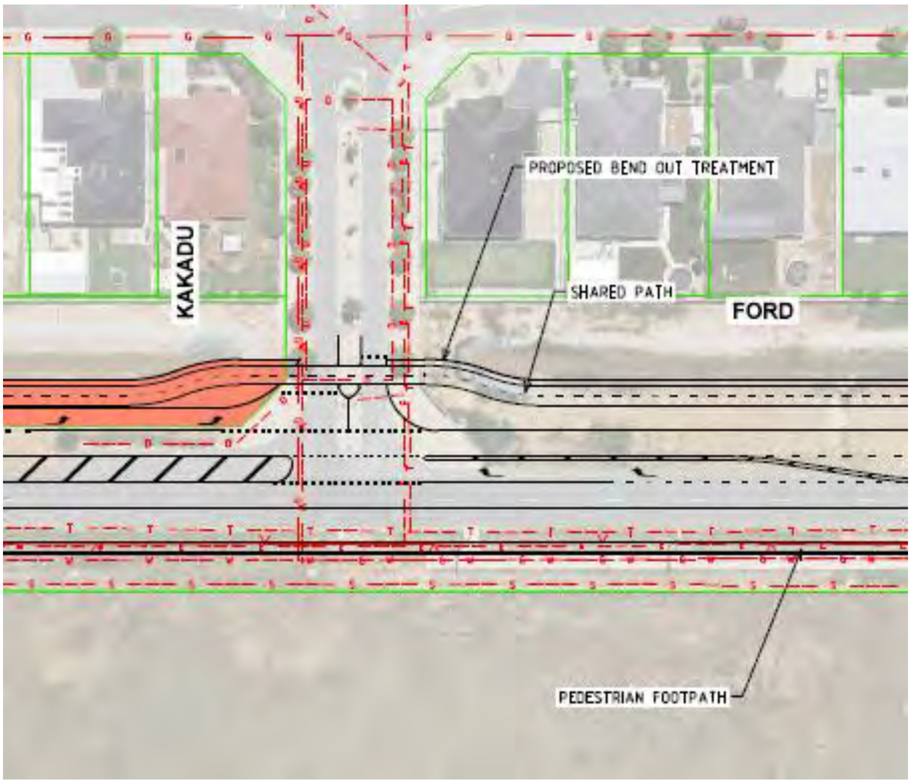
A full set of the concept level designs developed for the upgrade of Wanganui Road and Ford Road are provided in Appendix C, along with supporting swept paths to confirm critical vehicle movements.

6.4 Road Safety Audit

An independent Road Safety Audit has been undertaken by RSA of the concept level designs, which is included in Appendix D.

Based on the Audit, the majority of the identified potential safety issues relate to or will be able to be dealt with as part of the subsequent project design stages. However, treatment of the shared path crossings of the intersecting roads has been addressed through the updated concept design provided in Appendix C, where they now 'bend out' as shown in Figure 6.8.

Figure 6.8: Revised Shared Path Bend Out Treatment



7. Impact Assessments

7.1 Introduction

Various sub-consultants have been engaged to undertake assessments of various impacts that the upgrading of Wanganui Road and Ford Road will have. These impact assessments include the following:

- Environmental and Ecology
- Cultural and Heritage
- Acoustic Noise
- Landscaping
- Flooding
- Pavement Design

The associated reports for each of the sub-consultants are included in Appendix E, with their key findings and implications with the upgrading of Wanganui Road and Ford Road provided below.

7.2 Environmental and Ecology

Ecology and Heritage Partners Pty Ltd has conducted a desktop Flora and Fauna Assessment of proposed road upgrade of Wanganui Road and Ford Road. The purpose of the assessment was to identify the potential presence of significant ecological constraints such as remnant vegetation, and threatened species and ecological communities within the study area, and to provide important background information and site context prior to a field assessment.

This desktop assessment for the proposed development has identified several significant ecological constraints that have potential to be impacted, including:

- Suitable habitat for threatened ecological communities and species listed under the Environmental Protection and Biodiversity Conservation (EPBC) Act and Flora and Fauna Guarantee (FFG) Act
- Remnant native vegetation protected under the Victoria's Planning and Environment (P&E) Act and that would require a planning permit under Clause 52.17 of the local planning scheme.

Based on the information reviewed as part of this desktop assessment, development of both Ford Road and Wanganui Road has potential to require approval under the Commonwealth EPBC Act, and Victorian FFG Act, Environment Effects (EE) Act and P&E Act. Demonstration of compliance with the Catchment and Land Protection (CaLP) Act and *Wildlife Act 1975* is also required.

To clarify what permits and approvals are required for the project, a field assessment will be required including a habitat hectares assessment (DSE 2004) within the study area, and a survey to collect other site-based information to support a planning permit application to remove native vegetation. Contextual information on the value of habitat for significant species and ecological communities identified as having potential to occur would also need to be obtained.

A list of species that may require further field assessment depending on the availability of habitat is provided in Table 7.1. This list will be revised after the field assessment is completed. Survey effort should concentrate on the Wanganui Road section of the study area, which is likely to support more sensitive ecological values due its proximity to Reedy Swamp.

Table 7.1: Targeted Surveys that may be Required

Species	Methods	Habitat
Regent Honeyeater	Area search. Twenty hours of survey over 10 days in early to mid-morning (sunrise to 10 am) using call playback and visual searches preferably outside the breeding season when the species is more likely to be found in suitable habitat (DEWHA 2010a).	Woodland (Box-Ironbox E. leucoxylon dominated or associated)
Superb Parrot	Area search. Twelve hours of survey over 4 days in early to mid-morning (sunrise to 10 am) and evening (4pm to sunset). Using call playback and visual searches. Vehicle-based transects appropriate in areas where most habitat is restricted to roadside remnants. Survey effort will need to be increased outside the breeding season (DEWHA 2010a).	Nests in loose colonies in riparian woodland of river red gum Eucaluptus camaldulensis. Forages in box eucalypt woodland particularly that dominated by yellow box E. melliodora or grey box E. microcarpa.
Swift Parrot	Area search. Twelve hours of survey over 8 days in early to mid-morning (sunrise to 10 am) and evening (4pm to sunset). Using call playback and visual searches. Vehicle-based transects appropriate in areas where most habitat is restricted to roadside remnants. Survey effort will need to be increased outside the breeding season (DEWHA 2010a).	Flowering eucalypts during the species' migratory period from Tasmania to Box Gum Woodland vegetation north of the study area, from March to June.
Growling Grass Frog	Call-playback, spot-lighting and active searches on two non-consecutive nights between October and February when night-time temperatures are greater than 12°C and there is moderate or no wind.	Ponds, dams, drainage-lines or natural waterbodies preferably with fringing aquatic and semi-aquatic vegetation, and terrestrial habitat around these features.
River Swamp Wallaby-grass	Flowering and fruiting occurs mainly between November and March. As such surveys should occur during first flowering period (Summer). A detailed habitat assessment should be undertaken to determine the likelihood of the species presence.	Permanent swamps and also lagoons, billabongs, dams and roadside ditches.

Practical measures should be made where possible to reduce the ecological footprint of the study area. The footprints along Ford Road and Wanganui Road largely avoids modelled patches of native vegetation, although may impact scattered remnant trees. The proposed road-reserve easements are likely to impact contiguous patches of remnant native vegetation that may also support habitat for significant species (e.g. Regent Honeyeater, Superb Parrot and significant flora species).

A planning permit is required if areas supporting remnant native vegetation are proposed to be impacted. This includes scattered remnant trees where greater than 10% of the Tree Retention Zone is proposed to be impacted (DSE 2011).

7.3 Cultural and Heritage Implications

Ecology and Heritage Partners Pty Ltd has conducted a Preliminary Cultural Heritage Study (PCHS) for the proposed road upgrade of Wanganui Road and Ford Road. The purpose of the assessment was to identify Aboriginal and historical cultural heritage values that may be present within the study area. Information gathered throughout the assessment was used to determine potential legislative implications (associated with cultural heritage values) for the proposed Road Upgrade.

7.3.1 Aboriginal Cultural Heritage

Recommendation 1: Requirement for a mandatory CHMP

A Cultural Heritage Management Plan (CHMP) may be required for the study area, given that the current proposed works are a high impact activity. Given that the study area is located in multiple areas of Aboriginal cultural heritage sensitivity as defined by the Aboriginal Heritage Act

2006, a CHMP is typically mandatory. However, a CHMP will not be required by the Aboriginal Heritage Regulations if the following can be determined:

- *Part of a waterway or part of the land within 200 m of a waterway has been subject to significant ground disturbance, that part is not an area of cultural heritage sensitivity (r.23 [2]); and/or*
- *Part of a prior waterway or part of the land within 200 m of a prior waterway has been subject to significant ground disturbance, that part is not an area of cultural heritage sensitivity (r.24 [2])*

Due to the potential for significant ground disturbance (SGD) to be present within these areas of sensitivity, a CHMP may not be required. A Preliminary Aboriginal Heritage Test (PAHT) can be used to verify SGD, which, if certified by AV, would remove the requirement for a mandatory CHMP, as outlined as Recommendation 2 below.

Recommendation 2: Preliminary Aboriginal Heritage Test

The Preliminary Aboriginal Heritage Test (PAHT) provides sponsors with certainty about whether a CHMP is required for a proposed activity. The PAHT is a voluntary process, which allows for the Secretary to the Department of Premier and Cabinet (Secretary) to certify whether a CHMP is required for a proposed activity.

A person may be unclear whether an approved CHMP is required for a proposed activity in accordance with the requirements of the Aboriginal Heritage Act 2006 (Act) and the Aboriginal Heritage Regulations 2007 (Regulations). For instance, a sponsor may be unclear as to whether their proposed activity area has been subject to significant ground disturbance (see Practice Note: Significant Ground Disturbance which is available on the Aboriginal Victoria website and in Appendix 3).

In such cases, a person is able to prepare a PAHT to establish whether a CHMP is required for the activity. The PAHT can then be submitted to the Secretary, who must decide whether to certify the PAHT as correct within a 21-day evaluation period. The preparation of a PAHT for the study area may be able to utilise the results of this desktop assessment.

Recommendation 3: Proceed with a voluntary CHMP

Given that two previously registered Aboriginal places are located within 100m of the study area in addition to multiple areas of Aboriginal cultural heritage sensitivity, should future proposed works not be regarded as a high impact activity it is strongly recommended that the client undertake a voluntary CHMP. The preparation of a voluntary CHMP has the following advantages:

- No requirement for Cultural Heritage Permits at a later stage: there are no cultural heritage permit requirements in relation to a CHMP as long as you are acting in accordance with the CHMP. There is no requirement for an excavation permit or a permit to harm, or any of the other permit requirements. In effect, the approved CHMP is a permit. If Aboriginal cultural heritage is unexpectedly discovered during the activity, there is therefore no permit requirement if a CHMP has in place. Any unexpected Aboriginal cultural heritage is dealt with through contingency plans in the CHMP, already signed off and agreed to by RAP in the CHMP process.
- Increased certainty for your project: as there are no Cultural Heritage Permit requirements at a later stage, there is more certainty for the project. This certainty is provided during the planning phase, allowing the activity to remain unimpeded by cultural heritage legislation. A CHMP removes the activity from the harm provisions of

the Aboriginal Heritage Act 2006, as long as the proponent acts in accordance with the CHMP.

- Good Risk Management: rises and elevated areas and the margins of water courses are well documented as areas that retain Aboriginal cultural heritage sites in the general region. A voluntary CHMP could effectively investigate the area for any evidence of Aboriginal sites and minimise the risk that any significant Aboriginal sites would be impacted by the activity, which would cause delays and added expense to the construction process.

In the event that the client elects to pursue a voluntary CHMP, this must be undertaken by a qualified Heritage Advisor in association with relevant RAP. Any voluntary CHMP undertaken for the study area may be able to utilise the results of this desktop assessment.

7.3.2 Historical Heritage

To avoid potential impacts to historical heritage, the following recommendations are made:

- Conduct a Historical Heritage Assessment (HHA) to determine the nature and extent of H7921-0040 (Wanganui Homestead Complex), including an archaeological survey and further detailed historical research in addition to detailed design plans.
- Deploy landscaping approaches and planning measures to avoid impacts to sites, i.e. paths should avoid archaeological deposits and green spaces being planned to frame existing historic heritage.
- If impacts to the site cannot be avoided, Consent to Excavate from Heritage Victoria will be required prior to the commencement of works. The preparation of a Consent to Excavate will require consultation with Heritage Victoria in order to formulate the methodology of the initial investigation
- Consultation with Heritage Victoria should occur following the initial test excavation in order to determine any requirement for further archaeological works at the study area, i.e. open area excavation.
- If impacts to HO93 (Former Wanganui Homestead) cannot be avoided, a Planning Permit from Greater Shepparton City Council will be required.

These works should be undertaken by a suitably qualified Heritage Advisor in association with Heritage Victoria and/or Greater Shepparton City Council.

7.4 Acoustic Noise

Watson Moss Growcott has conducted an Acoustic Impact Assessment for the proposed road upgrade of Wanganui Road and Ford Road. The purpose of the assessment was to identify what the existing and future noise levels will be with the use of the road corridor, whether the resulting noise level is acceptable, and/or what measures could be used to mitigate the impact on abutting residents.

The proposed road upgrade does not strictly fit with what roads are typically covered by the VicRoads Traffic Noise Policy, but is considered to provide a desirable target, together with consideration of traffic noise level increases from the existing levels associated with the proposed upgrade.

In the future, Ford Road benefits from the 60 km/h speed limit and relatively low traffic volumes compared with Wanganui Road, and based on a road surface no noisier than what currently exists (i.e. a worn stone seal), noise modelling results for 2031 and 2041 remain below the 63 dB(A) L10 (18 hour) VicRoads Traffic Noise Policy target without any noise barriers. However, based on a comparison of the existing measured levels and modelled future levels, traffic noise levels would be expected to increase in the range 3-5 dB(A).

Changing to a fresh stone seal would likely increase noise levels by at least 2 dB(A). This would be enough to push some locations along Ford Road above 63 dB(A) L10 (18 hour), but the majority would remain below 63 dB(A). As such, a suitable pavement choice for Ford Road, such as an open graded asphalt road surface, should keep the resulting noise levels to a reasonable level.

At 15 Freemans Road and 80 Wanganui Road, predicted future noise levels of 65-66 dB(A) L10 (18 hour) are expected. These could be kept at or close to 63 dB(A) through the use of an open graded asphalt road surface without adding noise barriers, which are expected to reduce the modelled noise levels by about 2 dB(A).

The predicted increase in traffic noise level at 80 Wanganui Road is 12 dB(A) compared with the existing measured level. This is a significant increase, due to both the significant increase in traffic volume and movement of the nearest traffic lane closer to the house. This magnitude of noise level increase is equivalent to a perceived doubling of loudness.

Noise barriers could be provided at 80 Wanganui Road, but need to ensure access to the property from Wanganui Road is maintained. As such, any noise barriers would require gaps, which would reduce their effectiveness, but would still provide a noise reduction.

7.5 Landscape Masterplan

McGregor Coxall has developed a landscaping masterplan for the entire length of the road corridor. Given the linear nature of the corridor, the following approach around five ribbons has been developed and able to be visually seen in their associated report in Appendix E:

- Pink Ribbon - Culture and Community: looks to provide opportunities for and link small moments of community life along the road corridor.
- Green Ribbon – Tree Canopy and Ground Cover: As per the Council's Urban Forest Strategy, increasing the tree canopy that helps create bio habitats and define quality of spaces is desired. However, this needs to be balanced against safety implications, as set out in the VicRoads Tree Policy.
- Blue Ribbon – Water Management: With Shepparton and its surrounds being shaped by water, connecting and extending these systems as part of the project helps achieve a number of environmental and amenity benefits.
- Yellow Ribbon – Shared User Path: Encouraging the use of active transport modes is proposed through a series of 'hubs' that provide users with supporting facilities and resting areas.
- Black Ribbon – Road Network: The design of the road carriageway will provide a clear delineation between the above ribbons and other corridor elements.

The Landscape Masterplan is only indication of what is potentially possible to provide along the road corridor. But it is considered to be a critical element in ultimately providing a facility that benefits the community. Roads are important, but can have negative community impacts, especially from an amenity and environmental perspective. As such, the implementation of a high-quality landscaped environment can off-set these negative impacts, if not actually provide an improved environment to what currently exists.

7.6 Flood Modelling

Water Technology has conducted Flooding Modelling for the proposed road upgrade of Wanganui Road and Ford Road. The purpose of the modelling is to understand what the implications of the resulting road structures will have on flooding in the area and how to best maintain access to the proposed arterial roads in a 1% AEP flood event.

Based on the flood modelling, it has been identified that Wanganui Road, especially for an 800m length to the east of Kittles Road, would be under the 1% AEP flood level if the existing road level is maintained.

As such, the following options have been put forward as part of the proposed road upgrade of Wanganui Road and Ford Road:

Option 1: Achieve Full Access in a 1% AEP Flood Event

This will require the construction of a large bridge section (800 metres in length that will sit above the 1% AEP flood level (AustRoads/ VicRoads Design standards require 1 m freeboard above 1% AEP flood level). This provides access to Wanganui Road in a 1% AEP Event. If 1 m freeboard is required, then bridge height would 1.5 -2.0 m higher at its highest point. This will also raise the eastern section (east of Freemans Road) to be above 1% AEP flood level ~111.5 m AHD.

Option 2: Achieve Access to Shepparton Bypass On-Ramp in a 1% AEP Flood Event

This is to maintain the existing Wanganui Road level to the west of the on-ramp to the proposed Shepparton Bypass, but incorporate a ford crossing of 150 m in line with the existing floodway to the south and raise the eastern section (east of Freemans Road) to be above the 1% AEP flood level ~ 111.5 m AHD. This scenario will allow the Shepparton Bypass to still be accessed from Wanganui Road. However, the full length of Wanganui Road will not be able to be accessed during 1% AEP (traffic who come from south on the Shepparton Bypass will not be able to directly access Wanganui Road, they will need to go up north to Goulburn Valley Highway and travel south down to it).

At this stage, Option 1 has been adopted as part of this feasibility study, but further investigations and consideration of the suitability of both options is expected as part of subsequent design stages. It is also noted that the on and off-ramps for Shepparton Bypass may have an impact on flooding if a typical land banked arrangement is used, which is also going to be investigated further.

7.7 Existing Pavement Evaluation and Pavement Design

Graham Foley & Associates has completed a geotechnical investigation of the existing pavement condition and advised on what pavement composition will be required to support the future traffic loadings and other factors as part of the proposed upgrade of Wanganui Road and Ford Road.

7.7.1 Activities

The activities undertaken to inform the advice included the following:

- Detailed inspections of Wanganui Road and Ford Road in Shepparton from Golf Drive in the west to Grahamvale Road in the east, over a distance of approximately 6 km
- Deflection testing in both wheel paths in both lanes over the full length as described above of Wanganui Road and Ford Road
- Geotechnical investigations at selected sites along Wanganui Road and Ford Road.

DRAFT

7.7.2 Findings

Interpretive analysis of the above three tasks has been undertaken to assess the structural adequacy of these pavements to sustain substantially heavier loading should these roads serve as part of a heavy vehicle bypass of Shepparton.

The report concludes that substantial works are required to increase the structural capacity of both pavements.

A pavement design has also been prepared for the intersection of these roads with the Goulburn Valley Highway.

7.7.3 Recommendation

It is recommended that deep strength asphalt pavement be selected over granular pavement due to following reasons:

- Reduced ongoing maintenance costs
- Less noise
- Best performance with heavy vehicle loadings, especially turning movements

Specific details on the make-up (depths) of the pavement required to support the proposed future traffic loadings are below:

Wanganui Road

Golf Road to Kittles Road:

- Size 14 Type H asphalt – 40mm
- Size 20 Type SS asphalt – 75mm
- Size 20 Type SF asphalt – 75mm
- 3% CTCR (Class 3 CR)(VR current) – 180mm
- Class 4 CR (VicRoads current) – 150mm
- *Total - 520mm*

Kittles Road to Goulburn Valley Highway:

- Size 14 Type H asphalt – 40mm
- Size 20 Type SS asphalt – 110mm
- Size 20 Type SF asphalt – 70mm
- 3% CTCR (Class 3 CR)(VR current) – 180mm
- Class 4 CR (VicRoads current) – 150mm
- *Total - 550mm*

Goulburn Valley Highway, Ford Road, and Wanganui Road intersection:

- Size 14 Type V asphalt – 40mm
- Size 20 Type SS asphalt – 140mm
- Size 20 Type SF asphalt – 75mm
- 3% CTCR (Class 3 CR)(VR current) – 180mm
- Class 4 CR (VicRoads current) – 150mm
- *Total - 585mm*

Ford Road

Goulburn Valley Highway to Verney Road:

- Size 14 Type H asphalt – 40mm
- Size 20 Type SS asphalt – 85mm

- Size 20 Type SF asphalt – 75mm
- 3% CTCR (Class 3 CR)(VR current) – 180mm
- Class 4 CR (VicRoads current) – 150mm
- *Total - 530mm*

Verney Road to Grahamvale Road:

- Size 14 Type H asphalt – 40mm
- Size 20 Type SS asphalt – 80mm
- Size 20 Type SF asphalt – 75mm
- 3% CTCR (Class 3 CR)(VR current) – 180mm
- Class 4 CR (VicRoads current) – 150mm
- *Total - 525mm*

It is noted that the type V asphalt wearing course need to be provided within the intersection along 80m of approach, within the intersection and 30m of departure.

8. Concept Design Costings

8.1 Introduction

A risk based cost estimate has been completed for the expected construction works shown in the concept level designs, together with information received from the various service authorities.

For convenience of funding and potential work packages, the proposed works have been costed as per following sections:

i Wanganui Road (Golf Drive to Goulburn Valley Highway)
ii Goulburn Valley Highway/ Wanganui Road/ Ford Road intersection
iii Ford Road (Goulburn Valley Highway to Grahamvale Road)

P90, P50 and Total Estimated Investment (TEI) cost estimates for the proposed works have been derived as per the following notes:

- P90 represents the project cost with sufficient risk provisions to provide a 90% level of confidence in the outcome, i.e. that there is a 90% likelihood that the project cost will not be exceeded.
- P50 represents the project cost with sufficient risk provisions to provide a 50% level of confidence in the outcome.
- TEI represents the project cost with sufficient risk provisions to provide a state overhead cost for the project.

8.2 Process

The VicRoads risk-based cost estimate spread sheet (Version 8.0 – May 2014) was used to evaluate the construction cost of the proposed road works. This spread sheet was setup to run the Monte Carlo simulation.

The risk profile for quantity of works and rates will predominantly be selected on available information. The general risk profile for quantities is -5% to +30% and unit rates -10% to +30%. However, given the greater level of unknown, the expected service relocation and protection risk profile rates vary between -5% to 40%.

The P90 and P50 cost estimates were calculated based on the applied risk profile for the identified quantities and rates.

TEI has been calculated based on the P90 estimate, with a 4% of state cost and a 0.7% on cost (unsuccessful proposal).

8.3 Key Inputs and Rates

The majority of the proposed construction works relate to new pavement construction, traffic signal intersection works, bridge and culvert works, and railway track works at the level crossing. In this regard, the following key cost inputs have been adopted:

i Pavement works - $180 - $200/m^2
ii Traffic signal intersection works - $350,000 - $500,000 / intersection
iii Bridge and - $3.5M to $5.0M at Grahamvale Road / Ford Road intersection
iv Culvert works across Wanganui Road adjacent to Freemans Road - $800,000
v Railway track works - $1.0 - $1.4M (on east approach)

vi The average cut depth of 0.4m and fill height of 0.3m was considered in order to calculate the earth works volume.

Services relocation and/or protection costs have been broadly estimated at this time i.e. based on the various discussions with authorities, DBYD information and other project experiences. It is noted that GTA did note formally receive cost estimates from the relevant authorities as part of this feasibility study.

Given the above, it is recommended that formal quotes be obtained from the following service authorities based on the preliminary design arrangements in order to obtain a more informed understanding of extents of works and the associated costs. The most appropriate time to do this would be when further design work is completed:

i Powercor
ii Telstra
iii Nextgen (Communication service)
iv Water
v Gas
vi Sewer
vii Irrigation channel protection

8.4 Cost Estimates

Road Construction

Given the above the P90, P50 and TEI cost estimates for the proposed construction works to upgrade Wanganui Road and Ford Road as part of Stage 1 of the Shepparton Bypass are presented in Table 8.1.

Table 8.1: Road Construction Cost Estimates

Section	Total Estimated Investment (TEI)	P50 Estimate	P90 Estimate
Wanganui Road (Golf Drive to Goulburn Valley Highway)	$46.42M	$42.38M	$44.24M
Goulburn Valley Highway/ Whanganui Road/ Ford Road intersection	$8.93M	$8.12M	$8.51M
Ford Road (Goulburn Valley Highway to Grahamvale Road)	$45.29M	$41.40M	$43.16M
Total	$100.64M	$91.90M	$95.91M

Landscaping

It is noted that at this time a provisional allowance for landscaping works has been included in the above costing and it equates to approximately 10% of the total cost. We would expect that this cost is generally consistent with the level of landscaping proposed through the Landscape Masterplan discussed in Section 7.5.

Road Construction Escalations

An escalation rate of 4%p.a. has been assumed for the next five years in Table 8.2. This is an average escalation rate based on material obtained from Department of Transport, Planning and Local Infrastructure in 2012 and 2013. More current escalation rates were not able to be obtained from the department at the time of this reports preparation.

Table 8.2: Cost Escalation Estimates

Financial Year	Escalation Index	Escalation amount (TEI)	Escalation amount (P50)	Escalation amount (P90)
2017/2018	0%	$100.64M	$91.90M	$95.91M
2018/2019	4%	$104.67M	$95.58M	$99.75M
2019/2020	4%	$108.85M	$99.40M	$103.74M
2020/2021	4%	$113.21M	$103.38M	$107.89M
2021/2022	4%	$117.73M	$107.51M	$112.20M

Full set out of the cost estimates is provided in Appendix F.

8.5 Next Steps (Business Case)

The next step towards delivery of the proposed bypass involves the preparation of a business case, as per the Department of Treasury and Finance (DTF) processes. Given the likely whole of life value of the road project, this project would be classified as "High Value High Risk" (HVHR) according to DTF and VAGO guidelines, and hence would require some additional levels of analysis and business case development to support a successful outcome.

To progress this feasibility study to a (HVHR) strategic or detailed business case for funding, a number of elements need to be completed and submitted to VicRoads/DEDJTR and DTF. These would be expected to include:

- Completion of an Investment Logic Map (ILM) and Benefits Management Plan (BMP) via 2 x 2 hour workshops to define and clarify the project needs, expected outcomes (benefits) and likely interventions, and how they might be ranked.
- Overview of the 'business as usual' base case where no capital investment is made, and the evidence which supports the predictions of the base case.
- Overview of the strategic options which were considered in meeting the project needs, and the basis for selecting a preferred strategic approach.
- Review of policy and strategy alignment of addressing the problem / service need.
- Overview of the project-specific options (or solutions) which were then developed, and the basis for selecting a preferred, either on the basis of Cost Benefit Analysis or Cost Effectiveness analysis (this will involve review / extension of the CBA/CEA undertaken thus far, which was limited to travel time and safety impacts, as well as a detailed cost estimate and financial cash flows for the preferred option).
- List what stakeholders were engaged, why they are relevant and what they said.
- Develop project implementation advice, including:
  - risk analysis of the project for both detailed planning and delivery, highlighting pre-mitigation and post-mitigation risks, their level of materiality and responsibility for the risk outcomes
  - project governance advice, detailing the roles and responsibilities of various parties in delivering the project to a high degree of quality, cost and schedule certainty
  - procurement and delivery model advice which will support delivery of the project according to a preferred time / cost / risk outcome.

The development of such a business case typically takes 2-4 months. However, given the material already assembled above, it could be expected to be towards the lower end of this range, noting that detailed designs and costings would also need to be prepared to suitably inform the business case.

Appendix A

Safe System Assessment – Intersection Selection

Safe System Assessment

FORD RD / WANGANUI RD / GVH
FORD RD / VERNEY RD
FORD RD / GRAHAMVALE RD

Report for Greater Shepparton City Council and VicRoads

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Information Page

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1 Executive Summary

The Safe System is a road safety philosophy that requires roads to be designed and managed so that crash-related death and serious injury are avoidable.

A Safe System Assessment is a safety examination of a road-related program, project or initiative carried out using the *AP-R509-16 Austroads Safe System Assessment Framework,* which has the following characteristics:

Type: Existing conditions and proposed works
Method: Assessment team – investigation, site inspection
Depth: Road safety expert assessment (Level 3)

For this project the Safe System Assessment evaluated the current intersections:

1. Goulburn Valley Highway, Wanganui Road and Ford Road;
2. Ford Road and Verney Road; and
3. Ford Road and Grahamvale Road.

The assessment also looked at two main options for each intersection, which are traffic signals or a roundabout.

Assumptions were made as part of this assessment which are documented in the assessment.

The Safe System Matrix score for each option – with the lower score being better - is shown in table 1. The table also shows the score that would be achieved if the recommendations from the Safe System Assessment (SSA) were to be incorporated.

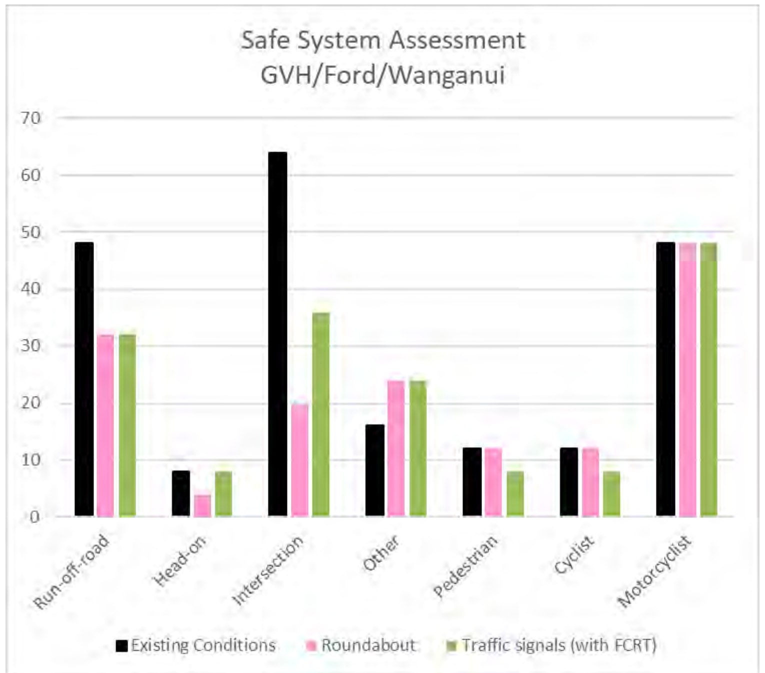
Table 1 Matrix Score

Option	GVH/Wanganui	Ford/Verney	Ford/Grahamvale
1. Existing Conditions	208.0 / 448	56.0 / 448	198.0 / 448
2. Traffic Signals (with FCRTs)	164.0 / 448	62.4 / 448	143.5 / 448
3. Roundabouts (1-Lane, except GHV/Wanganui, which required 2-Lanes)	151.6 / 448	59.0 / 448	83.9 / 448

While roundabouts have been identified as having the greater alignment with Safe System principles at these locations, it should be noted that if cyclist and/or pedestrian volumes significantly increase the Safe System alignment may skew towards traffic signals. It should also be noted that the score difference for Ford Road and Verney Road is so close that it can be considered that either a roundabout or signals will perform with the same Safe System alignment.

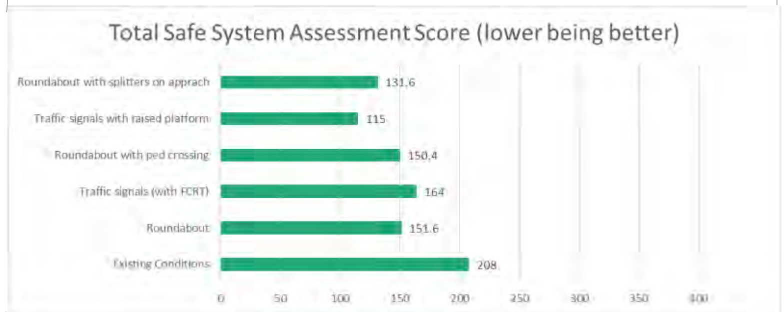
Consistency of treatment may factor into the decision making for Ford Road/Verney Road. As the difference between a roundabout and traffic signals is very small, a roundabout should be considered.

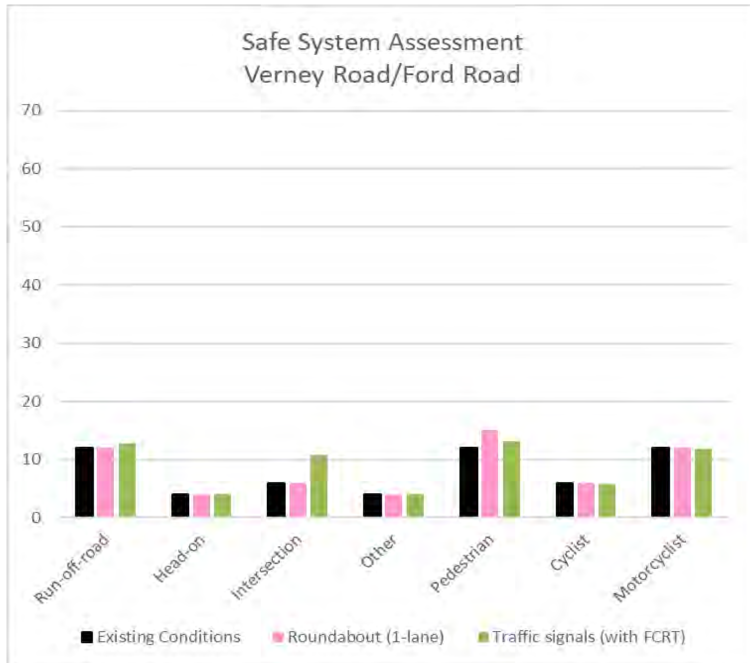
Presented on the next page is a graphical representation of the alignment with Safe System principles (with lower scores being more favourable).



164.0 / 448

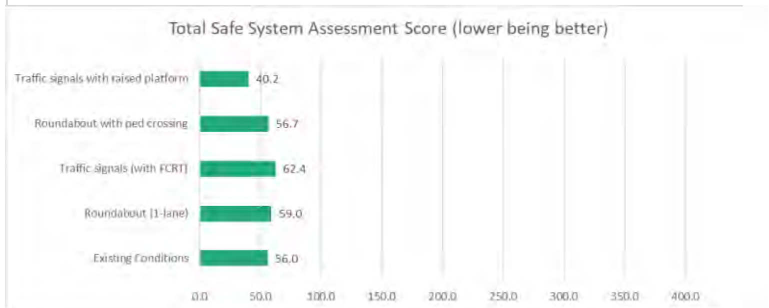
151.6 / 448 (Better Safe System Alignment)

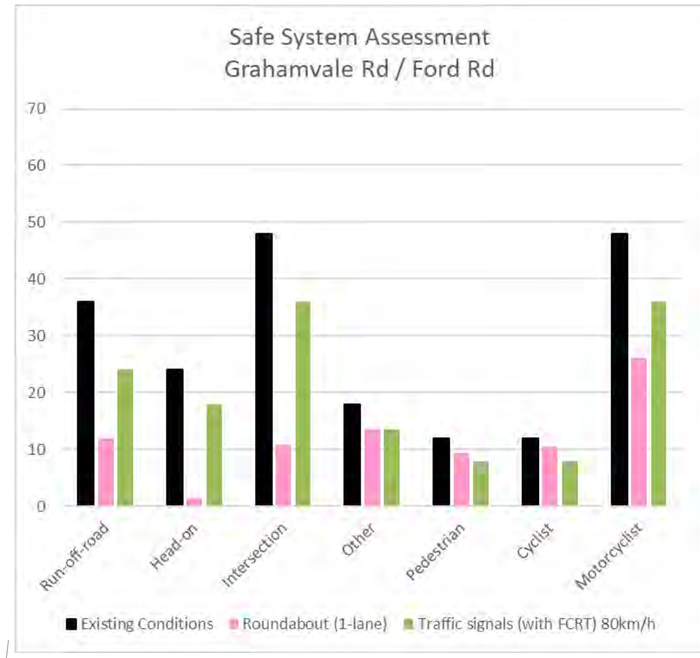




62.4 / 448 (Too close to call)

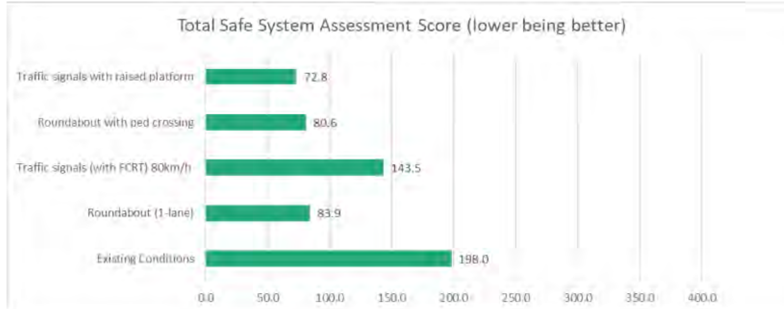
59.0 / 448 (Too close to call)

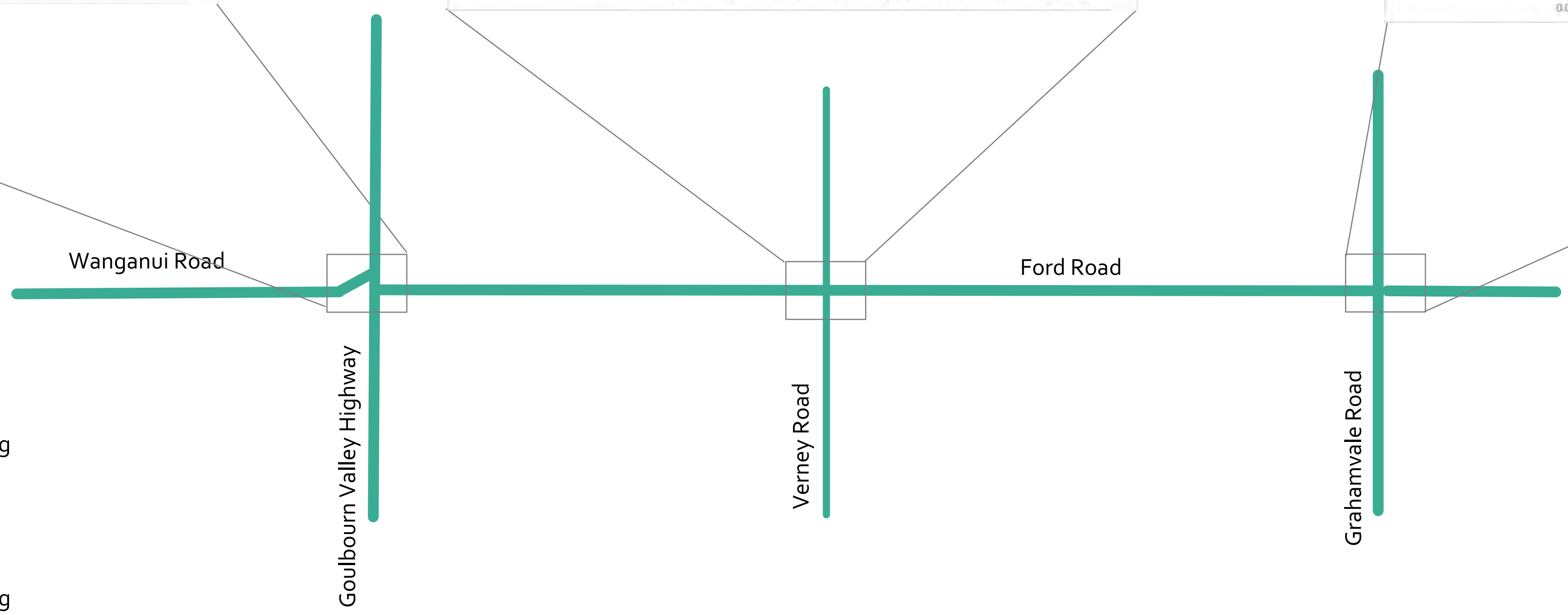




143.5 / 448

101.6 / 448 (Better Safe System Alignment)





Assumptions:

Traffic signals with fully controlled right turn (FCRT) on all legs. Designed as per GTA's drawings. Low pedestrian growth. Low cycling growth. 10 year forecast assumed, except Verney/Ford Road.

2 lane roundabout designed as per GTA's drawings. Low pedestrian growth. Low cycling

Other factors separately examined included:

- Safe road users
- Safer vehicles
- Advanced vehicle technology
- Maintenance and post-crash response and care

A series of recommendations have been made for both a roundabout and traffic signals to move both of them to better alignment with Safe System principles. If these recommendations are taken on, both traffic signals or a roundabout are considered to have good alignment with Safe System principles. These are listed below.

This Safe System Assessment provides a series of recommendations/options for the three intersections for both traffic signals or roundabouts to move the Project further Towards Zero.

Recommendations/options:

Primary Treatments:

Traffic Signals:

Consider:

- If traffic signals are installed as the intersection control, consider installing raised platforms or other devices to achieve a design speed of 50km/h.
- While conflicting with the function of these roads, to achieve primary Safe System for pedestrians crossing the road, the speeds would need to be reduced to 30km/h at all crossing points. Alternatively, a separated facility would be required (ie. an underpass or overpass). It is noted that the likely pedestrian volumes will be low at all crossing locations, except Verney/Ford.
- Reconsider the need for slip lanes at the signalised intersections. Crashes occur when vehicle drivers are looking to their right for gaps in traffic rather than concentrating on pedestrians. If slip lanes are required, ensure that there are acceptable sight lines to the pedestrian crossing location and that the crossing point is raised to lower vehicle speeds (ie. Wombat Crossing).
- Consider the design specific recommendations in Appendix G.

Roundabout:

Consider:

- Installing a single lane roundabout and accept a small level of congestion during some hours of peak traffic volume.
- Installing separators/splitters on the approach to the intersection to minimise 'straight lining' through the two-lane roundabout at GVH/Wanganui (see example design in Appendix H).
- Consider the addition of signalised pedestrian crossings on pedestrian desire lines.
- See design specific recommendations in Appendix G.

Supporting Treatments:

Traffic Signals:

Consider:

- If the intersection is not raised and supplemented with advisory speeds, consider adjusting the regulatory speed limit on Grahamvale Road to 60km/h on the approach to the intersection. Consider extending the 60km/h speed limit on the GVH to the north, and on other roads implementing speed limit reductions to 60km/h if traffic signals are being implemented.

- Ensure that the traffic signals at Grahamvale Road are linked to the railway level crossing to eliminate the possibility of a stacking issue.
- Even with the signal linking, add measures to ensure that a vehicle trapped on the level crossing could 'escape' if required.
- If traffic signals are installed without raised safety platforms, consider designing the intersections so that raised platforms can be easily installed in the future.
- If traffic signals are installed without raised safety platforms, consider designing the intersections so that speed and red light cameras can be easily installed in the future, or consult with the Department of Justice to ascertain if they can be installed as part of the project.
- See design specific recommendations in Appendix G.

Roundabout:

Consider:

- If pedestrian signals are not installed, consider designing pedestrian crossing points so that they can be retrofitted with traffic signals.
- Consider using Danish Offset (aka Z-Crossing) crossings.
- Consider installing cycling crossing points on the roundabout (see example in Appendix H)
- See design specific recommendations in Appendix G.

Other Safe System Elements:

Consider:

- Consider working with the main heavy vehicle operators to ensure that they have undertaken the Heavy Vehicle Rollover Program and they understand the risks of heavy vehicles rolling over at roundabouts.

Table of Contents

2 List of Acronyms

AADT – Annual Average Daily Traffic

FCRT – Fully Controlled Right Turn

GVH – Goulburn Valley Highway

SSA – Safe System Assessment

VMS – Variable Message Sign

WRSB – Wire Rope Safety Barrier

3 List of Figures and Tables

3.1 Figures

3.2 Tables

4 Background

4.1 The Safe System

The Safe System is a road safety philosophy that requires roads to be designed and managed so that crash-related death and serious injury are avoidable. The basic principles are:

1. Humans are fallible, and will inevitably make mistakes when driving, riding or walking.
2. Despite this, road trauma should not be accepted as inevitable. No one should be killed or seriously injured on our roads.
3. Consequently, to prevent serious trauma, the road system must be forgiving so that the forces of collisions do not exceed limits that the human body can tolerate.

In Victoria, the Safe System is represented by the diagram in Figure 1.

Figure 1: The Safe System

The Safe System is divided into five core interrelated components shown in Figure 2.

Figure 2: The Components of the Safe System

4.2 Safe System Assessment

A Safe System Assessment is a safety examination of a road-related program, project or initiative. The procedure for undertaking a Safe System Assessment is outlined in *AP-R509-16 Austroads Safe System Assessment Framework*. The Assessment can be undertaken on any of the following:

- An existing road, intersection or length;
- A road investment project, whether at feasibility, design or pre-opening stages;
- A community road safety program or application for funding;
- A road transport policy, strategy or operating procedure.

These assessments are carried out by a specialist, independent and qualified team that considers each of the core components of the Safe System.

4.3 Type and Depth of Assessment

Assess objectives

- Purpose
- Scale
- Depth

Safe System Assessments can be carried out to assess existing conditions or a future project, they can also be undertaken to compare two or more options.

Safe System Assessments can be conducted by a suitably qualified individual, a team or through a workshop. The depth of investigation can also vary from an in-depth assessment to an expert-opinion based assessment.

This Safe System Assessment has the following characteristics:

Type: Existing conditions and proposed works
Method: Assessment team – investigation, site inspection
Depth: Road safety expert assessment (Level 3)

4.4 Assessment Team or Group

Industry practice is to undertake Safe System Assessments as follows:

Level 1: Desktop Safe System Assessment
- Undertaken by an individual or a small team
- Participants can be part of the project team (eg. the designer, engineer, etc.)

Level 2: Workshop Safe System Assessment
- Undertaken by a group including the project team and Safe System experts
- Workshop is facilitated to assess aspects of the project and their alignment with the Safe System

Level 3: Independent Safe System Assessment
- A team of independent Safe System experts assess the project in consultation with the project team

This **Level 3** Safe System Assessment was conducted by:
- **Kenn Beer** (BEng, MPIA), Principal, Safe System Solutions Pty Ltd
- **Reece Gunther** (BEng), Safe System Design Engineer, Safe System Solutions Pty Ltd

At the time of this assessment, there is no formal accreditation process for Safe System Assessments.

4.5 Site Inspections and Meetings

Site inspections and meetings associated with this Safe System Assessment is provided in Table 2 below.

Table 2 Inspections and/or Meetings

ACTIVITY	LOCATION	DATE	TIME
Site visit 1	Ford Road	06/10/2017	1400-1445
Initial meeting	Shepparton City Council Offices	06/10/2017	1500 - 1600
Site visit 2	Ford Road	06/10/2017	1600-1800
Workshop to present initial/draft findings	Shepparton City Council Offices	23/10/2017	1500 - 1700

5 Assessment Framework

5.1 Process

The Safe System Assessment has been conducted for the existing conditions for the design of intersections for the following intersections:

1. Goulburn Valley Highway, Wanganui Road and Ford Road;
2. Ford Road and Verney Road; and
3. Ford Road and Grahamvale Road.

The application of the Safe System Assessment process considers likely and foreseeable crash types, particularly in relation to trauma forces that result from such crashes.

5.2 Project Background

The Goulburn Valley Highway is an integral transport route connecting the Goulburn Valley Region with Melbourne and forms a vital link in the national highway system between Melbourne and Brisbane.

Greater Shepparton has seen growth in parts of Goulburn Valley Highway and can no longer cater for the large and increasing volumes of traffic that use the Highway daily.

According to VicRoads, in 2016, the full 36km four-lane Shepparton Bypass was estimated to cost approximately $1.3 billion. The project has therefore been split into six stages in order to obtain funding to get the project underway, including a single carriageway each way in the first instance.

Stage 1 will construct 10 km of road from the Midland Highway extending northwards along Excelsior Avenue and Cornish Road to Echuca Road, then east to Wanganui Road where it would rejoin the Goulburn Valley Highway in Shepparton North.

The recent $10.2 million investment will go towards planning, land acquisition and upgrade the intersection of Goulburn Valley Highway at Ford Road and Wanganui Road, Shepparton associated with realising Stage 1 of the bypass.

Ford Road will serve as a critical link between Stage 1 of the Bypass and the Shepparton Alternate Route (Grahamvale Road and Doyles Road).
The Goulburn Valley Highway / Wanganui Road / Ford Road intersection will accommodate significant traffic volumes in the future with the implementation of Stage 1 and proposed levels of development in the area.

5.2.1 Existing Conditions:

Goulburn Valley Highway/Wanganui Road/Ford Road Intersection:

Wanganui Road

Wanganui Road is 3.25km long and extends between Goulburn Valley Highway to the east and Golf Drive to the west. Its entire length forms part of the study area. Also, it functions as a local council road but is located within a Road Zone (Category 2) in the Greater Shepparton Planning Scheme, , i.e. connection to Stage 1 of the Shepparton Bypass and Alternate Route.

Wanganui Road is a two-way semi-rural road aligned in an east-west direction and configured with a two-lane, 8.0 metre wide carriageway set within a 20 metre wide road reserve (approx.).Wanganui Road carries approximately 2,200 vehicles per day and has a speed limit of 80kmh along its entire length. There are two minor roadways and 26 property access points that intersect Wanganui Road, many of which are unsealed. The only intersecting road along its length that provides wider network connectivity is Rudd Road, noting that this road also provides access into the residential area to the south west. As such, the majority of the traffic that currently uses Wanganui Road accesses it from Goulburn Valley Highway at its eastern end.

Ford Road

Ford Road is 5.35km long and extends between Goulburn Valley Highway to the west and Lemons North Road to the east. Only the 2.65km section between Goulburn Valley Highway and Grahamvale Road (western end) forms part of the study area. Also, Ford Road is designated as a local council road, however between Verney Road and Grahamvale Road, Ford Road is located within a Road Zone (Category 2) in the Greater Shepparton Planning Scheme, , i.e. connection to Stage 1 of the Shepparton Bypass and Alternate Route.Ford Road is currently a two-way semi-rural road aligned in an east-west direction and configured with a two-lane, 9.0m wide carriageway set within a 20m wide road reserve (approx.). It has a 60km/h speed limit and carries approximately 3,000 vehicles per day.

There are five minor roadways and 22 property access points that intersect with Ford Road, with a mix of sealed and unsealed crossings. The main intersecting road along its length that provides broader network connectivity is Verney Road, but other roads are expected to so as well, as part of the adjacent growth areas and residential developments.

Goulburn Valley Highway

A major arterial route that connects the Goulburn Valley Freeway to the south through central Shepparton and continues north to the Murray Valley Highway. It provides a major freight link and forms part of the B-Double road network. This road intersects the study area at the staggered cross intersection between and where the east-west roads change names from Wanganui Road to Ford Road. The following provides a more brief list of the existing conditions of the Goulburn Valley Highway intersecting Ford/Wanganui Road.

- Unsignalised Intersection
- Goulburn Valley Highway (North bound)
    - Left turn slip lane into Wanganui Road
    - Dedicated right turn lane into Ford Road North bound; give way on approach
    - Dedicated through lane North bound
- Goulburn Valley Highway (South bound)
    - Left turn slip lane into Ford Road South bound
    - Dedicated through lane South bound
    - Dedicated right turn lane into Wanganui Road; give way on approach
    - Left turn Slip lane into Numurkah Road (Service road)
    - Dedicated Right lurn lane into Numurkah Road (Service road); give way on approach

Speed limit: 60km/h along Goulburn Valley Highway (although the 60km/h speed limit starts very close to the intersection of Ford Road), 80km/h along Wanganui Road and 60km/h along Ford Road.

Ford Road / Verney Road Intersection:

- Single lane roundabout
- Speed limit: 80km/h along Verney Road, transitioning to 60km/h toward approach

Ford Road / Grahamvale Road intersection:

- Staggered T-intersection
- Railway crossing on Ford Road (West bound)
- Speed limit: 80km/h along Grahamvale Road

5.2.2 Original Designs:

Goulburn Valley Highway/Wanganui Road/Ford Road Intersection

Signalised Intersection:

The Goulburn Valley Highway / Wanganui Road / Ford Road intersection will accommodate significant traffic volumes in the future with the implementation of the Stage 1 of the Shepparton Bypassand proposed levels of development in the area. As such, and until more detailed traffic analysis is completed, the following facilities are proposed as part of the intersection layout:

- Left-turn slip lanes on each approach
- Continuation of the duplication of Goulburn Valley Highway through the intersection
- Realignment of Wanganui Road and Ford Road to form a standard cross-intersection
- Two through lanes on each approach and departure (noting the Wanganui Road and Ford Road approaches will taper back to one-lane in each direction a suitable distance from Goulburn Valley Highway)
- Right-turn lane on each approach.

Roundabout Intersection 1:

- Multilane roundabout

Roundabout Intersection 2:

- Multilane roundabout
- Deflected alignment on east side of roundabout

Ford Road / Verney Road Intersection

Signalised Intersection:

The Ford Road / Verney Road intersection will accommodate moderate traffic volumes in the future (majority along Ford Road) with the implementation of Stage 1 of the Shepparton Bypassand proposed levels of development in the area. It is also noted that shared paths will connect at this intersection, with an existing facility on Verney Road to the south and one proposed along the length of Ford Road. As such, the following facilities are proposed as part of the intersection layout:

- Two through lanes on Ford Road approaches and departures that taper back to one-lane in each direction a suitable distance from Verney Road
- Right-turn lane on each approach.

Roundabout Intersection:

- Single Lane/Multilane roundabout

Ford Road / Grahamvale Road intersection

Signalised Intersection:

The Ford Road / Grahamvale Road intersection will accommodate significant traffic volumes in the future (with the exception of the east approach) with the implementation of the East-West Link and proposed levels of development in the area. As such, the following facilities are provided in the design:

- Left-turn slip lanes on the south and west approaches (i.e. traffic volumes to and from the east approach are expected to be low)
- Dedicated left turn lane from north approach
- Realignment of the east and west approaches to form a standard cross-intersection
- Separate through and right-turn lanes on each approach, except for the east approach (also allows phasing to isolate the east approach when the boom gates on the rail line are down).

Roundabout Intersection:

- Single Lane/Multilane roundabout

As discussed during the project team workshop on 23 October 2017, it is expected that a single lane roundabout will be sufficient at this time, but ability to be converted to a two-lane roundabout should be allowed for..

Figure 3: Map showing location of site under assessment (note: not the ultimate design) (source: whereis.com)

5.3 Context of Assessment

Project context

- Project objectives
- Road function
- Speed environment
- Road users
- Vehicles

Table 3 Austroads AP-R509-16 Prompts

Austroads AP-R509-16 Prompts	Comments
What road users are present? Consider the presence of elderly, school children and cyclists. Also note what facilities are available to vulnerable road users (e.g. signalised crossings, bicycle lanes, school zone speed limits, etc.).	• Majority of road use is expected to be passenger vehicles • Low volumes of cyclists and pedestrians expected on road and roadside (with the exception of Verney/Ford). • Medium/High volume of heavy vehicles expected • Development including a shopping centre proposed on the SE corner of GVH/Ford Rd. • School on the south side of Ford Road and significant residential.
What is the function of the road? Consider location, roadside land use, area type, speed limit, intersection type, presence of parking, public transport services and vehicle flows. What traffic features exist nearby (e.g. upstream and downstream)?	• Goulburn Valley Highway is a major arterial road. • The surrounding area is primarily classified as residential • The speed limit along the subject section of the Goulburn Valley Highway is 60km/h. • The speed limit along the subject section of Wanganui Road is 80km/h and Ford Road is 60km/h • Types of existing and proposed intersections within the project length are detailed in section 5.2 • No parking is present or proposed along the roadside
What is the vehicle composition? Consider the presence of heavy vehicles (and what type), motorcyclists and other vehicles using the roadway.	• More than 30,000 traffic movements per day including 10% heavy vehicles. • Standard composition of motorcyclists expected (1%).
What is the reason for the project? Is there a specific crash type risk? Is it addressing specific issues such as poor speed limit compliance, road access, congestion, future traffic growth, freight movement, amenity concerns from the community, etc.	• The project aims to improve safety, access and traffic movements, also addressing future traffic growth and reducing through traffic though the town centre in terms of safety and efficiency.

5.4 Austroads AP-R509-16 Matrix

In order to ensure that Safe System elements are considered, or to measure how well a given project (e.g. an intersection, road length, area, treatment type etc.) aligns with Safe System principles, a Safe System matrix is used. The purpose of the matrix is to use a risk assessment approach to assess different major crash types (those identified as the predominant contributors to fatal and serious crash outcomes) against the **exposure** to that crash risk, the **likelihood** of it occurring and the **severity** of the crash should it occur. These three attributes form the rows of the matrix.

The columns of the Safe System matrix show the crash types that represent the main crash and road user types that contribute to death and serious injury. They are included as an element of the matrix to help concentrate thinking on crash causes and solutions. They are also provided in this way to ensure that vulnerable road users are directly considered.

The seven major crash types as shown in the matrix columns are:

1. run-off-road (also referred to as 'loss of control', or 'off path on curve/straight')
2. head-on (or 'vehicles from opposing directions')
3. intersection ('vehicles from adjacent directions')
4. other (this incorporates all same direction, manoeuvring, overtaking, on path and miscellaneous crashes)
5. pedestrian
6. cyclist
7. motorcyclist.

Pedestrian, cyclist and motorcyclist crashes are separated to highlight the special focus on vulnerable road users. Note that in some circumstances (depending on the purpose of the assessment) other columns may also be added for specific crash types if these are of high importance (e.g. heavy vehicles).

Safe System Matrix

- Exposure, likelihood, severity
- Other Safe System pillars

The aim of the Safe System matrix is to reduce the total score **towards zero**. TOWARDS ZERO

As scores vary along routes and between intersections, an average score is taken for the project as a whole. Detailed matrix assessments were undertaken to determine the overall scores.

When quantifying alignment with Safe System principles, reference is made to AP-R509-16 Table 4.2 which is helps to quantify the risk rating scores.

5.5 Goulburn Valley Highway/Ford Road/Wanganui Road Intersection

5.5.1 Safe System matrix for Safer Roads, Roadsides and Speeds - Austroads AP-509-16 Matrix for this project

Table 4: Safe System Assessment Matrix – ***Existing Conditions – Goulburn Valley Highway/Ford Road/Wanganui Road Intersection***

	Run-off-road	Head-on	Intersection	Other	Pedestrian	Cyclist	Motorcyclist
Exposure	For run-off-road crash types, AADT is greater than 10,000 vehicles per day (Austroads trigger).	For head-on crash types, AADT is greater than 10,000 vehicles per day (Austroads trigger).	For intersection crash types, AADT is greater than 10,000 vehicles per day (Austroads trigger).	For other crash types, AADT is greater than 10,000 vehicles per day (Austroads trigger). Crash types: Rear end, side swipe.	For pedestrian crash types, pedestrian volumes are expected to be very low based on visual observations.	For pedestrian crash types, pedestrian volumes are cyclists to be very low based on visual observations.	For motorcyclist crash types, AADT is estimated between 50 and 100 vehicles per day (Austroads trigger).
	4/4	4/4	4/4	4/4	1/4	1/4	3/4
Likelihood	Factors that **increase** the likelihood include: • High operating speeds (60-70km/h) • Uncontrolled intersection meaning that vehicles are likely to run off the road avoiding a vehicle entering or exiting the side road. • Pavement condition is poor. • Many fixed point source hazards in the roadside close to the lane. Factors that **decrease** the likelihood include: • Acceptable line marking and delineation • Good lighting (assumed based on hardware). • Straight alignment	Factors that **increase** the likelihood include: • High operating speeds (60-70km/h) • No median separating Factors that **decrease** the likelihood include: • Straight alignment • Acceptable line marking and delineation • Good lighting (assumed based on hardware).	Factors that **increase** the likelihood include: • Controlled only by a give way sign (Wanganui) and a Stop Sign (Ford). • Left turn deceleration lanes (thus sight distance blocking via dynamic visual obstruction) • High traffic volume during peak hours, thus people take more risks to exit. • All movements open. • High operating speeds (60-70km/h) • Slip lane angle off Wanganui creates vision issues. • Dynamic visual obstruction for left turners out of Wanganui. • Pavement condition. Factors that **decrease** the likelihood include: • Auxiliary turning lane or channelized turning lane provided for right turning vehicles • Good lighting (assumed based on hardware). • Generally good sight distances at intersection. • Acceptable line marking and delineation	Factors that **increase** the likelihood include: • High operating speeds (60-70km/h) increases the likelihood of rear end crashes. • Pavement condition may not have high skid resistance (visual inspection only) Factors that **decrease** the likelihood include: • Auxiliary turning lane or channelized turning lane provided reduces the likelihood for vehicles decelerating in the traffic lane. • Straight alignment • Acceptable line marking and delineation • Good lighting (assumed based on hardware).	Factors that **increase** the likelihood include: • High traffic volumes • High operating speeds (60-70km/h) • No footpaths and crossing facilities • Two lanes and turn lanes increases complexity • Pavement condition may not have high skid resistance (visual inspection only) Factors that **decrease** the likelihood include: • Good lighting • Not a major desire line • Generally good sight distances at intersection.	Factors that **increase** the likelihood include: • High traffic volumes • High operating speeds (60-70km/h) • No separated facilities • Uncontrolled intersection thus vehicles are more likely to exit/enter the intersection in front of a cyclist Factors that **decrease** the likelihood include: • Some shoulder area for cyclists to ride • Acceptable line marking and delineation • Good lighting	Factors that **increase** the likelihood include: • Inherent stability issues of motorcycles • Surface is in average condition • Motorcyclists are smaller than other vehicles and thus more likely to be hidden behind another vehicle. Factors that **decrease** the likelihood include: • none
	3/4	1/4	4/4	2/4	3/4	3/4	4/4
Severity	Factors that **increase** the severity include: • High operating speeds (60-70km/h) • Many point source hazards (power poles and trees) near the intersection in the secondary crash zone areas.	Factors that **increase** the severity include: • High percentage of heavy vehicles. Factors that **decrease** the severity include:	Factors that **increase** the severity include: • High operating speeds (60-70km/h) for intersection type crashes. • Right angle crashes possible. • High percentage of heavy vehicles Factors that **decrease** the severity include:	Factors that **increase** the severity include: • Medium operating speeds (60-70km/h) for rear end and side swipe crashes • High percentage of heavy vehicles may	Pedestrians struck at speeds above 30 km/h are likely to be seriously injured or killed. Also, vehicle/pedestrian crashes at even lower speeds (especially involving heavy vehicles) can cause serious injury when the	Cyclists struck at speeds above 30 km/h are likely to be seriously injured or killed. Factors that **increase** the severity include: • High speeds for this crash type • High percentage of heavy vehicles	Due to the vulnerability of motorcyclists, a crash between a motorcycle and a larger vehicle or a tree or barrier is likely to result in serious trauma unless speeds are very low. Factors that **increase** the severity include:

	Run-off-road	Head-on	Intersection	Other	Pedestrian	Cyclist	Motorcyclist
	• Culverts and drop offs close to the road. Factors that **decrease** the severity include: • Some frangible poles (sign supports)	• For head on crash types the operating speeds (60-70km/h) are considered to be close to tolerable levels for fatalities, however not serious injuries.	• Some crash angles may be less severe.	contribute to the severity of crashes such as rear-end Factors that **decrease** the severity include: • Medium operating speeds (60-70km/h) for rear end and side swipe crashes	vehicle runs over the pedestrian Factors that **increase** the severity include: • High speeds for pedestrians • High percentage of heavy vehicles Factors that **decrease** the severity include:	Factors that **decrease** the severity include: • none	• High speeds for this road user • High percentage of heavy vehicles • Lack of motorcycle friendly sign supports Factors that **decrease** the severity include: • None
	4/4	**2**/4	**4**/4	**2**/4	**4**/4	**4**/4	**4**/4
Product	**48**/64	**8**/64	**64**/64	**16**/64	**12**/64	**12**/64	**48**/64
						TOTAL	**208 / 448**

The aim of the Safe System matrix is to reduce the total score **towards zero**.

TOWARDS ZERO

Table 5: Safe System Assessment Matrix – ***Signalised Intersection***

LEGEND
Black text: Common factor between this plan and the existing conditions
Factor (strikethrough): factor that is removed or significantly diminished between the existing conditions and this option
Red text: New or significantly altered in this option compared to the existing conditions

	Run-off-road	Head-on	Intersection	Other	Pedestrian	Cyclist	Motorcyclist
Exposure	For run-off-road crash types, AADT is greater than 10,000 vehicles per day (Austroads trigger).	For head-on crash types, AADT is greater than 10,000 vehicles per day (Austroads trigger).	For intersection crash types, AADT is greater than 10,000 vehicles per day (Austroads trigger).	For other crash types, AADT is greater than 10,000 vehicles per day (Austroads trigger). Crash types: Rear end, side swipe.	For pedestrian crash types, pedestrian volumes are expected to be very low based on visual observations.	For pedestrian crash types, pedestrian volumes are cyclists to be very low based on visual observations. Future developments have the potential to draw additional pedestrian volumes	For motorcyclist crash types, AADT is estimated between 50 and 100 vehicles per day (Austroads trigger).
	4/4	4/4	4/4	4/4	1/4	1/4	3/4
Likelihood	Factors that **increase** the likelihood include: • High operating speeds (60-70km/h) • ~~Uncontrolled intersection meaning that vehicles are likely to run off the road avoiding a vehicle entering or exiting the side road.~~ • ~~Pavement condition is poor.~~ • Many fixed point source hazards in the roadside close to the lane. Factors that **decrease** the likelihood include: • ~~Acceptable~~ Good line marking and delineation • Good lighting ~~(assumed based on hardware).~~ • Straight alignment • Signal control	Factors that **increase** the likelihood include: • High operating speeds (60-70km/h) • ~~No median separating~~ Factors that **decrease** the likelihood include: • Straight alignment • Acceptable line marking and delineation • Median on approaches • Good lighting (assumed based on hardware).	Factors that **increase** the likelihood include: • ~~Controlled only by a give way sign (Wanganui) and a Stop Sign (Ford).~~ • ~~Left turn deceleration lanes (thus sight distance blocking via dynamic visual obstruction)~~ • ~~High traffic volume during peak hours, thus people take more risks to exit.~~ • ~~All movements open.~~ • High operating speeds (60-70km/h) • High likelihood of red light runners • First signals entering the city • ~~Slip lane angle off Wanganui creates vision issues.~~ • ~~Dynamic visual obstruction for left turners out of Wanganui.~~ • ~~Pavement condition.~~ Factors that **decrease** the likelihood include: • Signal control • Fully controlled right turn • Auxiliary turning lane or channelized turning lane provided for right turning vehicles • Good lighting ~~(assumed based on hardware).~~ • ~~Generally good sight distances at intersection.~~ • ~~Acceptable line marking and delineation~~	Factors that **increase** the likelihood include: • High operating speeds (60-70km/h) increases the likelihood of rear end crashes. • Traffic signals will increase the number of rear end crashes. • ~~Pavement condition may not have high skid resistance (visual inspection only)~~ Factors that **decrease** the likelihood include: • Auxiliary turning lane or channelized turning lane provided reduces the likelihood for vehicles decelerating in the traffic lane. • Straight alignment • ~~Acceptable~~ Good line marking and delineation • Good lighting ~~(assumed based on hardware).~~	Factors that **increase** the likelihood include: • High traffic volumes • High operating speeds (60-70km/h) • ~~No crossing facilities~~ • ~~Two lanes and turn lanes increases complexity~~ • ~~Pavement condition may not have high skid resistance (visual inspection only)~~ • Many lanes to cross • Zebra crossings on slip lanes. Factors that **decrease** the likelihood include: • Good lighting • Not a major desire line • ~~Generally good sight distances at intersection.~~ • Pedestrian crossings as part of the intersection signalisation. • Fully controlled right turn	Factors that **increase** the likelihood include: • High traffic volumes • High operating speeds (60-70km/h) • No physically separated facilities • ~~Uncontrolled intersection thus vehicles are more likely to exit/enter the intersection in front of a cyclist~~ Factors that **decrease** the likelihood include: • Cyclist lanes provided • Signalised intersection to control movements. • ~~Some shoulder area for cyclists to ride~~ • ~~Acceptable~~ Good line marking and delineation • Good lighting	Factors that **increase** the likelihood include: • Inherent stability issues of motorcycles • ~~Surface is in average condition~~ • Motorcyclists are smaller than other vehicles and thus more likely to be hidden behind another vehicle. Factors that **decrease** the likelihood include: • Signalised intersection to control movements.
	2/4	1/4	3/4	3/4	2/4	2/4	4/4

	Run-off-road	Head-on	Intersection	Other	Pedestrian	Cyclist	Motorcyclist
Severity	Factors that **increase** the severity include: • High operating speeds (60-70km/h) • Many point source hazards (power poles and trees) near the intersection in the secondary crash zone areas. • ~~Culverts and drop offs close to the road.~~ Factors that **decrease** the severity include: • Some frangible poles (sign supports)	Factors that **increase** the severity include: • High percentage of heavy vehicles. Factors that **decrease** the severity include: • For head on crash types the operating speeds (60-70km/h) are considered to be close to tolerable levels for fatalities, however not serious injuries.	Factors that **increase** the severity include: • High operating speeds (60-70km/h) for intersection type crashes. • Right angle crashes possible. • High percentage of heavy vehicles Factors that **decrease** the severity include: • Some crash angles may be less severe.	Factors that **increase** the severity include: • Medium operating speeds (60-70km/h) for rear end and side swipe crashes • High percentage of heavy vehicles may contribute to the severity of crashes such as rear-end Factors that **decrease** the severity include: • Medium operating speeds (60-70km/h) for rear end and side swipe crashes	Pedestrians struck at speeds above 30 km/h are likely to be seriously injured or killed. Also, vehicle/pedestrian crashes at even lower speeds (especially involving heavy vehicles) can cause serious injury when the vehicle runs over the pedestrian Factors that **increase** the severity include: • High speeds for pedestrians • High percentage of heavy vehicles Factors that **decrease** the severity include:	Cyclists struck at speeds above 30 km/h are likely to be seriously injured or killed. Factors that **increase** the severity include: • High speeds for this crash type • High percentage of heavy vehicles Factors that **decrease** the severity include: • none	Due to the vulnerability of motorcyclists, a crash between a motorcycle and a larger vehicle or a tree or barrier is likely to result in serious trauma unless speeds are very low. Factors that **increase** the severity include: • High speeds for this road user • High percentage of heavy vehicles • Lack of motorcycle friendly sign supports Factors that **decrease** the severity include: • None
	4/4	**2**/4	**4**/4	**2**/4	**4**/4	**4**/4	**4**/4
Product	**32**/64	**8**/64	**36**/64	**24**/64	**8**/64	**8**/64	**48**/64
						TOTAL	**164 / 448**

The aim of the Safe System matrix is to reduce the total score **towards zero**.

TOWARDS ZERO

Table 6: Safe System Assessment Matrix – ***Roundabout***

LEGEND
Black text: Common factor between this plan and the existing conditions
~~Factor (strikethrough)~~: factor that is removed or significantly diminished between the existing conditions and this option
Blue text: New or significantly altered in this option compared to the existing conditions

	Run-off-road	Head-on	Intersection	Other	Pedestrian	Cyclist	Motorcyclist
Exposure	For run-off-road crash types, AADT is greater than 10,000 vehicles per day (Austroads trigger).	For head-on crash types, AADT is greater than 10,000 vehicles per day (Austroads trigger).	For intersection crash types, AADT is greater than 10,000 vehicles per day (Austroads trigger).	For other crash types, AADT is greater than 10,000 vehicles per day (Austroads trigger). Crash types: Rear end, side swipe.	For pedestrian crash types, pedestrian volumes are expected to be very low based on visual observations.	For pedestrian crash types, pedestrian volumes are cyclists to be very low based on visual observations.	For motorcyclist crash types, AADT is estimated between 50 and 100 vehicles per day (Austroads trigger).
	4/4	4/4	4/4	4/4	1/4	1/4	3/4
Likelihood	Factors that **increase** the likelihood include: • ~~High operating speeds (60-70km/h)~~ • ~~Uncontrolled intersection meaning that vehicles are likely to run off the road avoiding a vehicle entering or exiting the side road.~~ • ~~Pavement condition is poor.~~ • Many fixed point source hazards in the roadside close to the lane. • Curvature of a roundabout • Adverse crossfall Factors that **decrease** the likelihood include: • ~~Acceptable~~ Good line marking and delineation • Good lighting ~~(assumed based on hardware).~~ • Straight alignment • Medium/low operating speeds	Factors that **increase** the likelihood include: • High operating speeds (60-70km/h) • No median separating Factors that **decrease** the likelihood include: • ~~Acceptable~~ Good line marking and delineation • Good lighting ~~(assumed based on hardware).~~ • Medium/low operating speeds	Factors that **increase** the likelihood include: • ~~Controlled only by a give way sign (Wanganui) and a Stop Sign (Ford).~~ • ~~Left turn deceleration lanes (thus sight distance blocking via dynamic visual obstruction)~~ • High traffic volume during peak hours, thus people take more risks to exit. • ~~All movements open.~~ • ~~High operating speeds (60-70km/h)~~ • ~~Slip lane angle off Wanganui creates vision issues.~~ • ~~Dynamic visual obstruction for left turners out of Wanganui.~~ • ~~Pavement condition.~~ Factors that **decrease** the likelihood include: • ~~Auxiliary turning lane or channelized turning lane provided for right turning vehicles~~ • Good lighting (~~assumed based on hardware).~~ • Medium/low operating speeds • Generally good sight distances at intersection. • ~~Acceptable~~ Good line marking and delineation	Factors that **increase** the likelihood include: • ~~High operating speeds (60-70km/h) increases the likelihood of rear end crashes.~~ • ~~Pavement condition may not have high skid resistance (visual inspection only)~~ • Roundabouts increase the likelihood of rear end crashes Factors that **decrease** the likelihood include: • ~~Auxiliary turning lane or channelized turning lane provided for right turning vehicles~~ • Good lighting ~~(assumed based on hardware).~~ • Medium/low operating speeds • Generally good sight distances at intersection. • ~~Acceptable~~ Good line marking and delineation	Factors that **increase** the likelihood include: • High traffic volumes • ~~High operating speeds (60-70km/h)~~ • No crossing facilities • ~~Two lanes and turn lanes increases complexity~~ • ~~Pavement condition may not have high skid resistance (visual inspection only)~~ • Multiple lanes of a roundabout to cross Factors that **decrease** the likelihood include: • Good lighting • Not a major desire line • Generally good sight distances at intersection. • Medium/low operating speeds	Factors that **increase** the likelihood include: • High traffic volumes • ~~High operating speeds (60-70km/h)~~ • No separated facilities • ~~Uncontrolled intersection thus vehicles are more likely to exit/enter the intersection in front of a cyclist~~ • Multiple lanes of a roundabout to cross Factors that **decrease** the likelihood include: • ~~Some shoulder area for cyclists to ride~~ • ~~Acceptable~~ Good line marking and delineation • Good lighting • Medium/low operating speeds	Factors that **increase** the likelihood include: • Inherent stability issues of motorcycles • ~~Surface is in average condition~~ • Motorcyclists are smaller than other vehicles and thus more likely to be hidden behind another vehicle. Factors that **decrease** the likelihood include: • Medium/low operating speeds
	4/4	1/4	3.5/4	3/4	3/4	3/4	4/4

	Run-off-road	Head-on	Intersection	Other	Pedestrian	Cyclist	Motorcyclist
Severity	Factors that **increase** the severity include: • ~~High operating speeds (60-70km/h)~~ • Many point source hazards (power poles and trees) near the intersection in the secondary crash zone areas. • ~~Culverts and drop offs close to the road.~~ Factors that **decrease** the severity include: • Some frangible poles (sign supports) • Medium/low operating speeds	Factors that **increase** the severity include: • High percentage of heavy vehicles. • If a head on crash occurs it is likely to be high speed. Factors that **decrease** the severity include: • For head on crash types the operating speeds (40-60km/h) are within most tolerable levels.	Factors that **increase** the severity include: • ~~High operating speeds (60-70km/h) for intersection type crashes.~~ • ~~Right angle crashes possible.~~ • High percentage of heavy vehicles Factors that **decrease** the severity include: • ~~Some crash angles may be less severe.~~ • Medium/low operating speeds • Favourable angles	Factors that **increase** the severity include: • ~~Medium operating speeds (60-70km/h) for rear end and side swipe crashes~~ • High percentage of heavy vehicles may contribute to the severity of crashes such as rear-end Factors that **decrease** the severity include: • ~~Medium operating speeds (60-70km/h) for rear end and side swipe crashes~~ • Medium/low operating speeds	Pedestrians struck at speeds above 30 km/h are likely to be seriously injured or killed. Also, vehicle/pedestrian crashes at even lower speeds (especially involving heavy vehicles) can cause serious injury when the vehicle runs over the pedestrian Factors that **increase** the severity include: • High speeds for pedestrians • High percentage of heavy vehicles Factors that **decrease** the severity include:	Cyclists struck at speeds above 30 km/h are likely to be seriously injured or killed. Factors that **increase** the severity include: • High speeds for this crash type • High percentage of heavy vehicles Factors that **decrease** the severity include: • none	Due to the vulnerability of motorcyclists, a crash between a motorcycle and a larger vehicle or a tree or barrier is likely to result in serious trauma unless speeds are very low. Factors that **increase** the severity include: • High speeds for this road user • High percentage of heavy vehicles • Lack of motorcycle friendly sign supports Factors that **decrease** the severity include: • None
	2/4	**1**/4	**1.4**/4	**2**/4	**4**/4	**4**/4	**4**/4
Product	**32**/64	**4**/64	**19.6**/64	**24**/64	**12**/64	**12**/64	**48**/64
						TOTAL	**151.6 / 448**

The aim of the Safe System matrix is to reduce the total score **towards zero**.

TOWARDS ZERO

5.6 Ford Road/Verney Road Intersection

5.6.1 Safe System matrix for Safer Roads, Roadsides and Speeds - Austroads AP-509-16 Matrix for this project

Table 7: Safe System Assessment Matrix – ***Existing Conditions – Ford Road/Verney Road Intersection***

	Run-off-road	Head-on	Intersection	Other	Pedestrian	Cyclist	Motorcyclist
Exposure	For run-off-road crash types, AADT is between 1,000 and 5,000 vehicles per day (Austroads trigger).	For head-on crash types, AADT is between 1,000 and 5,000 vehicles per day (Austroads trigger).	For intersection crash types, AADT is between 1,000 and 5,000 vehicles per day (Austroads trigger).	For other crash types, AADT is between 1,000 and 5,000 vehicles per day (Austroads trigger). Crash types: Rear end, side swipe.	For pedestrian crash types, pedestrian volumes are expected to be very low based on visual observations.	For pedestrian crash types, pedestrian volumes are cyclists to be very low based on visual observations.	For motorcyclist crash types, AADT is estimated between 10 and 50 vehicles per day (Austroads trigger).
	2/4	**2/4**	**2/4**	**2/4**	**1/4**	**1/4**	**2/4**
Likelihood	Factors that **increase** the likelihood include: • Many fixed point source hazards in the roadside close to the lane. • Curvature of the roundabout. Factors that **decrease** the likelihood include: • Medium /Low operating speeds (40-50km/h) • Acceptable signs and line marking. • Good lighting (assumed based on hardware). • Straight alignment	Factors that **increase** the likelihood include: • No extended median separator on the approach or departure Factors that **decrease** the likelihood include: • Medium /Low operating speeds (40-50km/h) • Straight alignment • Acceptable line marking and delineation • Good lighting (assumed based on hardware).	Factors that **increase** the likelihood include: • Observed hoon behaviour • Roundabouts can increase the number of crashes due to human decision making (noting the severity is less). Factors that **decrease** the likelihood include: • Medium /Low operating speeds (40-50km/h) • Good lighting (assumed based on hardware). • Generally good sight distances at intersection. • Acceptable line marking and signs	Factors that **increase** the likelihood include: • Roundabouts may increase the number of rear end crashes. Factors that **decrease** the likelihood include: • Single lane roundabout. • Straight alignment • Acceptable line marking and delineation • Good lighting (assumed based on hardware).	Factors that **increase** the likelihood include: • Medium traffic volumes • Medium /Low operating speeds (40-50km/h) • No priority crossing facilities Factors that **decrease** the likelihood include: • Good lighting • Refuge island • Formalised crossing points • Generally good sight distances at intersection.	Factors that **increase** the likelihood include: • Medium traffic volumes • Medium /Low operating speeds (40-50km/h) • No separated facilities • Cyclists may not be identified at the roundabout. • Cyclist lanes end on the approach to the roundabout. Factors that **decrease** the likelihood include: • Some shoulder area for cyclists to ride on the approach. • Acceptable line marking and delineation • Good lighting • Refuge area for shared path users • Shared path	Factors that **increase** the likelihood include: • Inherent stability issues of motorcycles • Medium traffic volumes • Medium /Low operating speeds (40-50km/h) • Motorcyclists are smaller than other vehicles and thus more likely to be hidden behind another vehicle. Factors that **decrease** the likelihood include: • Medium /Low operating speeds (40-50km/h)
	2/4	**1/4**	**3/4**	**2/4**	**3/4**	**3/4**	**2/4**
Severity	Factors that **increase** the severity include: • Medium operating speeds (40-50km/h) for run-off-road type crashes • Many point source hazards (power poles and trees) near the intersection. Factors that **decrease** the severity include: • Some frangible poles (sign supports)	Factors that **increase** the severity include: • High percentage of heavy vehicles. Factors that **decrease** the severity include: • For head on crash types the operating speeds (40-50km/h) are considered to be close to tolerable levels for fatalities, however not all serious injuries.	Factors that **increase** the severity include: • Higher probability of those crashing travelling at higher speeds. Factors that **decrease** the severity include: • Medium /Low operating speeds (40-50km/h) • Crash angles less severe.	Factors that **increase** the severity include: • High percentage of heavy vehicles may contribute to the severity of crashes such as rear-end Factors that **decrease** the severity include: • Low operating speeds (40-50km/h)	Pedestrians struck at speeds above 30 km/h are likely to be seriously injured or killed. Also, vehicle/pedestrian crashes at even lower speeds (especially involving heavy vehicles) can cause serious injury when the vehicle runs over the pedestrian Factors that **increase** the severity include: • Medium /Low operating speeds (40-50km/h)	Cyclists struck at speeds above 30 km/h are likely to be seriously injured or killed. Factors that **increase** the severity include: • Medium /Low operating speeds (40-50km/h) • High percentage of heavy vehicles Factors that **decrease** the severity include: • Medium /Low operating speeds (40-50km/h)	Due to the vulnerability of motorcyclists, a crash between a motorcycle and a larger vehicle or a tree or barrier is likely to result in serious trauma unless speeds are very low. Factors that **increase** the severity include: • Medium /Low operating speeds (40-50km/h) • High percentage of heavy vehicles • Lack of motorcycle friendly sign supports Factors that **decrease** the severity include: • Medium /Low operating speeds (40-50km/h)

	Run-off-road	Head-on	Intersection	Other	Pedestrian	Cyclist	Motorcyclist
		• Vehicles head on crashing are likely to be travelling a higher speed.			• High percentage of heavy vehicles Factors that **decrease** the severity include: • Medium /Low operating speeds (40-50km/h)		
	3/4	**2**/4	**1**/4	**1**/4	**2**/4	**2**/4	**2**/4
Product	**12**/64	**4**/64	**6**/64	**4**/64	**6**/64	**6**/64	**12**/64
						TOTAL	**50 / 448**

The aim of the Safe System matrix is to reduce the total score **towards zero**.

Table 8: Safe System Assessment Matrix – ***Signalised Intersection***

LEGEND
Black text: Common factor between this plan and the existing conditions
Factor (strikethrough): factor that is removed or significantly diminished between the existing conditions and this option
Red text: New or significantly altered in this option compared to the existing conditions

	Run-off-road	Head-on	Intersection	Other	Pedestrian	Cyclist	Motorcyclist
Exposure	For run-off-road crash types, AADT is between 1,000 and 5,000 vehicles per day (Austroads trigger).	For head-on crash types, AADT is between 1,000 and 5,000 vehicles per day (Austroads trigger).	For intersection crash types, AADT is between 1,000 and 5,000 vehicles per day (Austroads trigger).	For other crash types, AADT is between 1,000 and 5,000 vehicles per day (Austroads trigger). Crash types: Rear end, side swipe.	For pedestrian crash types, pedestrian volumes are expected to be very low based on visual observations.	For pedestrian crash types, pedestrian volumes are cyclists to be very low based on visual observations.	For motorcyclist crash types, AADT is estimated between 10 and 50 vehicles per day (Austroads trigger).
	2/4	**2**/4	**2**/4	**2**/4	**1**/4	**1**/4	**2**/4
Likelihood	Factors that **increase** the likelihood include: • Many fixed point source hazards in the roadside close to the lane. • ~~Curvature of the roundabout.~~ • Medium/High operating speeds (60+km/h) Factors that **decrease** the likelihood include: • ~~Medium /Low operating speeds (40-50km/h)~~ • ~~Acceptable~~ Good signs and line marking. • Good lighting ~~(assumed based on hardware).~~ • Straight alignment	Factors that **increase** the likelihood include: • ~~No extended median separator on the approach or departure~~ Factors that **decrease** the likelihood include: • ~~Medium /Low operating speeds (40-50km/h)~~ • Medium/High operating speeds (60+km/h) • Straight alignment • ~~Acceptable~~ Good signs and line marking. • Good lighting ~~(assumed based on hardware).~~	Factors that **increase** the likelihood include: • Observed hoon behaviour • Medium/High operating speeds (60+km/h) • Red light running is likely to occur • ~~Roundabouts can increase the number of crashes due to human decision making (noting the severity is less).~~ Factors that **decrease** the likelihood include: • ~~Medium /Low operating speeds (40-50km/h)~~ • Good lighting (a~~ssumed based on hardware).~~ • ~~Generally good sight distances at intersection.~~ • ~~Acceptable~~ Good line marking and signs • Signal control with FCRTs	Factors that **increase** the likelihood include: • ~~Roundabouts may increase the number of rear end crashes.~~ • Multiple lanes Factors that **decrease** the likelihood include: • ~~Single lane roundabout.~~ • Straight alignment • ~~Acceptable~~ Good line marking and signs • Good lighting ~~(assumed based on hardware).~~	Factors that **increase** the likelihood include: • Medium traffic volumes • ~~Medium /Low operating speeds (40-50km/h)~~ • Medium/High operating speeds (60+km/h) • ~~No priority crossing facilities~~ • Skewed crossings • Long crossing distance Factors that **decrease** the likelihood include: • Good lighting • Refuge island • Formalised crossing points with ped control • Generally good sight distances at intersection. • Signal control with FCRTs	Factors that **increase** the likelihood include: • Medium traffic volumes • ~~Medium /Low operating speeds (40-50km/h)~~ • Medium/High operating speeds (60+km/h) • ~~No separated facilities~~ • ~~Cyclists may not be identified at the roundabout.~~ • ~~Cyclist lanes end on the approach to the roundabout.~~ Factors that **decrease** the likelihood include: • ~~Some shoulder area for cyclists to ride on the approach.~~ • Cyclist lanes • ~~Acceptable~~ Good line marking and signs • Good lighting (a~~ssumed based on hardware).~~ • Refuge area for shared path users • Shared path • Signal control with FCRTs	Factors that **increase** the likelihood include: • Inherent stability issues of motorcycles • Medium traffic volumes • ~~Medium /Low operating speeds (40-50km/h)~~ • Medium/High operating speeds (60+km/h) • Motorcyclists are smaller than other vehicles and thus more likely to be hidden behind another vehicle. Factors that **decrease** the likelihood include: • ~~Medium /Low operating speeds (40-50km/h)~~ • Signal control with FCRTs
	2/4	**1**/4	**2**/4	**1**/4	**2.7**/4	**2.8**/4	**1.8**/4
Severity	Factors that **increase** the severity include: • ~~Medium operating speeds (40-50km/h) for run-off-road type crashes~~ • Medium /High operating speeds (60+km/h) • Many point source hazards (power poles and	Factors that **increase** the severity include: • High percentage of heavy vehicles. Factors that **decrease** the severity include: • For head on crash types the operating speeds (~~40-~~	Factors that **increase** the severity include: • Higher probability of those crashing travelling at higher speeds. • Red light running is likely to occur. Factors that **decrease** the severity include:	Factors that **increase** the severity include: • High percentage of heavy vehicles may contribute to the severity of crashes such as rear-end • Medium/High operating speeds (60+km/h)	Pedestrians struck at speeds above 30 km/h are likely to be seriously injured or killed. Also, vehicle/pedestrian crashes at even lower speeds (especially involving heavy vehicles) can cause serious injury when the vehicle runs over the pedestrian	Cyclists struck at speeds above 30 km/h are likely to be seriously injured or killed. Factors that **increase** the severity include: • ~~Medium /Low operating speeds (40-50km/h)~~ • Medium/High operating speeds (60+km/h) • High percentage of heavy vehicles	Due to the vulnerability of motorcyclists, a crash between a motorcycle and a larger vehicle or a tree or barrier is likely to result in serious trauma unless speeds are very low. Factors that **increase** the severity include: • ~~Medium /Low operating speeds (40-50km/h)~~

	Run-off-road	Head-on	Intersection	Other	Pedestrian	Cyclist	Motorcyclist
	trees) near the intersection. Factors that **decrease** the severity include: • Some frangible poles (sign supports)	~~50~~60+km/h) are considered to be close to tolerable levels for fatalities, however not all serious injuries. • Vehicles head on crashing are likely to be travelling a higher speed.	• ~~Medium /Low operating speeds (40-50km/h)~~ • Medium/High operating speeds (60+km/h) • ~~crash angles less severe.~~	Factors that **decrease** the severity include: • ~~Low operating speeds (40-50km/h)~~	Factors that **increase** the severity include: • ~~Medium /Low operating speeds (40-50km/h)~~ • Medium/High operating speeds (60+km/h) • High percentage of heavy vehicles Factors that **decrease** the severity include: • ~~Medium /Low operating speeds (40-50km/h)~~	Factors that **decrease** the severity include: • ~~Medium /Low operating speeds (40-50km/h)~~	• Medium/High operating speeds (60+km/h) • High percentage of heavy vehicles • Lack of motorcycle friendly sign supports Factors that **decrease** the severity include: • ~~Medium /Low operating speeds (40-50km/h)~~
	3.2/4	**2**/4	**3**/4	**2**/4	**2.1**/4	**2.3**/4	**3.3**/4
Product	**12.8**/64	**4.0**/64	**12.0**/64	**4.0**/64	**5.7**/64	**6.4**/64	**11.9**/64
						TOTAL	**56.8 / 448**

The aim of the Safe System matrix is to reduce the total score **towards zero**.

Table 9: Safe System Assessment Matrix – ***Roundabout Intersection***

LEGEND
Black text: Common factor between this plan and the existing conditions
Factor (strikethrough): factor that is removed or significantly diminished between the existing conditions and this option
Blue text: New or significantly altered in this option compared to the existing conditions

	Run-off-road	Head-on	Intersection	Other	Pedestrian	Cyclist	Motorcyclist
Exposure	For run-off-road crash types, AADT is between 1,000 and 5,000 vehicles per day (Austroads trigger).	For head-on crash types, AADT is between 1,000 and 5,000 vehicles per day (Austroads trigger).	For intersection crash types, AADT is between 1,000 and 5,000 vehicles per day (Austroads trigger).	For other crash types, AADT is between 1,000 and 5,000 vehicles per day (Austroads trigger). Crash types: Rear end, side swipe.	For pedestrian crash types, pedestrian volumes are expected to be very low based on visual observations.	For pedestrian crash types, pedestrian volumes are cyclists to be very low based on visual observations.	For motorcyclist crash types, AADT is estimated between 10 and 50 vehicles per day (Austroads trigger).
	2/4	**2**/4	**2**/4	**2**/4	**1**/4	**1**/4	**2**/4
Likelihood	Factors that **increase** the likelihood include: • Many fixed point source hazards in the roadside close to the lane. • Curvature of the roundabout. • Multiple lanes Factors that **decrease** the likelihood include: • Medium /Low operating speeds ~~(40-50km/h)~~ (45-55km/h) • ~~Acceptable good~~ signs and line marking. • Good lighting ~~(assumed based on hardware).~~ • Straight alignment	Factors that **increase** the likelihood include: • No extended median separator on the approach or departure Factors that **decrease** the likelihood include: • Medium /Low operating speeds ~~(40-50km/h)~~ (45-55km/h) • ~~Acceptable good~~ signs and line marking. • Good lighting ~~(assumed based on hardware).~~ • Straight alignment	Factors that **increase** the likelihood include: • Observed hoon behaviour • Roundabouts can increase the number of crashes due to human decision making (noting the severity is less). • Multiple lanes Factors that **decrease** the likelihood include: • Medium /Low operating speeds ~~(40-50km/h)~~ (45-55km/h) • ~~Acceptable good~~ signs and line marking. • Good lighting ~~(assumed based on hardware).~~ • Straight alignment • Generally good sight distances at intersection.	Factors that **increase** the likelihood include: • Roundabouts may increase the number of rear end crashes. • Multiple lanes Factors that **decrease** the likelihood include: • ~~Single lane roundabout.~~ • ~~Acceptable good~~ signs and line marking. • Good lighting ~~(assumed based on hardware).~~ • Straight alignment Medium /Low operating speeds ~~(40-50km/h)~~ (45-55km/h)	Factors that **increase** the likelihood include: • Medium traffic volumes • Medium /Low operating speeds ~~(40-50km/h)~~ (45-55km/h) • No priority crossing facilities • Multiple lanes Factors that **decrease** the likelihood include: • Good lighting • Refuge island • Formalised crossing points • Generally good sight distances at intersection.	Factors that **increase** the likelihood include: • Medium traffic volumes • Medium /Low operating speeds ~~(40-50km/h)~~ (45-55km/h) • No separated facilities • Cyclists may not be identified at the roundabout. • Cyclist lanes end on the approach to the roundabout. • Multiple lanes Factors that **decrease** the likelihood include: • Some shoulder area for cyclists to ride on the approach. • ~~Acceptable good~~ signs and line marking. • Good lighting ~~(assumed based on hardware).~~ • Straight alignment • Refuge area for shared path users • Shared path	Factors that **increase** the likelihood include: • Inherent stability issues of motorcycles • Medium traffic volumes • Medium /Low operating speeds ~~(40-50km/h)~~ (45-55km/h) • Motorcyclists are smaller than other vehicles and thus more likely to be hidden behind another vehicle. • Multiple lanes Factors that **decrease** the likelihood include: • Medium /Low operating speeds ~~(40-50km/h)~~ (45-55km/h)
	2.2/4	**1.0**/4	**3.1**/4	**2.0**/4	**3.2**/4	**3.3**/4	**2.3**/4
Severity	Factors that **increase** the severity include: • Medium operating speeds ~~(40-50km/h)~~ (45-55km/h) for run-off-road type crashes • Many point source hazards (power poles and trees) near the intersection.	Factors that **increase** the severity include: • High percentage of heavy vehicles. Factors that **decrease** the severity include: • For head on crash types the operating speeds ~~(40-50km/h)~~ (45-55km/h) are	Factors that **increase** the severity include: • Higher probability of those crashing travelling at higher speeds. Factors that **decrease** the severity include: • Medium /Low operating speeds ~~(40-50km/h)~~ (45-55km/h) • crash angles less severe.	Factors that **increase** the severity include: • High percentage of heavy vehicles may contribute to the severity of crashes such as rear-end Factors that **decrease** the severity include:	Pedestrians struck at speeds above 30 km/h are likely to be seriously injured or killed. Also, vehicle/pedestrian crashes at even lower speeds (especially involving heavy vehicles) can cause serious injury when the vehicle runs over the pedestrian	Cyclists struck at speeds above 30 km/h are likely to be seriously injured or killed. Factors that **increase** the severity include: • Medium /Low operating speeds ~~(40-50km/h)~~ (45-55km/h) • High percentage of heavy vehicles Factors that **decrease** the severity include:	Due to the vulnerability of motorcyclists, a crash between a motorcycle and a larger vehicle or a tree or barrier is likely to result in serious trauma unless speeds are very low. Factors that **increase** the severity include: • Medium /Low operating speeds ~~(40-50km/h)~~ (45-55km/h) • High percentage of heavy vehicles

	Run-off-road	Head-on	Intersection	Other	Pedestrian	Cyclist	Motorcyclist
	Factors that **decrease** the severity include: • Some frangible poles (sign supports)	considered to be close to tolerable levels for fatalities, however not all serious injuries. • Vehicles head on crashing are likely to be travelling a higher speed.		• Low operating speeds (~~40-50km/h~~) (45-55km/h)	Factors that **increase** the severity include: • Medium /Low operating speeds (~~40-50km/h~~) (45-55km/h) • High percentage of heavy vehicles Factors that **decrease** the severity include: • Medium /Low operating speeds (~~40-50km/h~~) (45-55km/h)	• Medium /Low operating speeds (~~40-50km/h~~) (45-55km/h)	• Lack of motorcycle friendly sign supports Factors that **decrease** the severity include: • Medium /Low operating speeds (~~40-50km/h~~) (45-55km/h)
	3.2/4	2.0/4	1.2/4	1.1/4	2.1/4	2.1/4	3.1/4
Product	14.1/64	4/64	7.4/64	4.4/64	6.7/64	6.9/64	14.3/64
						TOTAL	**57.8 / 448**

The aim of the Safe System matrix is to reduce the total score **towards zero**.

TOWARDS ZERO

5.7 Ford Road/Grahamvale Road Intersection

5.7.1 Safe System matrix for Safer Roads, Roadsides and Speeds - Austroads AP-509-16 Matrix for this project

Table 10: Safe System Assessment Matrix – ***Existing Conditions –Ford Road/Grahamvale Road Intersection***

	Run-off-road	Head-on	Intersection	Other	Pedestrian	Cyclist	Motorcyclist
Exposure	For run-off-road crash types, AADT is between 5,000 and 10,000 vehicles per day (Austroads trigger).	For head-on crash types, AADT is between 5,000 and 10,000 vehicles per day (Austroads trigger).	For intersection crash types, AADT is between 5,000 and 10,000 vehicles per day (Austroads trigger).	For other crash types, AADT is between 5,000 and 10,000 vehicles per day (Austroads trigger). Crash types: Rear end, side swipe, level crossing.	For pedestrian crash types, pedestrian volumes are expected to be very low based on visual observations.	For pedestrian crash types, pedestrian volumes are cyclists to be very low based on visual observations.	For motorcyclist crash types, AADT is estimated between 50 and 100 vehicles per day (Austroads trigger).
	4/4	4/4	4/4	4/4	1/4	1/4	3/4
Likelihood	Factors that **increase** the likelihood include: • High operating speeds (80-85km/h) • Uncontrolled intersection meaning that vehicles are likely to run off the road avoiding a vehicle entering or exiting the side road. • Many fixed point source hazards in the roadside close to the lane. • No lighting Factors that **decrease** the likelihood include: • Acceptable line marking and delineation • Straight alignment	Factors that **increase** the likelihood include: • High operating speeds (80-85km/h) • No median separating Factors that **decrease** the likelihood include: • Straight alignment • Acceptable line marking and delineation	Factors that **increase** the likelihood include: • Medium traffic volume during peak hours, thus people take more risks to exit. • All movements open. • High operating speeds (80-85km/h) • No lighting • No turn lanes Factors that **decrease** the likelihood include: • Generally good sight distances at intersection. • Acceptable line marking and delineation	Factors that **increase** the likelihood include: • High operating speeds (80-85km/h) increases the likelihood of rear end crashes. • No lighting • Railway level crossing Factors that **decrease** the likelihood include: • Straight alignment • Acceptable line marking and delineation • Single lane • Active control on the level crossing	Factors that **increase** the likelihood include: • High traffic volumes • High operating speeds (80-85km/h) • No crossing facilities • No lighting Factors that **decrease** the likelihood include: • Not a major desire line • Generally good sight distances at intersection.	Factors that **increase** the likelihood include: • High traffic volumes • High operating speeds (80-85km/h) • No separated facilities • Uncontrolled intersection thus vehicles are more likely to exit/enter the intersection in front of a cyclist • No lighting Factors that **decrease** the likelihood include: • Acceptable line marking and delineation	Factors that **increase** the likelihood include: • Inherent stability issues of motorcycles • High operating speeds (80-85km/h) • Motorcyclists are smaller than other vehicles and thus more likely to be hidden behind another vehicle. • No lighting Factors that **decrease** the likelihood include:
	3/4	2/4	4/4	2/4	3/4	3/4	4/4
Severity	Factors that **increase** the severity include: • High operating speeds (80-85km/h) • Many point source hazards (power poles) near the intersection in the secondary crash zone areas. • Culverts and drop offs/channel close to the road. Factors that **decrease** the severity include: • Some frangible poles (sign supports) • Some cleared area	Factors that **increase** the severity include: • High percentage of heavy vehicles. • High operating speeds (80-85km/h) Factors that **decrease** the severity include:	Factors that **increase** the severity include: • High operating speeds (80-85km/h) for intersection type crashes. • Right angle crashes possible. • High percentage of heavy vehicles Factors that **decrease** the severity include:	Factors that **increase** the severity include: • High operating speeds (80-85km/h) • High percentage of heavy vehicles may contribute to the severity of crashes such as rear-end Factors that **decrease** the severity include:	Pedestrians struck at speeds above 30 km/h are likely to be seriously injured or killed. Also, vehicle/pedestrian crashes at even lower speeds (especially involving heavy vehicles) can cause serious injury when the vehicle runs over the pedestrian Factors that **increase** the severity include: • High speeds for pedestrians • High percentage of heavy vehicles	Cyclists struck at speeds above 30 km/h are likely to be seriously injured or killed. Factors that **increase** the severity include: • High speeds for this crash type • High percentage of heavy vehicles Factors that **decrease** the severity include:	Due to the vulnerability of motorcyclists, a crash between a motorcycle and a larger vehicle or a tree or barrier is likely to result in serious trauma unless speeds are very low. Factors that **increase** the severity include: • High speeds for this road user • High percentage of heavy vehicles • Lack of motorcycle friendly sign supports Factors that **decrease** the severity include: • None

	Run-off-road	Head-on	Intersection	Other	Pedestrian	Cyclist	Motorcyclist
					Factors that **decrease** the severity include:		
	4/4	**4**/4	**4**/4	**3**/4	**4**/4	**4**/4	**4**/4
Product	**36**/64	**24**/64	**48**/64	**18**/64	**12**/64	**12**/64	**48**/64
						TOTAL	**198 / 448**

The aim of the Safe System matrix is to reduce the total score **towards zero**.

Table 11: Safe System Assessment Matrix – ***Signalised Intersection***

LEGEND
Black text: Common factor between this plan and the existing conditions
~~Factor~~ (strikethrough): factor that is removed or significantly diminished between the existing conditions and this option
Red text: New or significantly altered in this option compared to the existing conditions

	Run-off-road	Head-on	Intersection	Other	Pedestrian	Cyclist	Motorcyclist
Exposure	For run-off-road crash types, AADT is between 5,000 and 10,000 vehicles per day (Austroads trigger).	For head-on crash types, AADT is between 5,000 and 10,000 vehicles per day (Austroads trigger).	For intersection crash types, AADT is between 5,000 and 10,000 vehicles per day (Austroads trigger).	For other crash types, AADT is between 5,000 and 10,000 vehicles per day (Austroads trigger). Crash types: Rear end, side swipe, level crossing.	For pedestrian crash types, pedestrian volumes are expected to be very low based on visual observations.	For pedestrian crash types, pedestrian volumes are cyclists to be very low based on visual observations.	For motorcyclist crash types, AADT is estimated between 50 and 100 vehicles per day (Austroads trigger).
	4/4	4/4	4/4	4/4	1/4	1/4	3/4
Likelihood	Factors that **increase** the likelihood include: • High operating speeds (80-85km/h) • ~~Uncontrolled intersection meaning that vehicles are likely to run off the road avoiding a vehicle entering or exiting the side road.~~ • Many fixed point source hazards in the roadside close to the lane. • ~~No lighting~~ Factors that **decrease** the likelihood include: • ~~Acceptable~~ Good line marking and delineation • Straight alignment • Traffic signal control	Factors that **increase** the likelihood include: • High operating speeds (80-85km/h) • ~~No median separating~~ Factors that **decrease** the likelihood include: • Straight alignment • ~~Acceptable~~ Good line marking and delineation • Traffic signal control	Factors that **increase** the likelihood include: • ~~Medium traffic volume during peak hours, thus people take more risks to exit.~~ • ~~All movements open.~~ • High operating speeds (80-85km/h) which is high for traffic signals • ~~No lighting~~ • ~~No turn lanes~~ • Likely to be red light runners Factors that **decrease** the likelihood include: • Generally good sight distances at intersection. • Acceptable line marking and delineation • Traffic signal control • FCRTs	Factors that **increase** the likelihood include: • High operating speeds (80-85km/h) increases the likelihood of rear end crashes. • Multiple lanes • ~~No lighting~~ • Railway level crossing – this traffic signals will need to be linked Factors that **decrease** the likelihood include: • Straight alignment • ~~Acceptable~~ Good line marking and delineation • ~~Single lane~~ • Active control on the level crossing • Traffic signal control and linking to level crossing	Factors that **increase** the likelihood include: • High traffic volumes • High operating speeds (80-85km/h) • ~~No crossing facilities~~ • ~~No lighting~~ • Slip lanes on two approaches • Skewed crossings Factors that **decrease** the likelihood include: • Not a major desire line • Generally good sight distances at intersection. • Pedestrian crossing facilities at the signalised intersection	Factors that **increase** the likelihood include: • High traffic volumes • High operating speeds (80-85km/h) • No separated facilities • ~~Uncontrolled intersection thus vehicles are more likely to exit/enter the intersection in front of a cyclist~~ • ~~No lighting~~ Factors that **decrease** the likelihood include: • ~~Acceptable~~ Good line marking and delineation • Traffic signal control • FCRTs	Factors that **increase** the likelihood include: • Inherent stability issues of motorcycles • High operating speeds (80-85km/h) • Motorcyclists are smaller than other vehicles and thus more likely to be hidden behind another vehicle. • ~~No lighting~~ Factors that **decrease** the likelihood include: • ~~Acceptable~~ Good line marking and delineation • Traffic signal control • FCRTs
	2.0/4	1.5/4	3.0/4	1.5/4	2.0/4	2.0/4	3.0/4
Severity	Factors that **increase** the severity include: • High operating speeds (80-85km/h) • Many point source hazards (power poles) near the intersection in the secondary crash zone areas.	Factors that **increase** the severity include: • High percentage of heavy vehicles. • High operating speeds (80-85km/h)	Factors that **increase** the severity include: • High operating speeds (80-85km/h) for intersection type crashes. • Right angle crashes possible. • High percentage of heavy vehicles Factors that **decrease** the severity include:	Factors that **increase** the severity include: • High operating speeds (80-85km/h) • High percentage of heavy vehicles may contribute to the severity of crashes such as rear-end	Pedestrians struck at speeds above 30 km/h are likely to be seriously injured or killed. Also, vehicle/pedestrian crashes at even lower speeds (especially involving heavy vehicles) can cause serious injury when the vehicle runs over the pedestrian	Cyclists struck at speeds above 30 km/h are likely to be seriously injured or killed. Factors that **increase** the severity include: • High speeds for this crash type • High percentage of heavy vehicles Factors that **decrease** the severity include:	Due to the vulnerability of motorcyclists, a crash between a motorcycle and a larger vehicle or a tree or barrier is likely to result in serious trauma unless speeds are very low. Factors that **increase** the severity include: • High speeds for this road user • High percentage of heavy vehicles

	Run-off-road	Head-on	Intersection	Other	Pedestrian	Cyclist	Motorcyclist
	• Culverts and drop offs/channel close to the road. Factors that **decrease** the severity include: • Some frangible poles (sign supports) • Some cleared area	Factors that **decrease** the severity include:		Factors that **decrease** the severity include:	Factors that **increase** the severity include: • High speeds for pedestrians • High percentage of heavy vehicles Factors that **decrease** the severity include:		• Lack of motorcycle friendly sign supports Factors that **decrease** the severity include: • None
	4/4	**4**/4	**4**/4	**3**/4	**4**/4	**4**/4	**4**/4
Product	**24**/64	**18**/64	**36**/64	**13.5**/64	**8**/64	**8**/64	**36**/64
						TOTAL	**143.5 / 448**

The aim of the Safe System matrix is to reduce the total score **towards zero**.

TOWARDS ZERO

Table 12: Safe System Assessment Matrix – ***Roundabout Intersection***

LEGEND
Black text: Common factor between this plan and the existing conditions
Factor (strikethrough): factor that is removed or significantly diminished between the existing conditions and this option
Blue text: New or significantly altered in this option compared to the existing conditions

	Run-off-road	Head-on	Intersection	Other	Pedestrian	Cyclist	Motorcyclist
Exposure	For run-off-road crash types, AADT is between 5,000 and 10,000 vehicles per day (Austroads trigger).	For head-on crash types, AADT is between 5,000 and 10,000 vehicles per day (Austroads trigger).	For intersection crash types, AADT is between 5,000 and 10,000 vehicles per day (Austroads trigger).	For other crash types, AADT is between 5,000 and 10,000 vehicles per day (Austroads trigger). Crash types: Rear end, side swipe.	For pedestrian crash types, pedestrian volumes are expected to be very low based on visual observations.	For pedestrian crash types, pedestrian volumes are cyclists to be very low based on visual observations.	For motorcyclist crash types, AADT is estimated between 50 and 100 vehicles per day (Austroads trigger).
	4/4	4/4	4/4	4/4	1/4	1/4	3/4
Likelihood	Factors that **increase** the likelihood include: • ~~Medium operating speeds (80-85km/h)~~ • ~~Uncontrolled intersection meaning that vehicles are likely to run off the road avoiding a vehicle entering or exiting the side road.~~ • Multi lanes • Many fixed point source hazards in the roadside close to the lane. • ~~No lighting~~ • Roundabout curvature Factors that **decrease** the likelihood include: • ~~Acceptable~~ Good line marking and delineation • Straight alignment • Medium/low operating speeds	Factors that **increase** the likelihood include: • ~~High operating speeds (80-85km/h)~~ • ~~No median separating~~ Factors that **decrease** the likelihood include: • Straight alignment • Separated approach • ~~Acceptable~~ Good line marking and delineation • Medium/low operating speeds	Factors that **increase** the likelihood include: • Medium traffic volume during peak hours, thus people take more risks to exit. • ~~All movements open.~~ • ~~High operating speeds (80-85km/h)~~ • ~~No lighting~~ • ~~No turn lanes~~ • Multi lanes Factors that **decrease** the likelihood include: • Generally good sight distances at intersection. • ~~Acceptable~~ Good line marking and delineation • Medium/low operating speeds • Favourable angles	Factors that **increase** the likelihood include: • ~~High operating speeds (80-85km/h) increases the likelihood of rear end crashes.~~ • ~~No lighting~~ • Railway level crossing and increased possibility of queuing over level crossing • Multi lanes • Roundabouts tend to have increased rear end crashes Factors that **decrease** the likelihood include: • Straight alignment • ~~Acceptable~~ Good line marking and delineation • Single lane • Active control on the level crossing • Medium/low operating speeds	Factors that **increase** the likelihood include: • High traffic volumes • ~~High operating speeds (80-85km/h)~~ • No crossing facilities • ~~No lighting~~ • Multi lanes Factors that **decrease** the likelihood include: • Not a major desire line • Generally good sight distances at intersection. • Medium/low operating speeds	Factors that **increase** the likelihood include: • High traffic volumes • ~~High operating speeds (80-85km/h)~~ • No separated facilities • ~~Uncontrolled intersection thus vehicles are more likely to exit/enter the intersection in front of a cyclist~~ • ~~No lighting~~ • Multi lanes • No cycle facilities Factors that **decrease** the likelihood include: • ~~Acceptable~~ Good line marking and delineation • Medium/low operating speeds	Factors that **increase** the likelihood include: • Inherent stability issues of motorcycles • ~~High operating speeds (80-85km/h)~~ • Motorcyclists are smaller than other vehicles and thus more likely to be hidden behind another vehicle. • ~~No lighting~~ • Multi lanes Factors that **decrease** the likelihood include: • ~~Acceptable~~ Good line marking and delineation • Medium/low operating speeds
	2.0/4	1.0/4	3.0/4	3.0/4	3.0/4	3.0/4	4.0/4
Severity	Factors that **increase** the severity include: • ~~High operating speeds (80-85km/h)~~ • Many point source hazards (power poles) near the intersection in the secondary crash zone areas.	Factors that **increase** the severity include: • High percentage of heavy vehicles. • ~~High operating speeds (80-85km/h)~~	Factors that **increase** the severity include: • ~~High operating speeds (80-85km/h) for intersection type crashes.~~ • ~~Right angle crashes possible.~~ • High percentage of heavy vehicles Factors that **decrease** the severity include: • Medium/low operating speeds	Factors that **increase** the severity include: • ~~High operating speeds (80-85km/h)~~ • High percentage of heavy vehicles may contribute to the severity	Pedestrians struck at speeds above 30 km/h are likely to be seriously injured or killed. Also, vehicle/pedestrian crashes at even lower speeds (especially involving heavy vehicles) can cause serious injury when the	Cyclists struck at speeds above 30 km/h are likely to be seriously injured or killed. Factors that **increase** the severity include: • ~~High speeds for this crash type~~ • High percentage of heavy vehicles • Medium/low operating speeds	Due to the vulnerability of motorcyclists, a crash between a motorcycle and a larger vehicle or a tree or barrier is likely to result in serious trauma unless speeds are very low. Factors that **increase** the severity include:

	Run-off-road	Head-on	Intersection	Other	Pedestrian	Cyclist	Motorcyclist
	• Culverts and drop offs/channel close to the road. Factors that **decrease** the severity include: • Some frangible poles (sign supports) • Some cleared area • Medium/low operating speeds	Factors that **decrease** the severity include: • Medium/low operating speeds	• Favourable angles	of crashes such as rear-end Factors that **decrease** the severity include: • Medium/low operating speeds • Favourable angles for these crash types	vehicle runs over the pedestrian Factors that **increase** the severity include: • ~~High speeds for pedestrians~~ • High percentage of heavy vehicles • Medium/low operating speeds Factors that **decrease** the severity include: • Medium/low operating speeds	Factors that **decrease** the severity include: • Medium/low operating speeds	• ~~High speeds for this road user~~ • High percentage of heavy vehicles • Lack of motorcycle friendly sign supports • Medium/low operating speeds Factors that **decrease** the severity include: • Medium/low operating speeds
	2.0/4	0.5/4	1.2/4	2.0/4	3.5/4	3.5/4	4/4
Product	12.0/64	1.5/64	10.8/64	18/64	12.3/64	14.0/64	33.0/64
						TOTAL	**101.6 / 448**

The aim of the Safe System matrix is to reduce the total score **towards zero**.

TOWARDS ZERO

5.8 Safer Vehicles, People and Post-Crash Care (high level comments)

Table 13: Safe System Assessment Comments – Safer Vehicles, People and Post – Crash Care

Safe System Element	Prompt	Comments/issues
Road User	Are road users likely to be alert and compliant? Are there factors that might influence this?	• Anyone travelling from Melbourne will have passed through Shepparton and thus is less likely to be in an immediate state of fatigue when passing through these intersections. However, travelling from the north on the National Highway/Goulburn Valley highway this may be the first intersection with major treatment, and thus may surprise a fatigued driver.
Road User	What are the expected compliance and enforcement levels (alcohol/drugs, speed, road rules, and driving hours)? What is the likelihood of driver fatigue? Can enforcement of these issues be conducted safety?	• While the hoon driving check (see below) does not indicate a high level of hoon behaviour, it is expected that there will be some hoon behaviour. Some hoon behaviour was observed on site and there were skid marks witnessed. • There are no pubs/clubs directly adjacent to these intersections.
Road User	Are there special road uses (e.g. entertainment precincts, elderly, children, on-road activities, motorcyclist route), distraction by environmental factors (e.g. commerce, tourism), or risk-taking behaviours?	• No special road uses are noted, although there are recreational cyclists that use Ford Road.
Vehicle	What level of alignment is there with the ideal of safer vehicles?	• There is nothing to indicate this project contravenes the ideals of safer vehicles.
Vehicle	Are there factors which might attract large numbers of unsafe vehicles? Is the percentage of heavy vehicles too high for the proposed/existing road design? Is this route used by recreational motorcyclists?	• Motorcycle volumes are expected to be approximately 1% consistent with state averages.
Vehicle	Are there enforcement resources in the area to detect non-roadworthy, overloaded or unregistered vehicles and thus remove them from the network? Can enforcement of these issues be conducted safety?	• VicRoads TSS operate in the area • There is nothing hampering enforcement.
Vehicle	Has vehicle breakdown been catered for?	• Shoulders provide space for broken down vehicles to manoeuvre out of the traffic lane.
Vehicle	Have advanced vehicle features been considered?	• To support emerging technologies including Lane Departure Warning, Lane Keeping Assistance and Traffic Sign Recognition, standard road markings and signs must be used wherever required and must not be worn out, obscured, inconsistent or confusing. It has been identified that the combination of inadequate maintenance of roads and inconsistencies in road markings and traffic signs is a major obstacle to the effective implementation of advanced vehicle features. • Avoid blacking out redundant pavement markings, as this may confuse a vehicle that is reading the line marking
Post-crash care	Are there issues that might influence safe and efficient post-crash care in the event of a severe injury (e.g. congestion, access stopping space)?	• No issues identified.

Safe System Element	Prompt	Comments/issues
Post-crash care	Do emergency and medical services operate as efficiently and rapidly as possible?	• There are medical services in Shepparton, thus it is assumed that efficient post-crash care is available.
Post-crash care	Are other road users and emergency response teams protected during a crash event? Are drivers provided the correct information to address travelling speeds on the approach and adjacent to the incident? Is there reliable information available via radio, VMS etc.	• No specific features are part of this project • Consider utilising VMSs as part of a wider VMS strategy if appropriate.
Maintenance	Can all road features be maintained in a safe and efficient manner?	• No non-standard features which may create maintenance issues are noted.

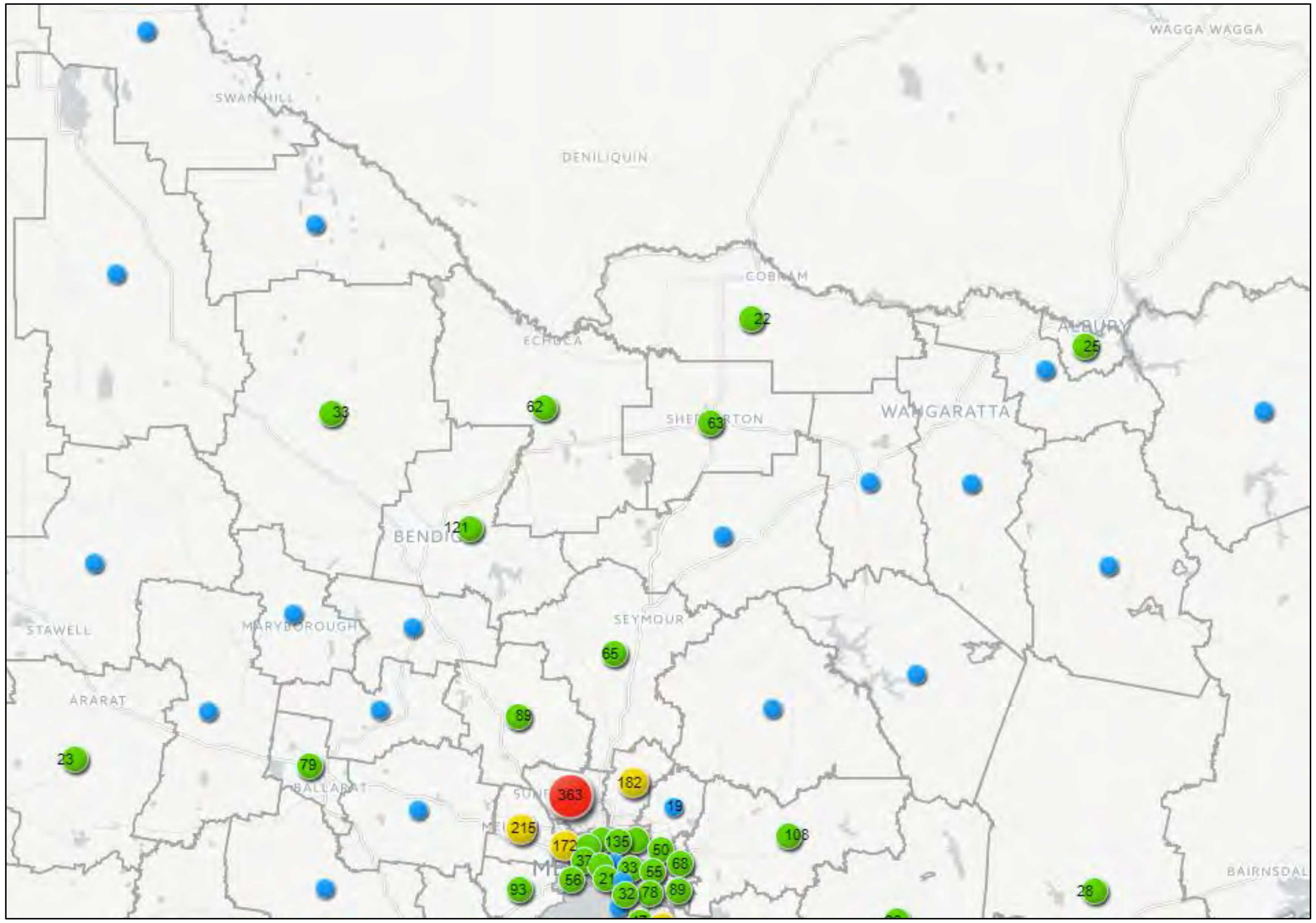
5.9 Safer People

For the Safe System to work, it is necessary for users of the system to behave in ways that will allow the system to protect them. It is therefore important that road users understand that they have to keep their side of the bargain (or agreement), if they are to be protected by the way the roads and vehicles have been configured to keep them safe. There are no guarantees of protection, however, if drivers choose to travel at speeds well over the speed limit or, as result of being impaired, if they drive in a risky or reckless manner. Crucial, then, is that the community understands what the Safe System is and what it hopes to achieve and, importantly, the way they need to observe traffic laws if they are to enjoy the protection that the system has to offer.

Hoon behaviour:

Figure below shows the Safe Driving Program Orders which has been used as a proxy for the level of hoon behaviour in the area. Compared to the surrounding regions, Ford Road has a low rate of hoon behaviour.

Figure 4: Safe Driving Program Orders



6 Recommendations

Infrastructure recommendations are classified into categories as instructed in *AP-R509-16 Austroads Safe System Assessment Framework*.

Definitions of the alignment with Safe System principles are:

Primary Treatments: Road planning, design and management considerations that virtually eliminate the potential of fatal or serious injuries occurring in association with the foreseeable crash types.

Step Towards: Road planning, design and management considerations that improve the overall level of safety associated with foreseeable crash types, but do not virtually eliminate the potential of fatal or serious injuries occurring. However, when applied to an existing road environment they improve the ability for a Primary Treatment to be implemented in the future.

Supporting Treatments: Road planning, design and management considerations that improve the overall level of safety associated with foreseeable crash types, but do not virtually eliminate the potential of fatal or serious injuries occurring. When applied to an existing road environment they do not change the ability for a primary treatment to be installed in the future.

Project managers are encouraged to implement as many of the recommendations as possible, with preference for Primary Treatments.

Where matrix scores still remain high, project managers are encouraged to look to the other elements of the Safe System to reduce risk.

This Safe System Assessment provides a series of recommendations/options to move the Project further Towards Zero.

Recommendations/options:

Primary Treatments:

Traffic Signals:

Consider:

- If traffic signals are installed as the intersection control, consider installing raised platforms or other devices to achieve a design speed of 50km/h.
- While conflicting with the function of these roads, to achieve primary Safe System for pedestrians crossing the road, the speeds would need to be reduced to 30km/h at all crossing points. Alternatively, a separated facility would be required (ie. an underpass or overpass). It is noted that the likely pedestrian volumes will be low at all crossing locations, except Verney/Ford.
- Reconsider the need for slip lanes at the signalised intersections. Crashes occur when vehicle drivers are looking to their right for gaps in traffic rather than concentrating on pedestrians. If slip lanes are required, ensure that there are acceptable sight lines to the pedestrian crossing location and that the crossing point is raised to lower vehicle speeds (ie. Wombat Crossing).
- Consider the design specific recommendations in Appendix G.

Roundabout:

Consider:

- Installing a single lane roundabout and accept a small level of congestion during some hours of peak traffic volume.
- Installing separators/splitters on the approach to the intersection to minimise 'straight lining' through the two-lane roundabout at GVH/Wanganui (see example design in Appendix H).
- Consider the addition of signalised pedestrian crossings on pedestrian desire lines.
- See design specific recommendations in Appendix G.

Supporting Treatments:

Traffic Signals:

Consider:

- If the intersection is not raised and supplemented with advisory speeds, consider adjusting the regulatory speed limit on Grahamvale Road to 60km/h on the approach to the intersection. Consider extending the 60km/h speed limit on the GVH to the north, and on other roads implementing speed limit reductions to 60km/h if traffic signals are being implemented.
- Ensure that the traffic signals at Grahamvale Road are linked to the railway level crossing to eliminate the possibility of a stacking issue.
- Even with the signal linking, add measures to ensure that a vehicle trapped on the level crossing could 'escape' if required.
- If traffic signals are installed without raised safety platforms, consider designing the intersections so that raised platforms can be easily installed in the future.
- If traffic signals are installed without raised safety platforms, consider designing the intersections so that speed and red light cameras can be easily installed in the future, or consult with the Department of Justice to ascertain if they can be installed as part of the project.
- See design specific recommendations in Appendix G.

Roundabout:

Consider:

- If pedestrian signals are not installed, consider designing pedestrian crossing points so that they can be retrofitted with traffic signals.
- Consider using Danish Offset (aka Z-Crossing) crossings.
- Consider installing cycling crossing points on the roundabout (see example in Appendix H)
- See design specific recommendations in Appendix G.

Other Safe System Elements:

Consider:

- Consider working with the main heavy vehicle operators to ensure that they have undertaken the Heavy Vehicle Rollover Program and they understand the risks of heavy vehicles rolling over at roundabouts.

7 Conclusion

The installation of either traffic signals or a roundabout at both the GVH and Grahamvale Road intersections with Ford Road will improve alignment with Safe System principles, however for both of these intersections the better alignment with Safe System principles are roundabouts (acknowledging that there are some complications with a roundabout near the railway level crossing at Grahamvale Road).

This is not the case for Verney / Ford Roads intersection. The installation of traffic signals or the retention of the single lane roundabout moves this intersection further from a Safe System intersection (the retention is score is driven by the expected increase in pedestrian volumes). The other scores are predominately due to the increased speeds and lanes.

Modifications to a roundabout or traffic signals can be incorporated into the current designs to give very high alignment with Safe System principles.

8 References

Bahouth, G., Graygo, J., Digges, K., Schulman, C. & Baur, P 2014, 'The benefits and tradeoffs for varied high-severity injury risk thresholds for advanced automatic crash notification systems', Traffic Injury Prevention, vol. 15, Supplement 1, pp143-140.

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Doecke, S. & Woolley, J. (2010) Effective use of clear zones and barriers in a Safe System's Context. Australasian Road Safety Research, Policing and Education Conference. Centre for Automotive Safety Research, University of Adelaide.

Jurewicz C, Sobhani Dr A, Woolley Dr J, Dutschke Dr J, Corben Dr B, 2015, Proposed vehicle impact speed - severe injury probability relationships for selected crash types, Australasian Road Safety Conference.

Moon and Mihailidis, Outcome Based Management of Roadside Hazards, ACRS 2013,

Appendix A: Photos

Photo 1: Goulbourn Valley Highway facing south on the approach to Ford Street.

Photo 2: Ford Street facing west on the approach to the Goulbourn Valley Highway

Photo 3: Goulbourn Valley Highway facing north at the intersection of Wanganui Road.

Photo 4: Goulbourn Valley Highway facing south at the intersection of Wanganui Road.

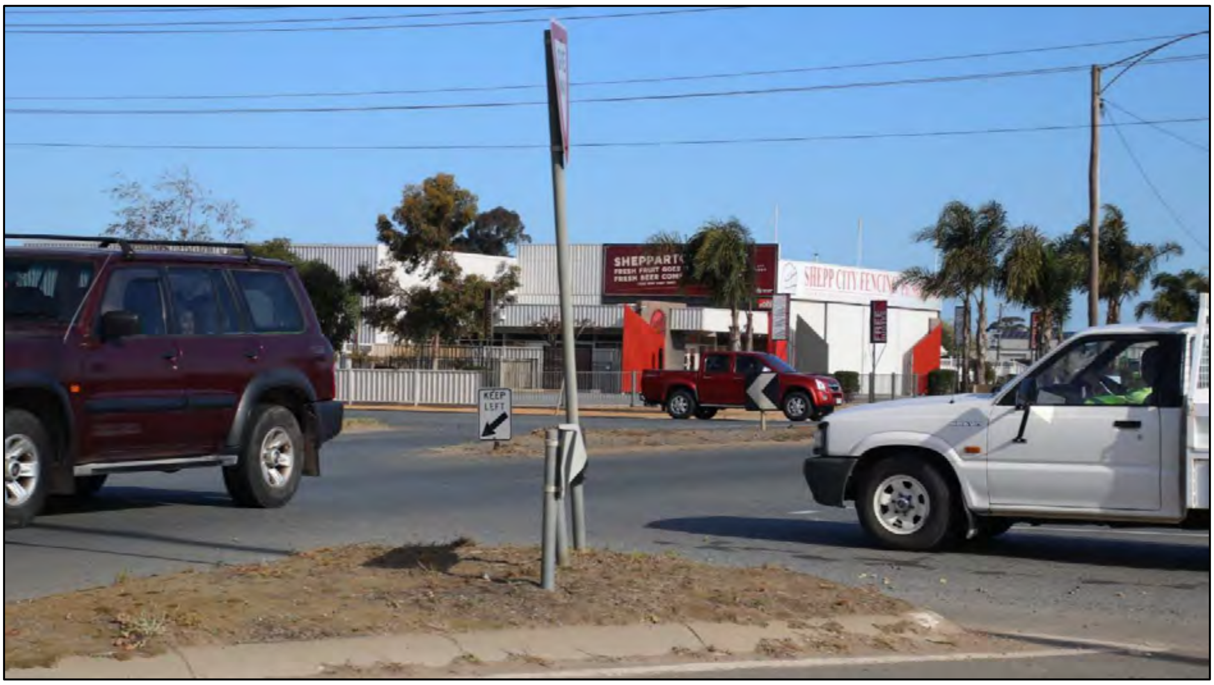


Photo 5: Goulbourn Valley Highway facing south east at the intersection of Wanganui Road.

Photo 6: Wanganui Road on the approach to the Goulbourn Valley Highway facing east.

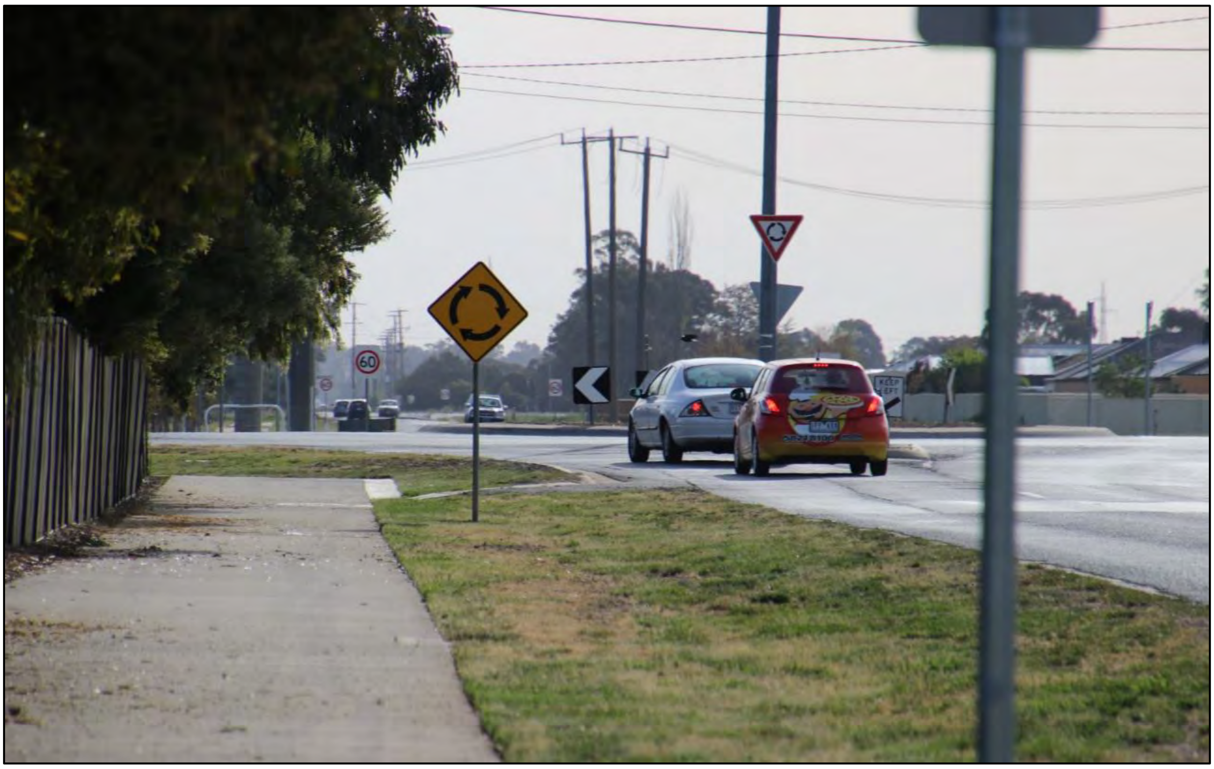


Photo 7: Ford Road facing west on the approach to the Verney Road roundabout.

Photo 8: Verney Road facing north on the approach to the Ford Road roundabout.

Photo 9: Verney Road shared path facing north on the approach to the Ford Road roundabout.

Photo 10: Verney Road facing south on the approach to the Ford Road roundabout.

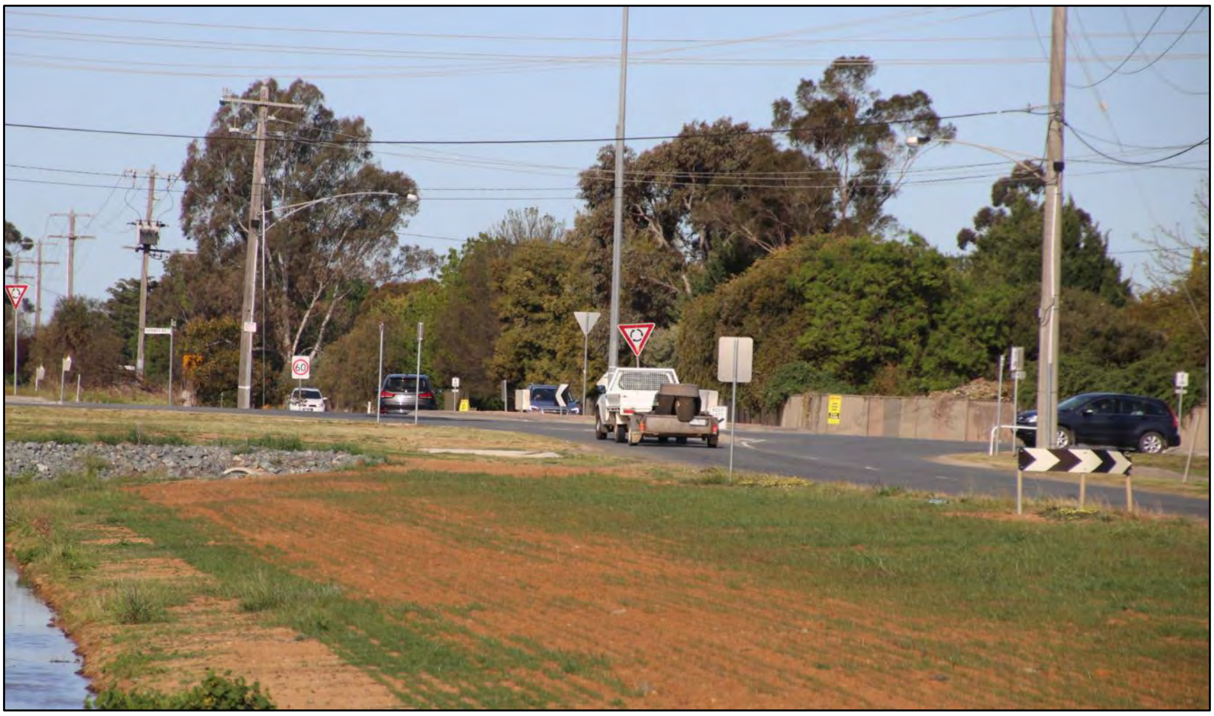


Photo 11: Ford Road facing east on the approach to the Verney Road roundabout.

Photo 12: Grahamvale Road on the approach to Ford Road facing north.

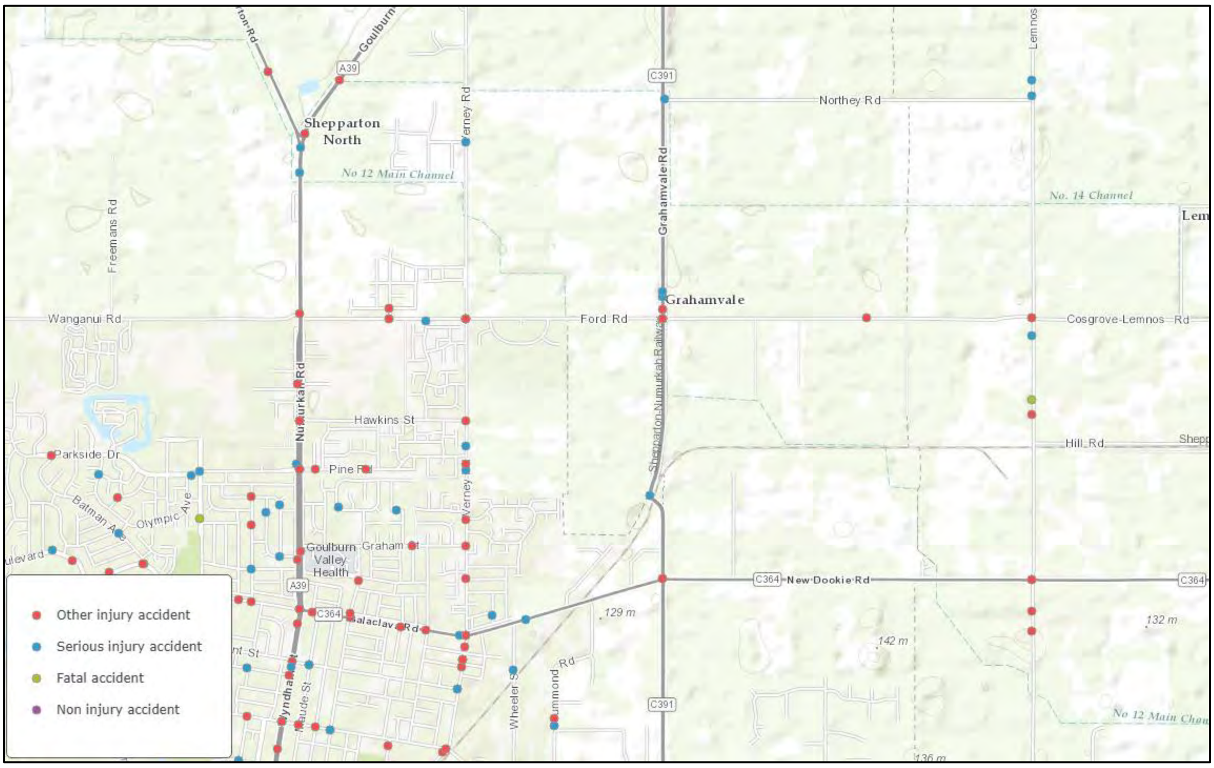
Photo 13: Ford Road facing west on the approach to Grahamvale Road.

Photo 14: Grahamvale Road on the approach to Ford Road facing south.

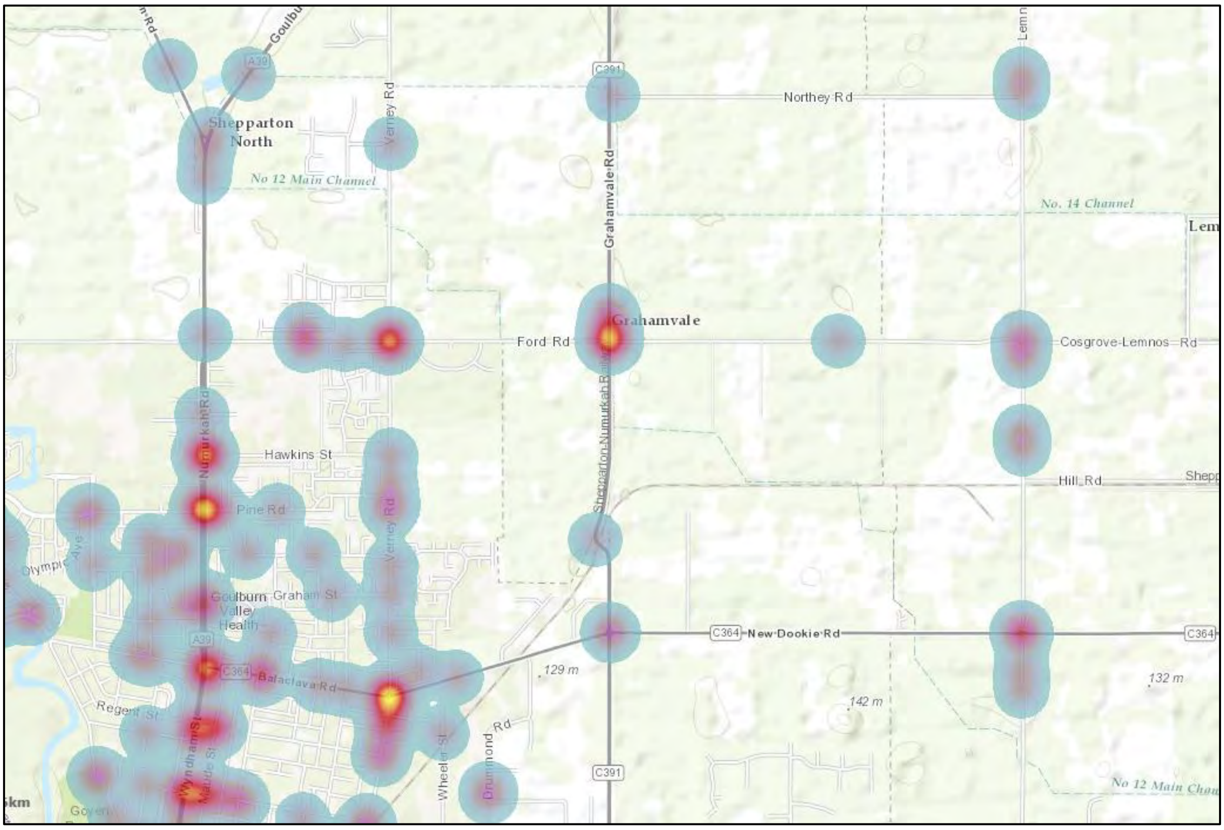
Photo 15: Ford Road facing east on the approach to Grahamvale Road.

Appendix B: Crash History (last 5 years)

All by node type

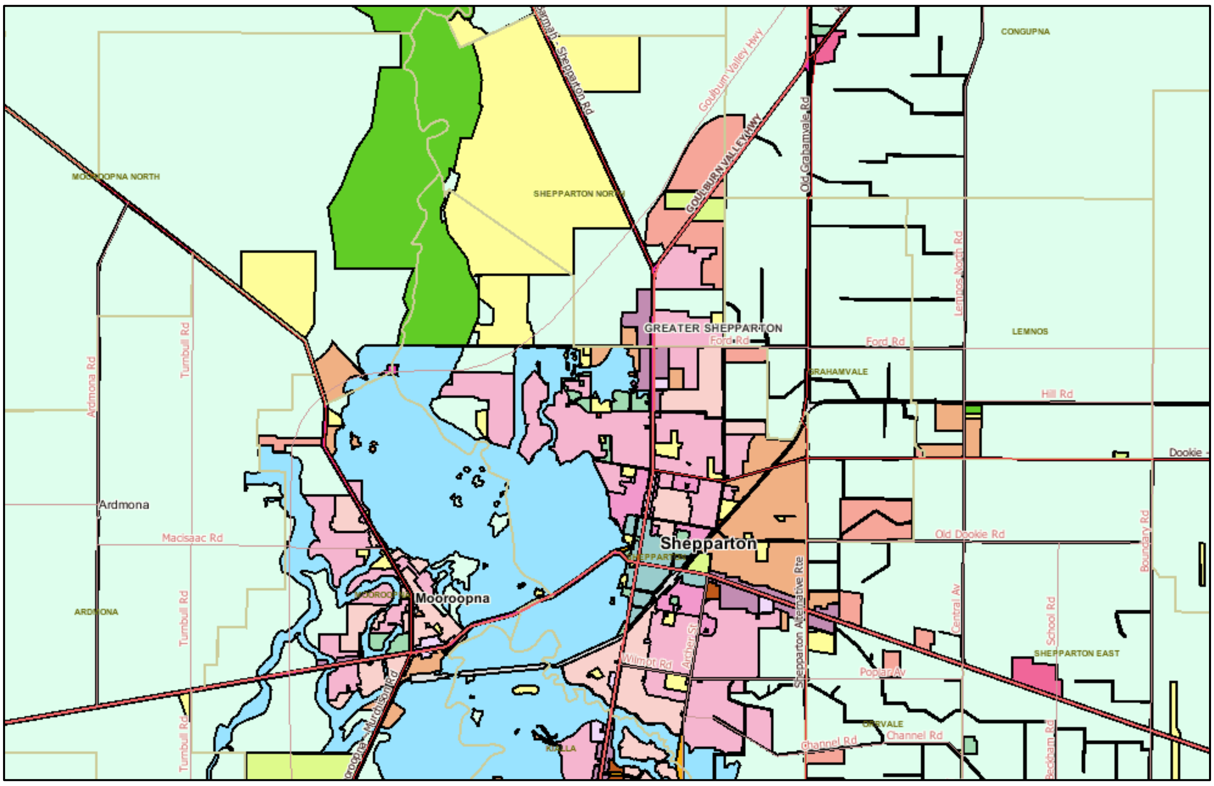


Source: ArcGIS



Source: ArcGIS

Appendix C: Surrounding Land Use



ZONES

- ACZ - Activity Centre
- B1Z - Commercial 1
- B2Z - Commercial 1
- B3Z - Commercial 2
- B4Z - Commercial 2
- B5Z - Commercial 1
- C1Z - Commercial 1
- C2Z - Commercial 2
- CA - Commonwealth Land
- CCZ - Capital City
- CDZ - Comprehensive Development
- DZ - Dockland
- ERZ - Environmental Rural
- FZ - Farming
- GRZ - General Residential
- GWAZ - Green Wedge A
- GWZ - Green Wedge
- IN1Z - Industrial 1
- IN2Z - Industrial 2
- IN3Z - Industrial 3
- LDRZ - Low Density Residential
- MUZ - Mixed Use
- NRZ - Neighbourhood Residential
- PCRZ - Public Conservation & Resource
- PDZ - Priority Development
- PPRZ - Public Park & Recreation
- PUZ1 - Public Use - Service & Utility
- PUZ2 - Public Use - Education
- PUZ3 - Public Use - Health Community
- PUZ4 - Public Use - Transport
- PUZ5 - Public Use - Cemetery/Crematorium
- PUZ6 - Public Use - Local Government
- PUZ7 - Public Use - Other Public Use
- PZ - Port
- R1Z - General Residential
- R2Z - General Residential
- R3Z - General Residential
- RAZ - Rural Activity
- RCZ - Rural Conservation
- RDZ1 - Road - Category 1
- RDZ2 - Road - Category 2
- RGZ - Residential Growth
- RLZ - Rural Living
- RUZ - Rural
- SUZ - Special Use
- TZ - Township
- UFZ - Urban Floodway
- UGZ - Urban Growth

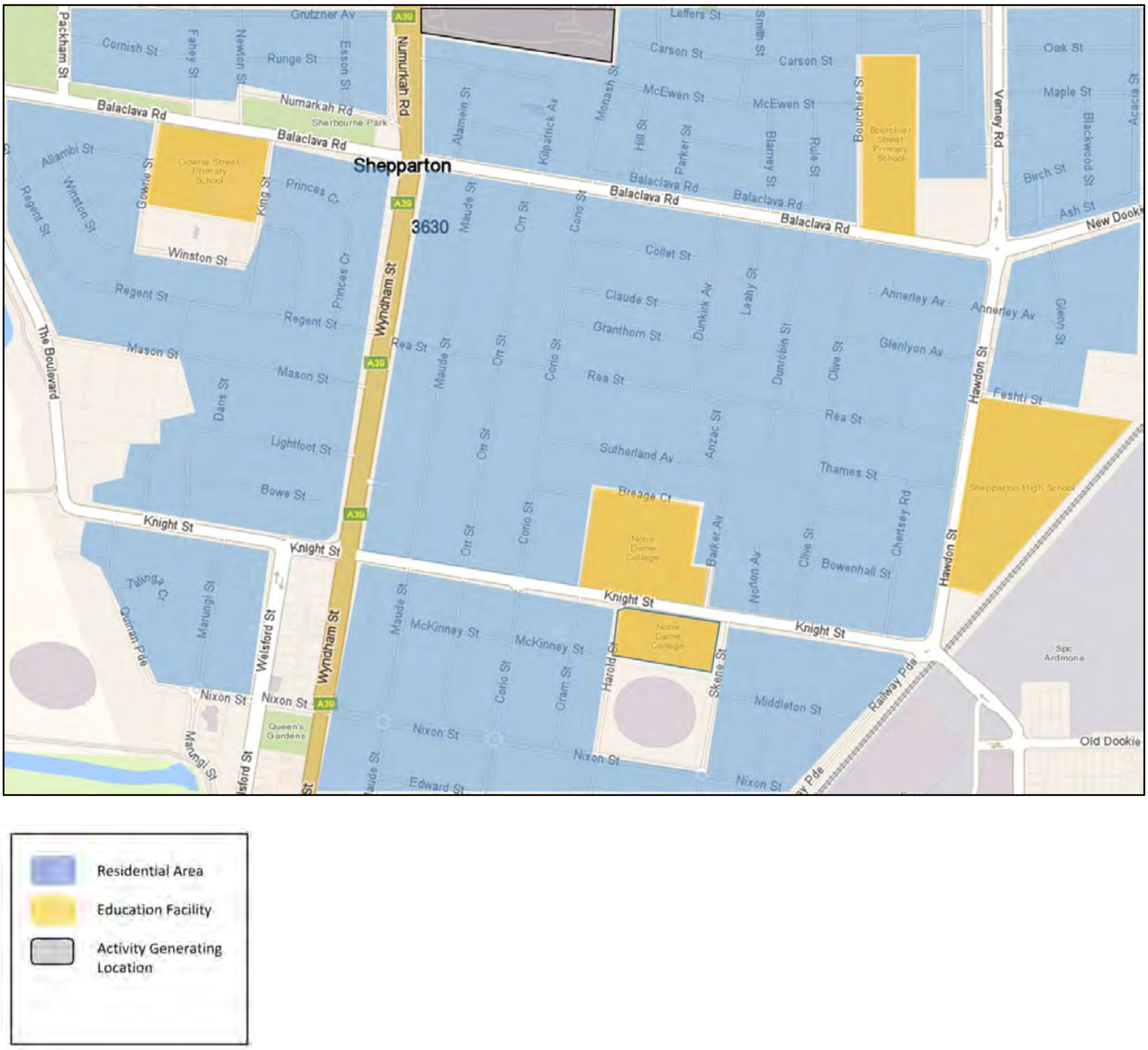
OVERLAYS

- AEO - Airport Environs
- BMO - Bushfire Management (also WMO)
- CLPO - City Link Project
- DCPO - Development Contributions Plan
- DDO - Design & Development
- DDOPT - Design & Development Part
- DPO - Development Plan
- EAO - Environmental Audit
- EMO - Erosion Management
- ESO - Environmental Significance
- FO - Floodway
- HO - Heritage
- IPO - Incorporated Plan
- LSIO - Land Subject to Inundation
- MAEO1 - Melbourne Airport Environs 1
- MAEO2 - Melbourne Airport Environs 2
- NCO - Neighbourhood Character
- PO - Parking
- PAO - Public Acquisition
- RO - Restructure
- RCO - Road Closure
- SBO - Special Building
- SLO - Significant Landscape
- SMO - Salinity Management
- SRO - State Resource
- VPO - Vegetation Protection

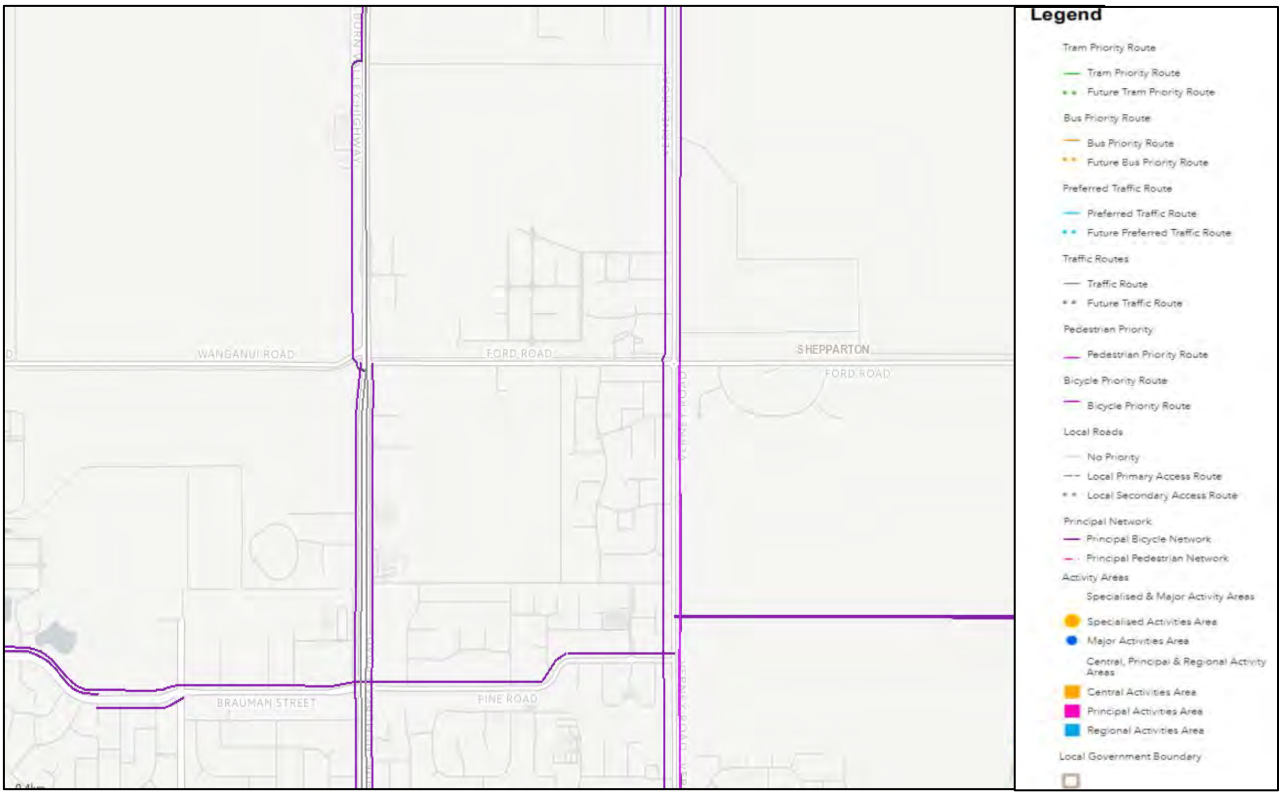
Source: land.vic.gov.au

Appendix D: Surrounding Land Use 2

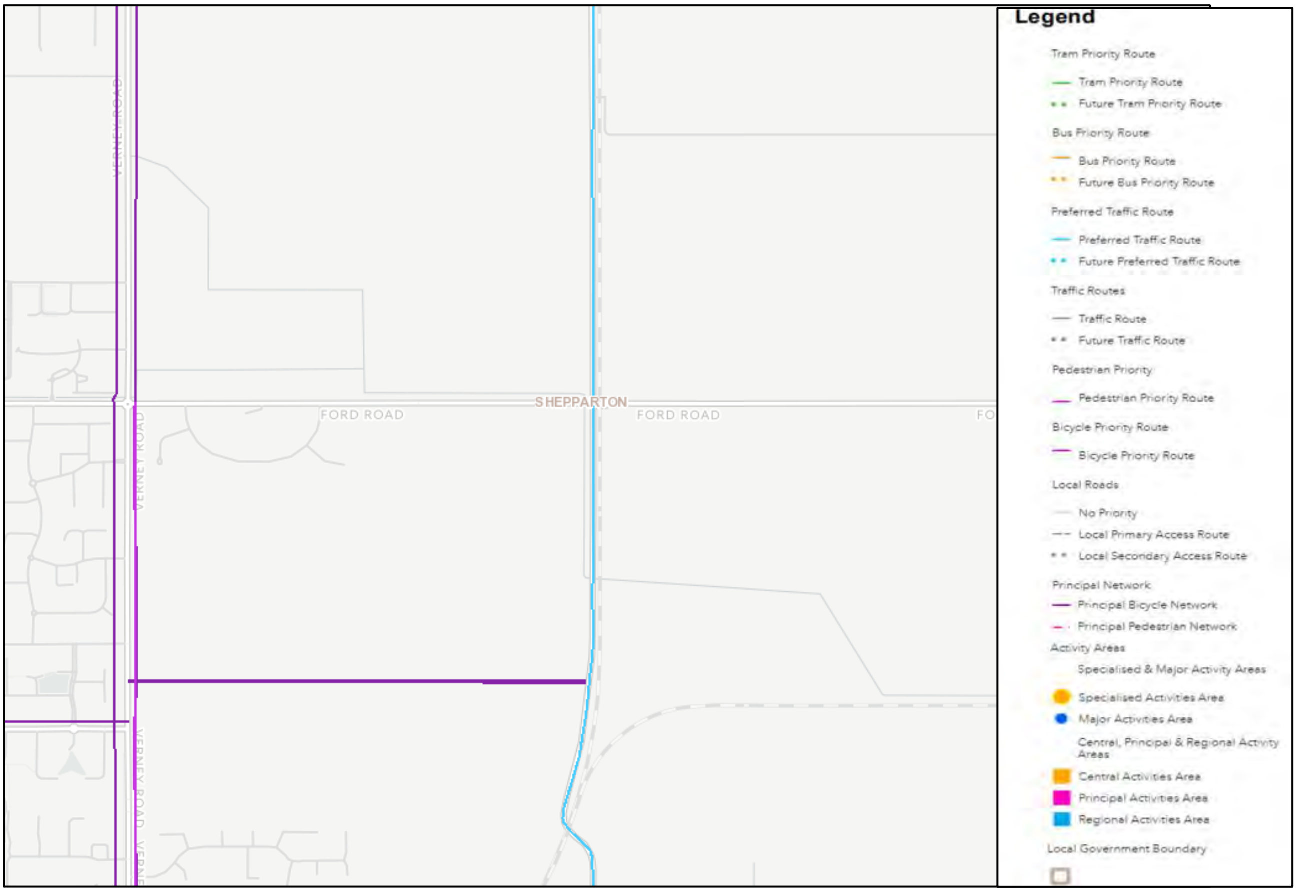

Shepparton North
Inter Continental Spares
Freemans Rd
Wanganui Rd
Wanganui Rd
Ford Rd
Numurkah Rd
A39
Warrumbungle Dr
Southdown St
Merino Dr
Hereford Dr
Ryeland Dr
Romney Ct
Verney Rd
Vincent St
Mercury Dr
Fairley's
Gum Rd
Banks Pl
Evergreen Wy
Wanganui Park Secondary College
Parkside Dr
Former Motel
Hawkins St
Alan St
Kestrel Dr
Chevrolet Av
Pontiac Av
Sabre Dr
Brauman St
Pine Rd
Botany Ct
Orchard Cct
Baldwyn Park
Cameron Av
Malcolm Cr
Hicken Cr
Tilton St
Phillips St
Lewis St
Fahey St
Newton St
Halpin Cr
Malcolm Cr
Lister Ct
Fowler St
Reid St
Fitzgerald St
Graham St
Smith St
Gillies St
Bourchier St
Carson St
McEwen St
Grutzner Av
Cornish St
Runge St
Numurkah Rd
Packham St
Dampier Av
Olympic Av
Glory Wy
Batman Av
Olympic Av
Hovell Ct
Wentworth St
Burke St
Wills St
Jacaranda Dr
Maculata Dr
The Boulevard
Chas Johnson Park
King Richard
Plane St
Oak St
Maple St
Residential Area
Education Facility
Activity Generating Location


Shepparton
3630
Balaclava Rd
Knight St
Wyndham St
Numurkah Rd
Hawdon St
Gowrie Street Primary School
Bourchier Street Primary School
Notre Dame College
Shepparton High School
Sherbourne Park
Queen's Gardens
Grutzner Av
Cornish St
Runge St
Numarkah Rd
Carson St
McEwen St
Oak St
Maple St
Birch St
Ash St
Collet St
Claude St
Granthorn St
Annerley Av
Glenlyon Av
Regent St
Mason St
Rea St
Lightfoot St
Bowe St
Sutherland Av
Thames St
Breage Ct
Bowenhall St
McKinney St
Nixon St
Middleton St
Edward St
Winston St
Princes Cr
The Boulevard
Fesahi St
Old Dookie
Residential Area
Education Facility
Activity Generating Location

Appendix E: Road Hierarchy Map

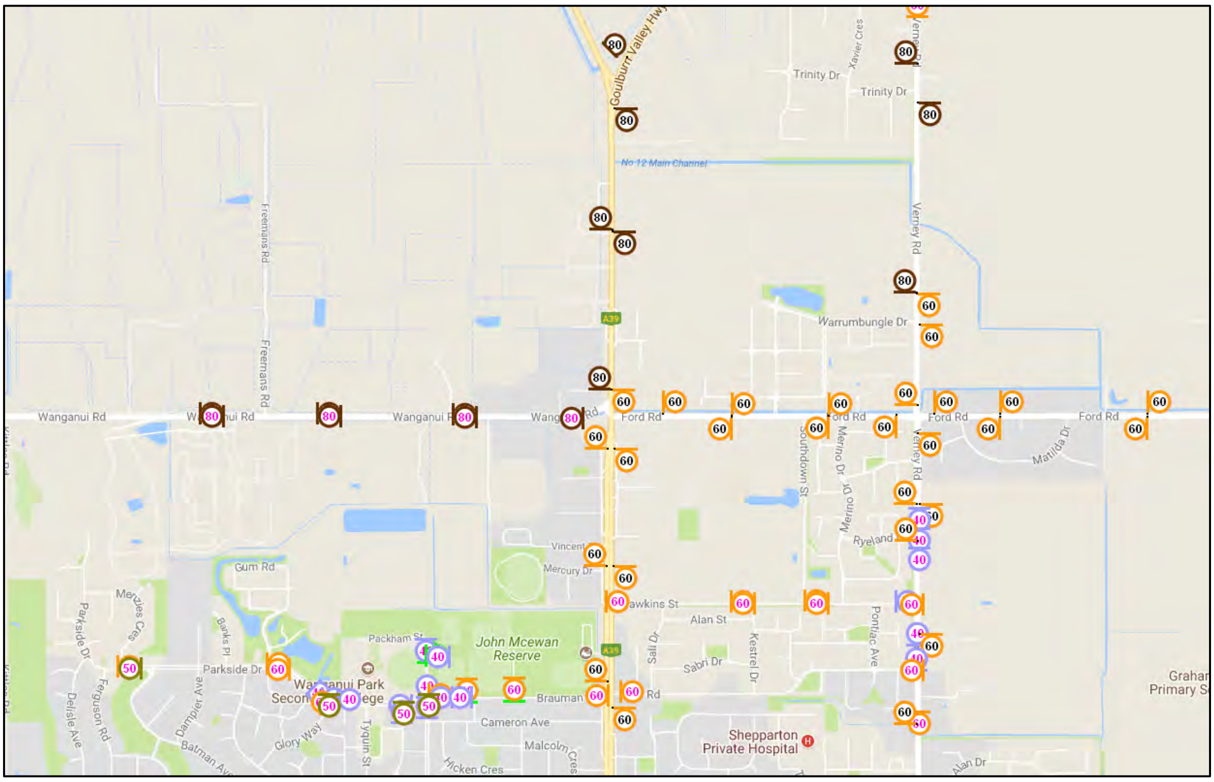


Source: VicRoads



Source: VicRoads

Appendix F: Speed Signs Locations



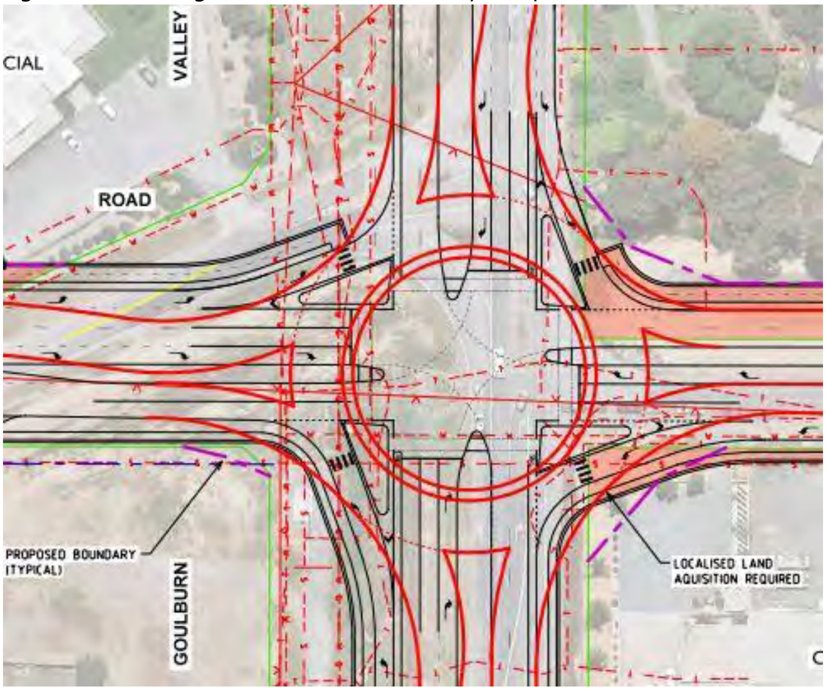
Goulburn Valley Hwy
Trinity Dr
Verney Rd
No 12 Main Channel
Freemans Rd
Warrumbungle Dr
Wanganui Rd
Ford Rd
Southdown St
Merino Dr
Matilda Dr
Ryeland
Gum Rd
Vincent
Mercury Dr
Hawkins St
Alan St
Packham St
John Mcewan Reserve
Parkside Dr
Wanganui Park Secondary College
Brauman Rd
Cameron Ave
Malcolm Cres
Sabri Dr
Kestrel Dr
Pontiac Ave
Shepparton Private Hospital
Glory Way
Tyquin St
Dampier Ave
Ferguson Rd
Delisle Ave
Batman Ave
Banks Pl
Menzies Cres
Hicken Cres
Alan Dr
Salli Dr

Appendix G: Design Review Comment

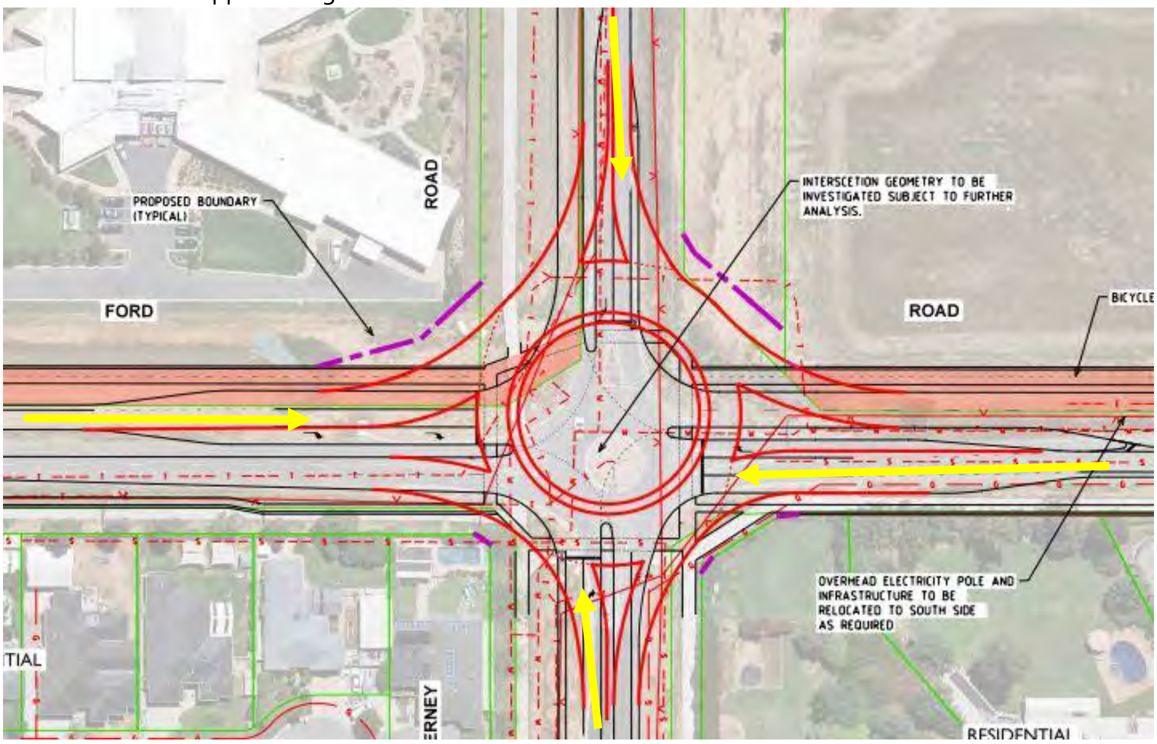
General Comments.

- For roundabout and signalised intersection options the design remains silent on the use of barriers to shield motorists from road side hazards such as major channels, vegetation, power poles. Consider developing a barrier strategy for the project to address the issues stated above and to improve road safety.

- For the roundabout intersection options, the design has remained silent on installing pedestrian and cyclist infrastructure. To improve pedestrian and cyclist safety consider developing a pedestrian and cyclist strategy, which should address issues such as but not limited to the following; crossing points at intersections, separation between traffic movements, and connectivity to any new developments and the existing network. (Image: roundabout with no cyclist/ped infrastructure)



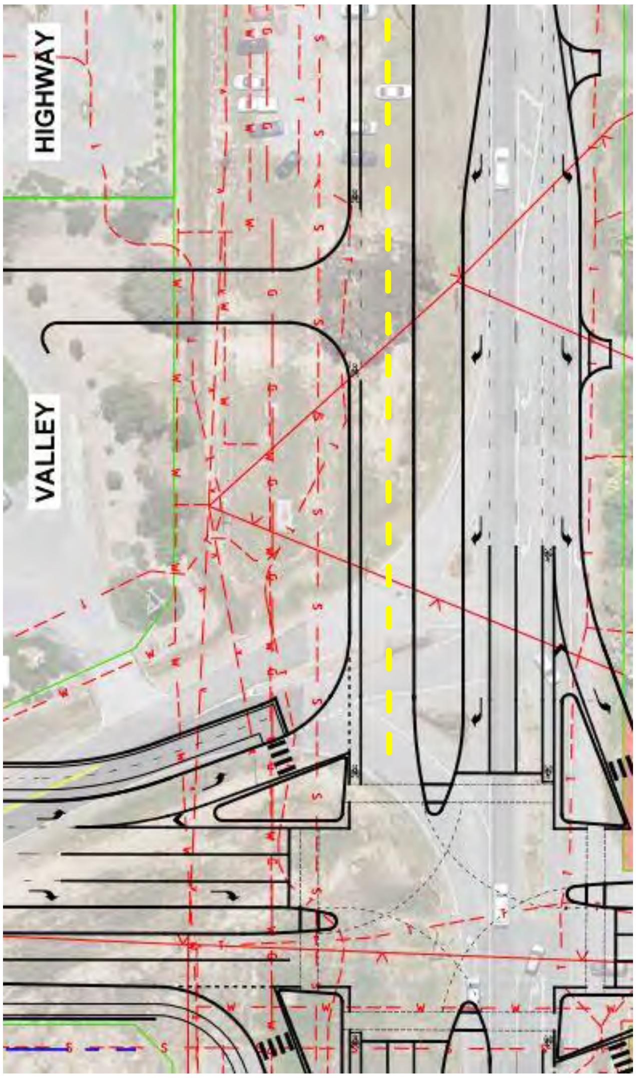
- For the roundabout intersection options, the approaches to the intersection remain straight. Motorists approaching the intersection can do so at higher speed which may result in failure to give - way and run-off road crashes at these locations. Consider installing reverse curves or raised platforms to slow motorists approaching the intersection.



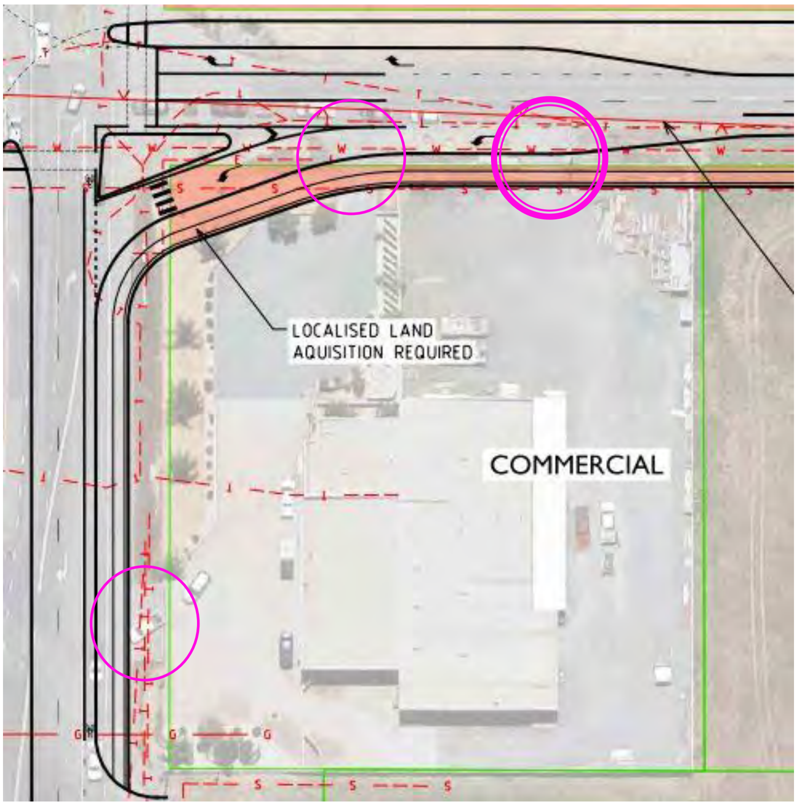
- For some signalised intersections options the plans detail a skew in the pedestrian path alignment when crossing at the intersection. Skews in pedestrian paths at intersections should be avoided where possible as the sudden change in direction is awkward for pedestrians and more importantly those with disabilities such as the vision impaired. Consider re-aligning the pedestrian paths as so pedestrians cross 90 degrees to traffic.

Goulburn Valley Highway – Ford Road Signalised Intersection.

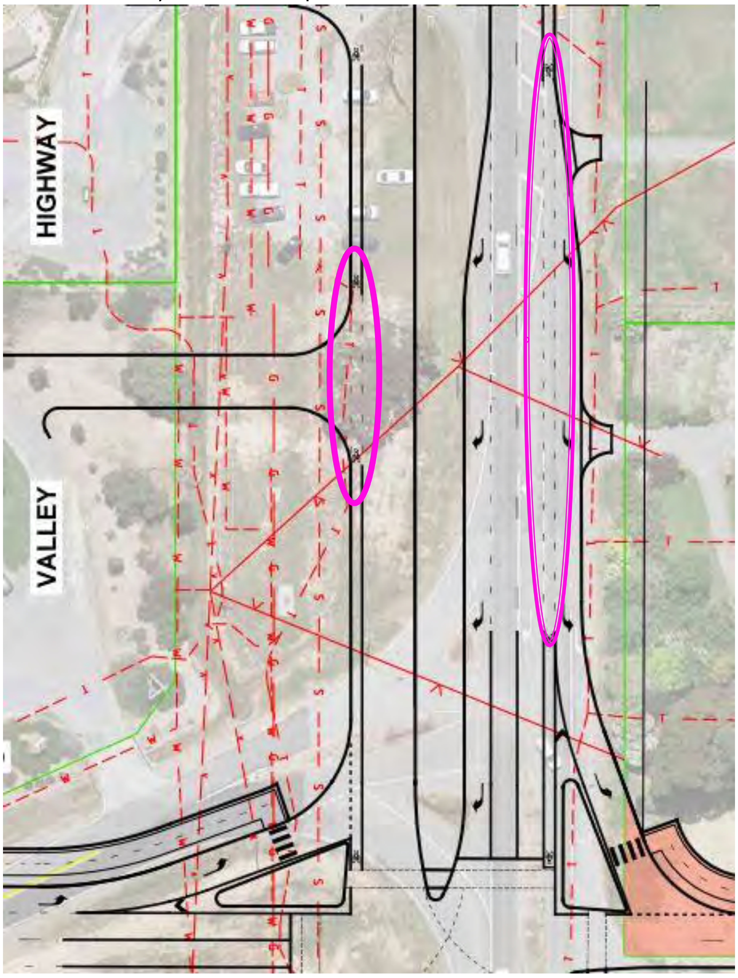
- For motorists traveling North along GVH, on the departure side of the intersection pavement markings are not shown. This could result in poor lane discipline and side-swipe crashes at this location. Consider installing pavement markings at this location to improve motorist safety.



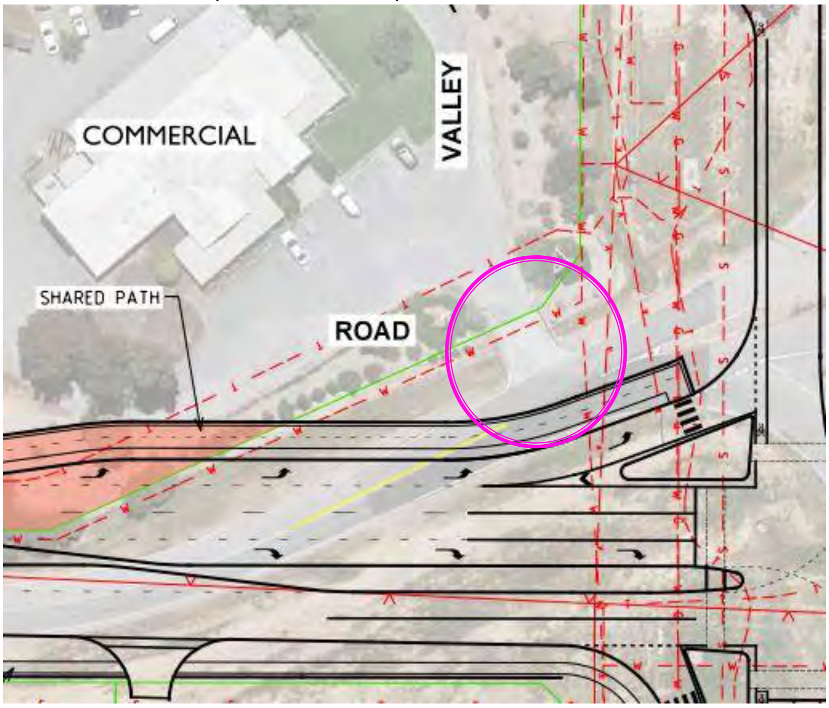
- There is a commercial business located on the South-East corner of the intersection. The design remains silent on re-instating access to this site which could result in un-safe movements and crashes at this location. Consider detailing access points on plans with consideration given to vehicle movements into and out of this business and ensure they can be performed safely.



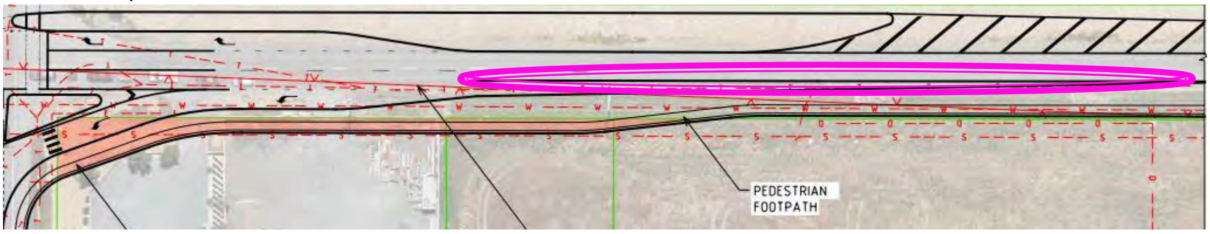
- The design details on-road cyclist lanes at the intersection location. Currently motorists and cyclists are unaware of conflict locations between intersection movements which could result in crashes at this location. Consider installing 'green pavement' at conflict points to alert motorists and cyclists alike as so they can act and proceed with caution at these locations.



- The design has remained silent on the existing access for the commercial business located on the North-West corner of the intersection. Consider removing this access to simply intersection movements and improve road safety at this location.

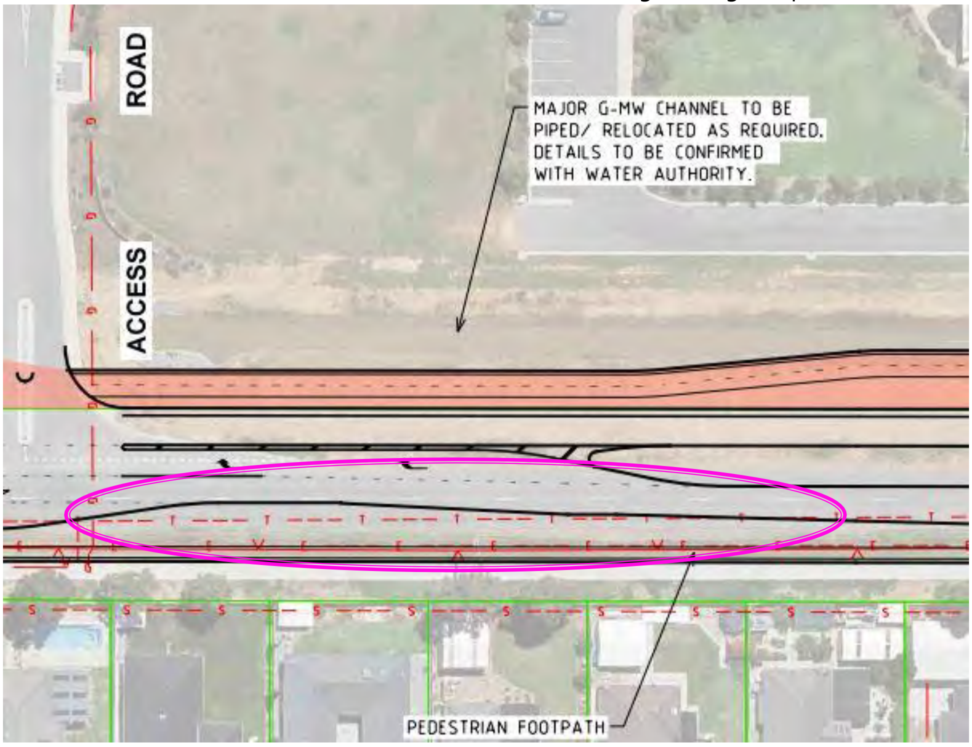


- Located on the South-East corner of the intersection there is a solid line shown, as such it is unclear as to the width of the traffic lane at this location. Consider removing the dark line as so the single lane develops into two lanes at the intersection location.



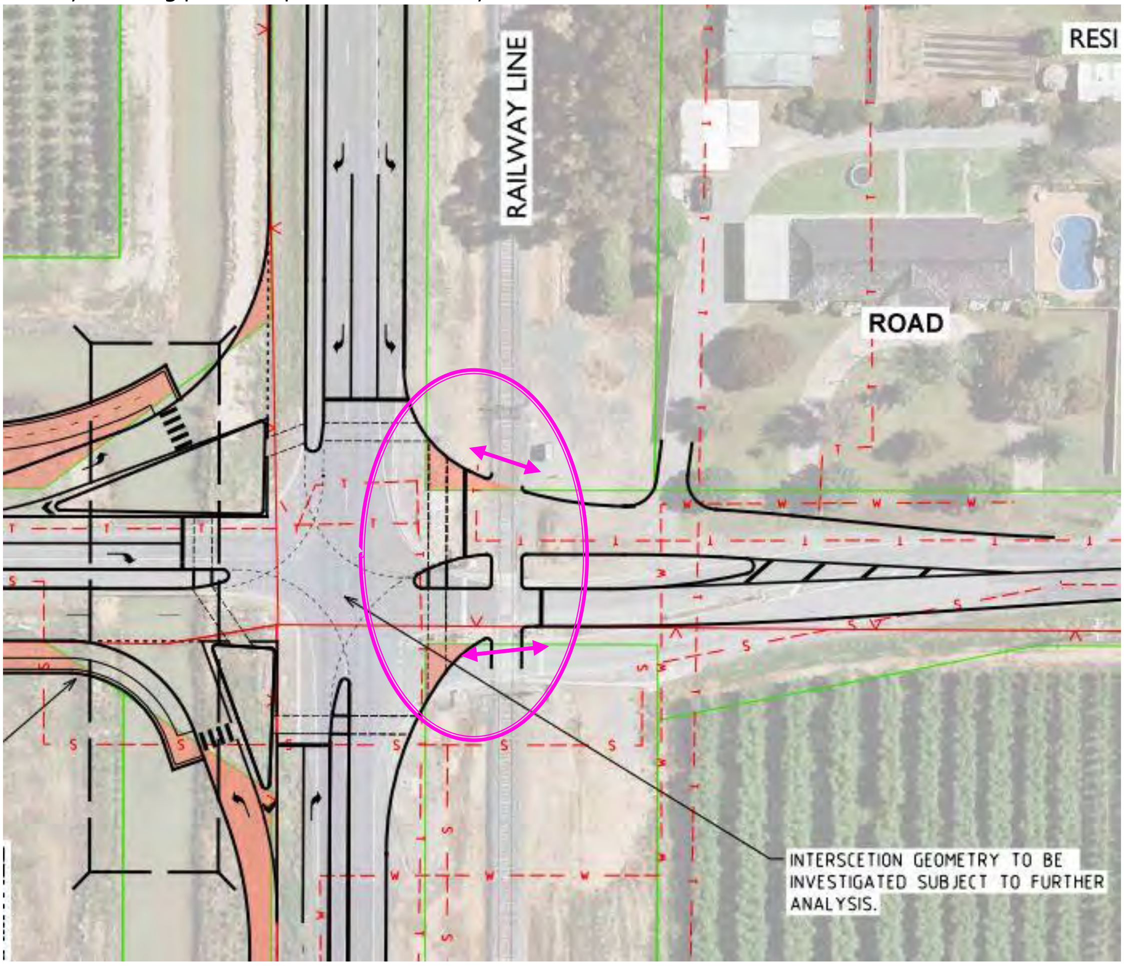
Verney Road – Ford Road Signalized Intersection

- For motorists traveling West on Ford Road approaching Access Road intersection are focused on intersection movements occurring ahead whilst performing a lateral shift. The kerb at this location has a number of kinks in its alignment which could result in a vehicle mounting the kerb and run-off road crashes at this location. Consider installing a straight taper at this location.

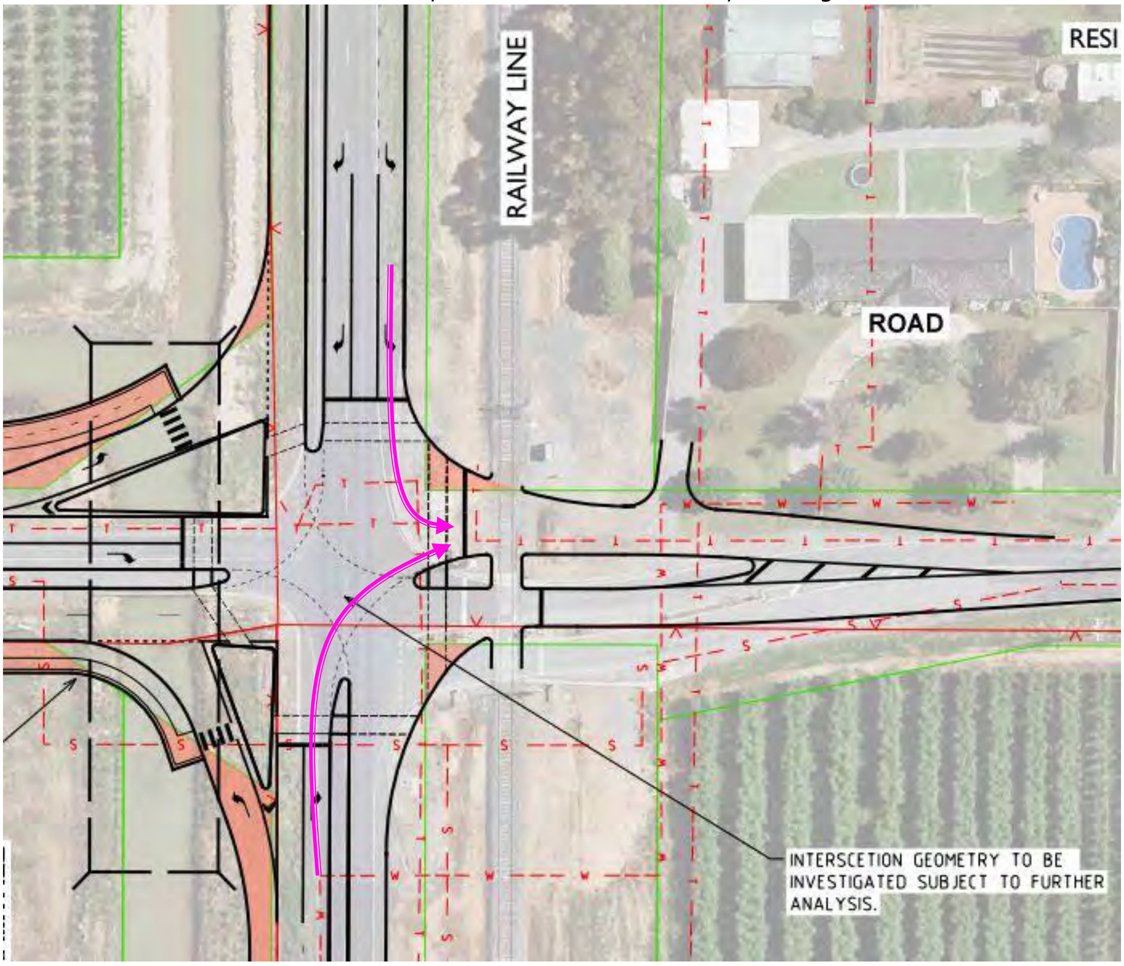


Grahamvale – Ford Road Signalised intersection.

- The plans detail no designated East-West crossing points for the existing railway crossing. This could result in unsafe movements and crashes at this location. Consider installing a designated railway crossing point for pedestrians and cyclists at this location.

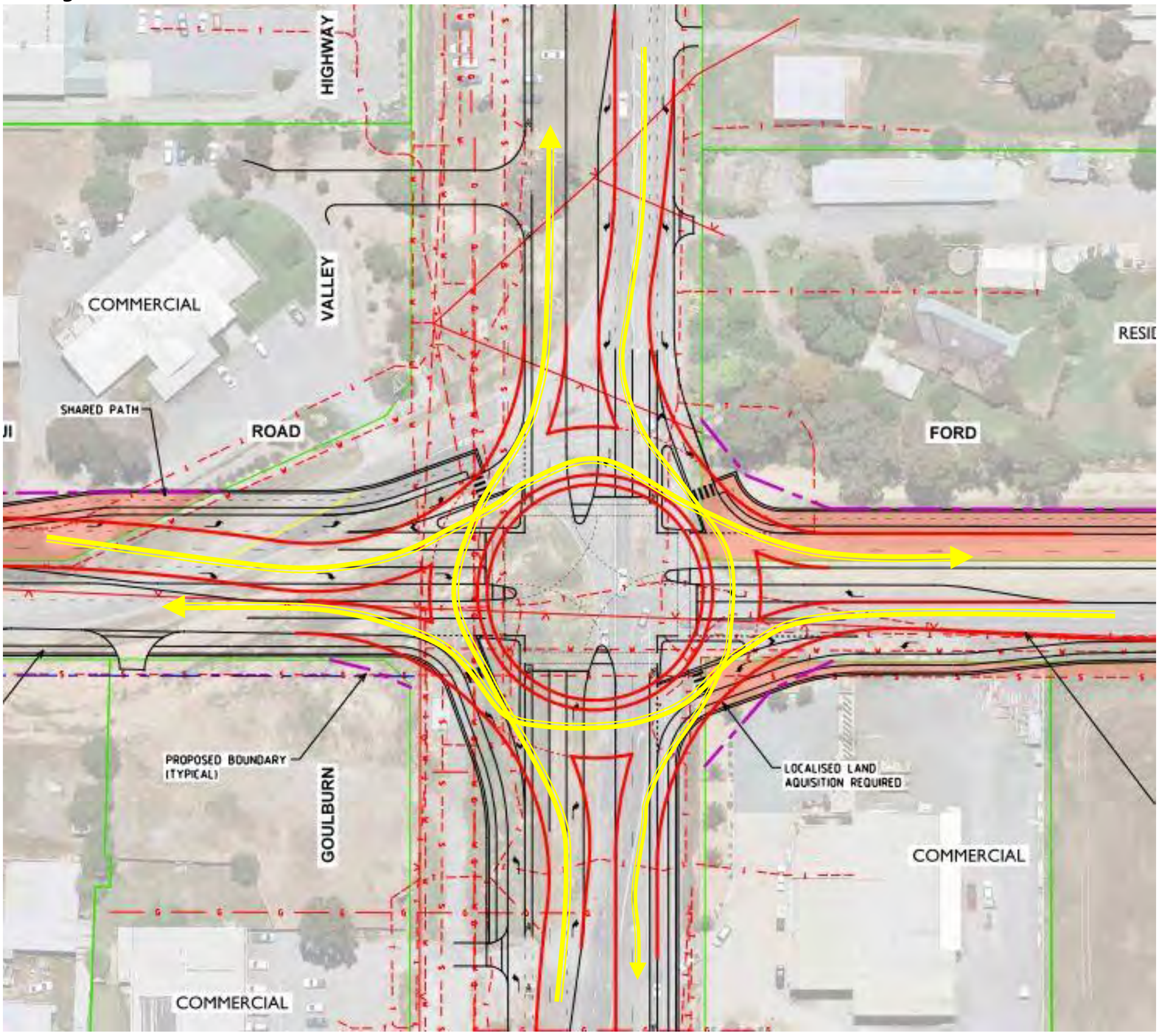


- If a train is coming and the railway crossing is activated, motorists turning into Ford Road or on Ford Road heading East may become stranded within the intersection resulting in crashes. Consider linking the phasing of the intersection to the railway crossing as so Eastbound movements at the intersection are not permitted whilst the railway crossing is activated.



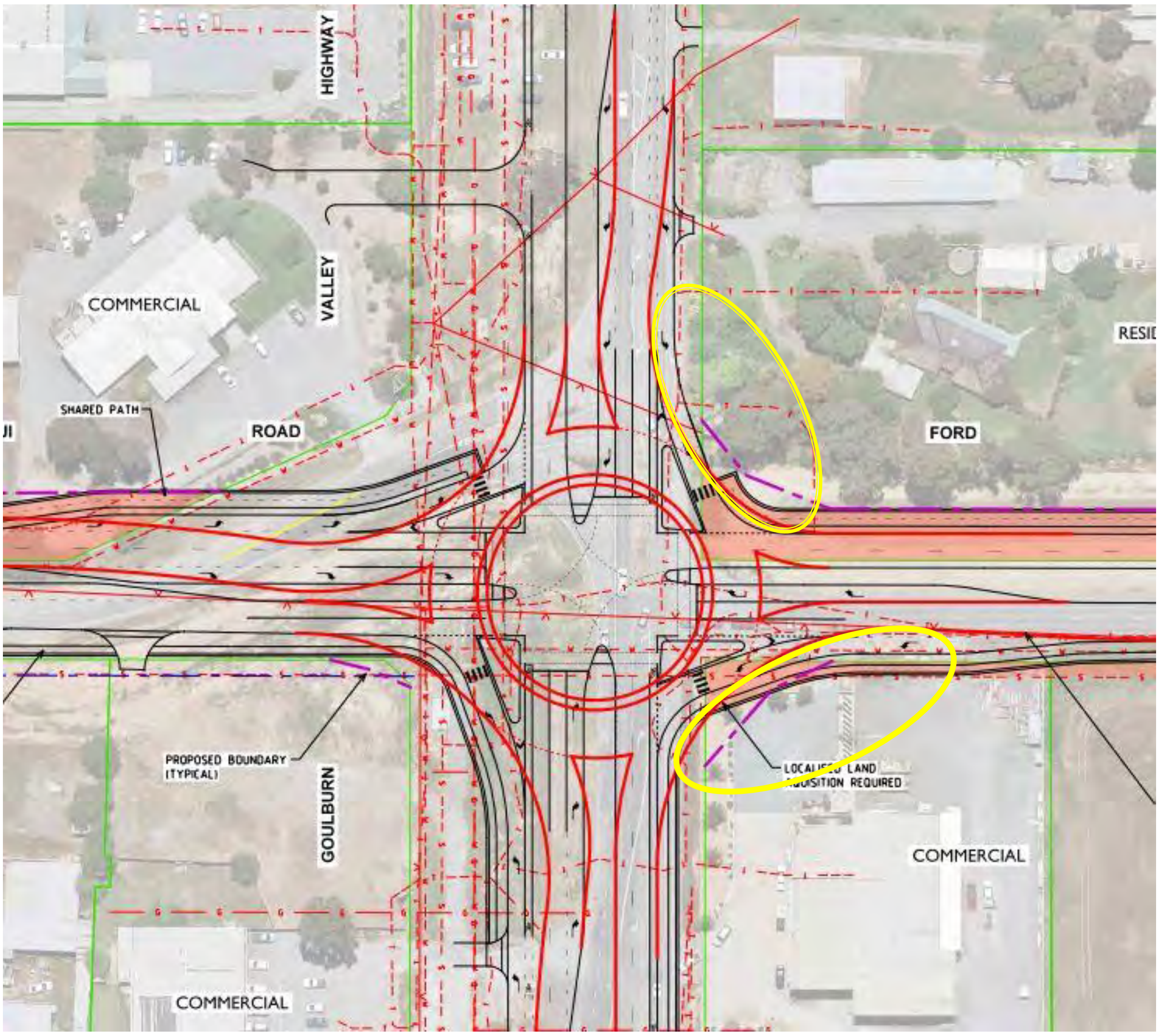
Goulburn Valley Highway – Ford Road Roundabout (Centred option).

- Centring the roundabout at this location ensures intersection deflection is equally distributed across all four approaches. This is the preferred layout as it offers the best results in reduced vehicle speeds through the intersection.



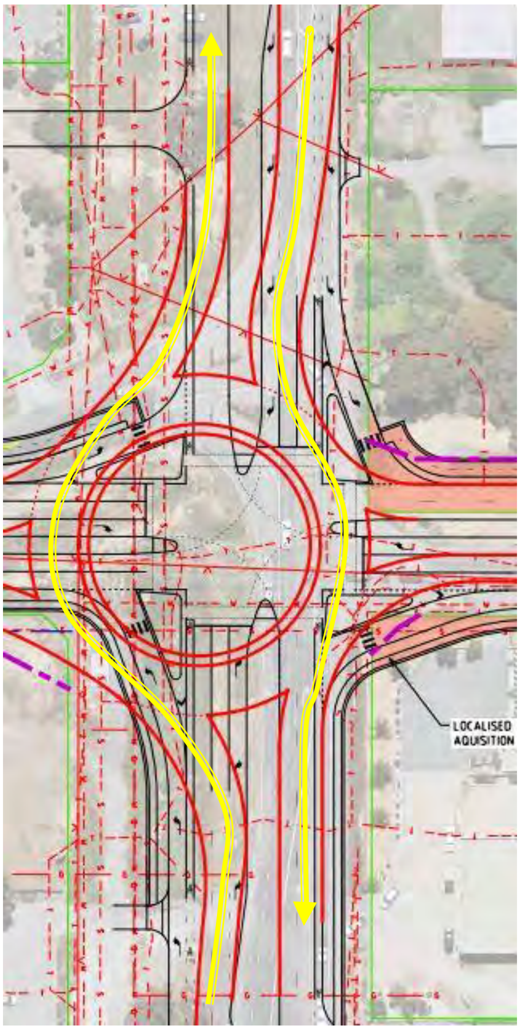
- Vehicle turn templates have not been provided for review. Conduct checks to ensure clearances to kerb and channel as well as other vehicle movements are being maintained as to reduce vehicle stability issues and sideswipe crashes at the intersection location.

- Intersection sightlines are being obscured East of the intersection by existing vegetation as well as commercial developments, which could result in crashes at these locations. Ensure that intersection sightlines are free of obstructions as to improve motorists/pedestrian/cyclist safety at the intersection location as per the Austroads Guidelines.

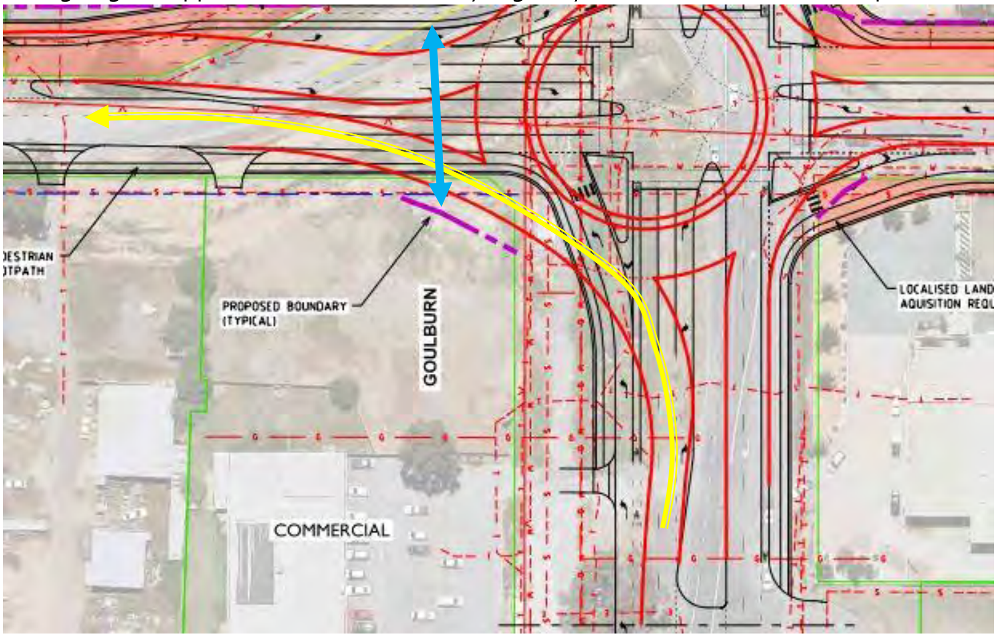


Goulburn Valley Highway – Ford Road Roundabout (Shift to the East option).

- Placing the roundabout off centre at this location has resulted in the intersection deflection being unevenly distributed for the North-South approaches. For motorists traveling south the intersection offers little in the way of deflection as such motorists can maintain their speed through the intersection which could result in failure to give-way and run-off road crashes at this location. And for the North approach the large deflection requirement for motorists has resulted in reduction in through speeds and high level of safety. Consider installing a centrally located roundabout at this location as it will offer the best results in terms of safety for all intersection approaches.



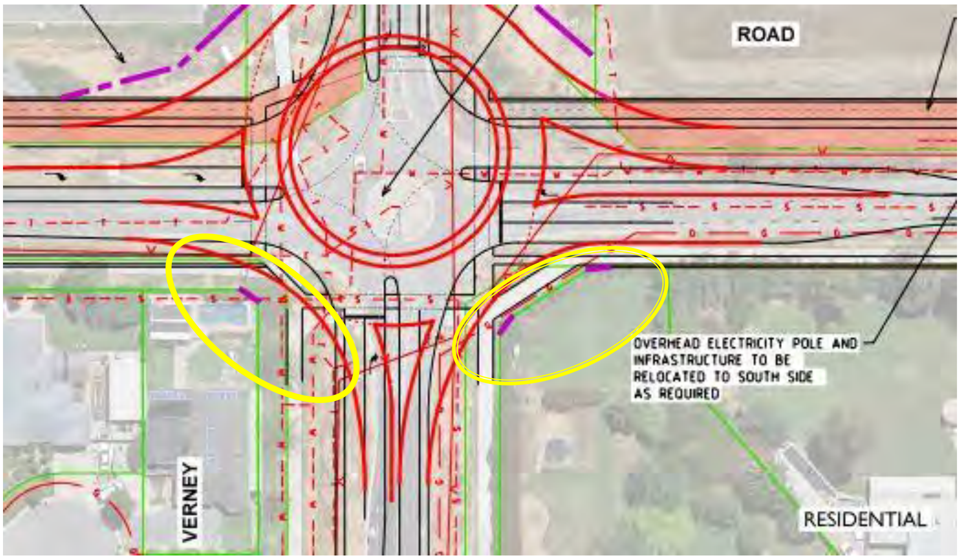
- Shifting the roundabout to the East at this location has resulted in less deflection and greater vehicle speeds for motorists turning left from Goulburn Valley Highway onto Ford Road. This may result in run-off road as well crashes with pedestrian/cyclists crossing North-South at this location. Consider re-aligning the approach of Goulburn Valley Highway to further reduce vehicle speeds.



- Refer to dot points 2&3 (centred option) and general comments 1,3 & 4 as they apply for this layout also.

Verney Road – Ford Road Roundabout.

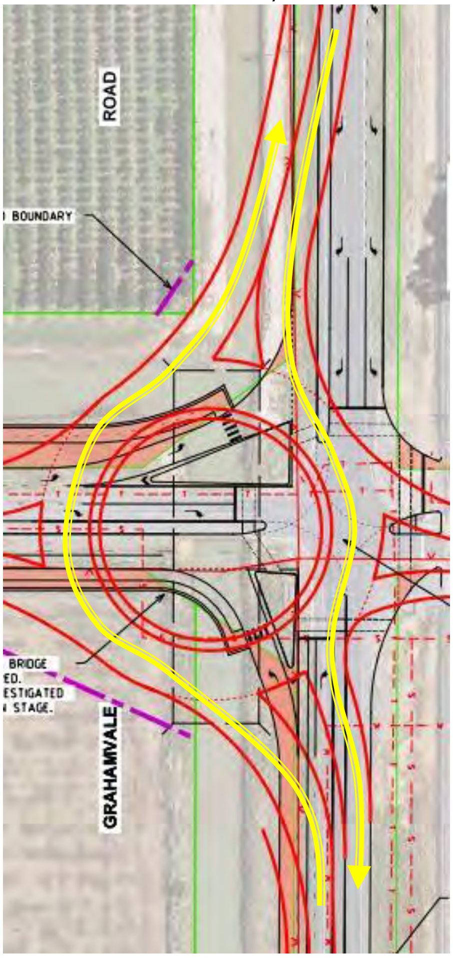
- Vehicle turn templates have not been provided for review. Conduct checks to ensure clearances to kerb and channel as well as other vehicle movements are being maintained as to reduce vehicle stability issues and sideswipe crashes at the intersection location.
- Intersection sightlines are being obscured South of the intersection by existing vegetation as well as residential developments, which could result in crashes at these locations. Ensure that intersection sightlines are free of obstructions as to improve motorists/pedestrian/cyclist safety at the intersection location.



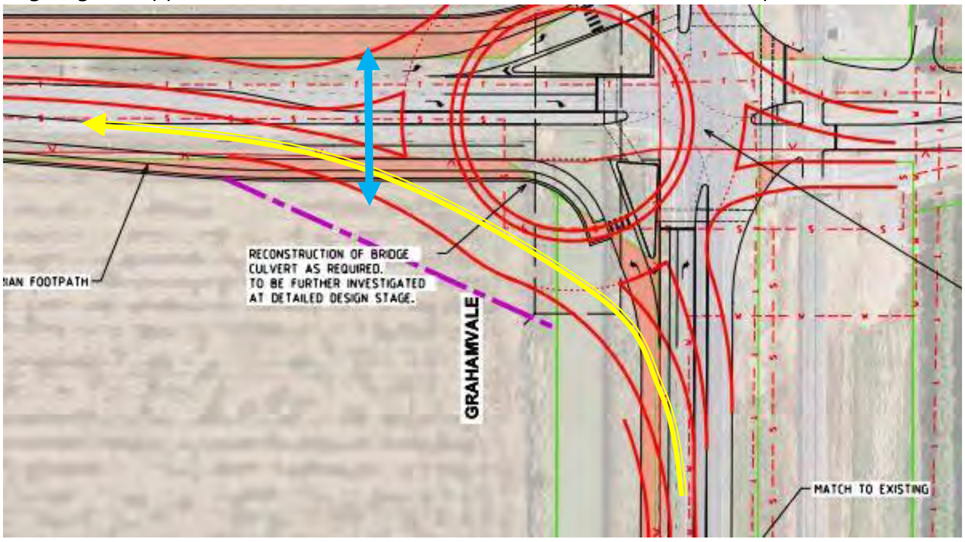
- Refer general comments 1,3&4 as they apply for this layout also.

Grahamvale Road – Ford Road Roundabout.

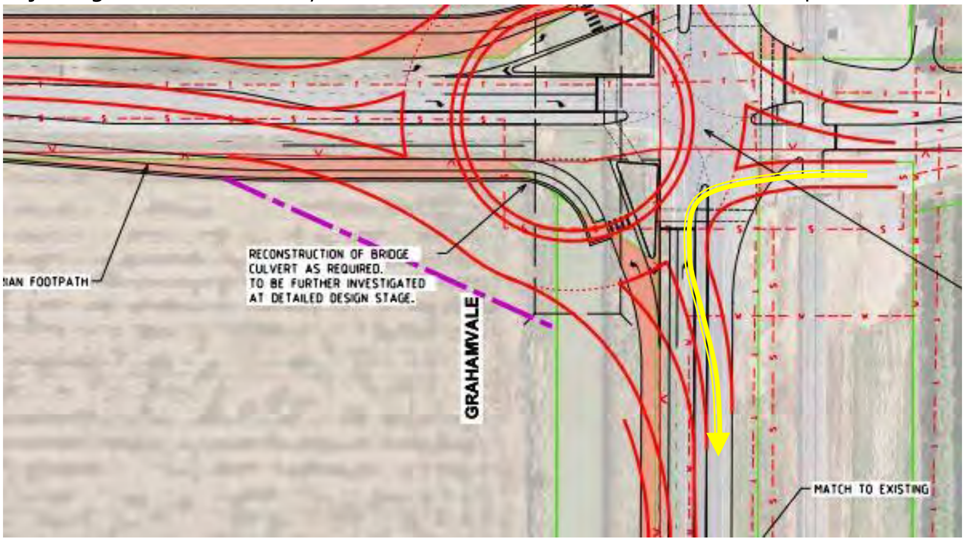
- Placing the roundabout off centre at this location has resulted in the intersection deflection being unevenly distributed for the North-South approaches. For motorists traveling south the intersection offers little in the way of deflection as such motorists can maintain their speed through the intersection which could result in failure to give-way and run-off road crashes at this location. And for the North approach the large deflection requirement for motorists has resulted in reduction in through speeds and high level of safety. Consider installing a centrally located roundabout at this location as it will offer the best results in terms of safety for all intersection approaches.



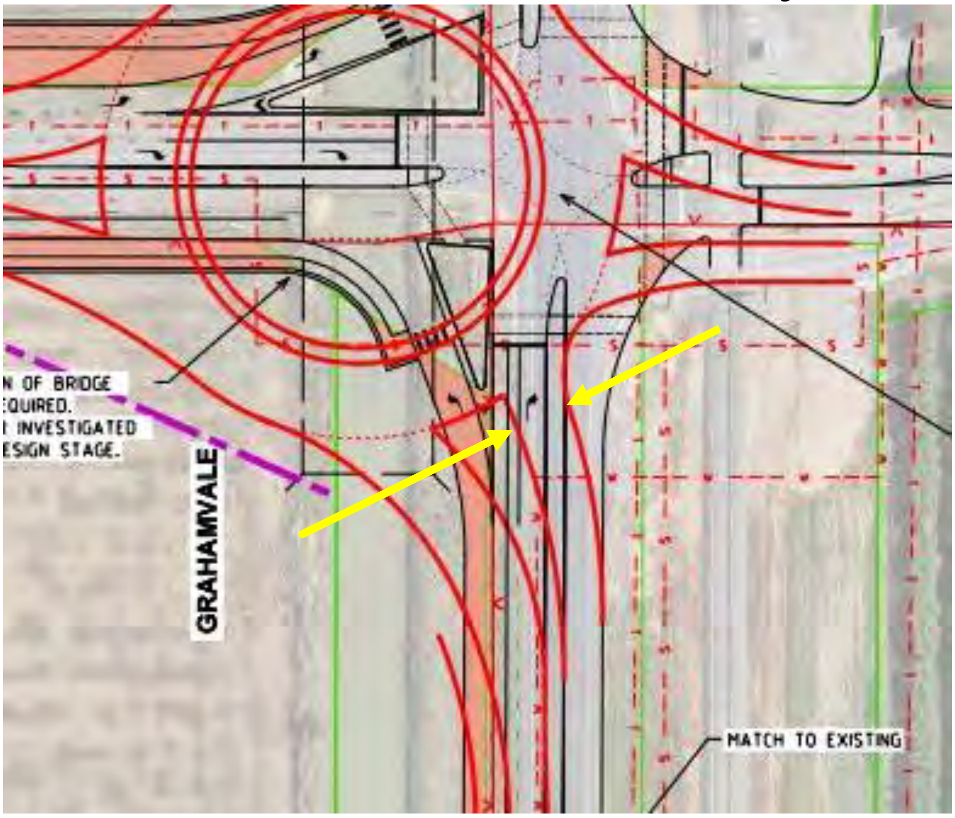
- Shifting the roundabout to the East at this location has resulted in less deflection and greater vehicle speeds for motorists turning left from Grahamvale Road onto Ford Road. This may result in run-off road as well crashes with pedestrian/cyclists crossing North-South at this location. Consider re-aligning the approach of Grahamvale Road to further reduce vehicle speeds.



- The combination of shifting the roundabout to the East and the proximity of the existing rail crossing to the proposed intersection has resulted in a sharp curve located on the south-east corner. Large vehicles turning left from Ford Road into Grahamvale Road at this location may be required to mount the kerb and channel causing stability issues which could result in crashes at this location. Consider adjusting the intersection layout as so all intersection movements can be performed safely



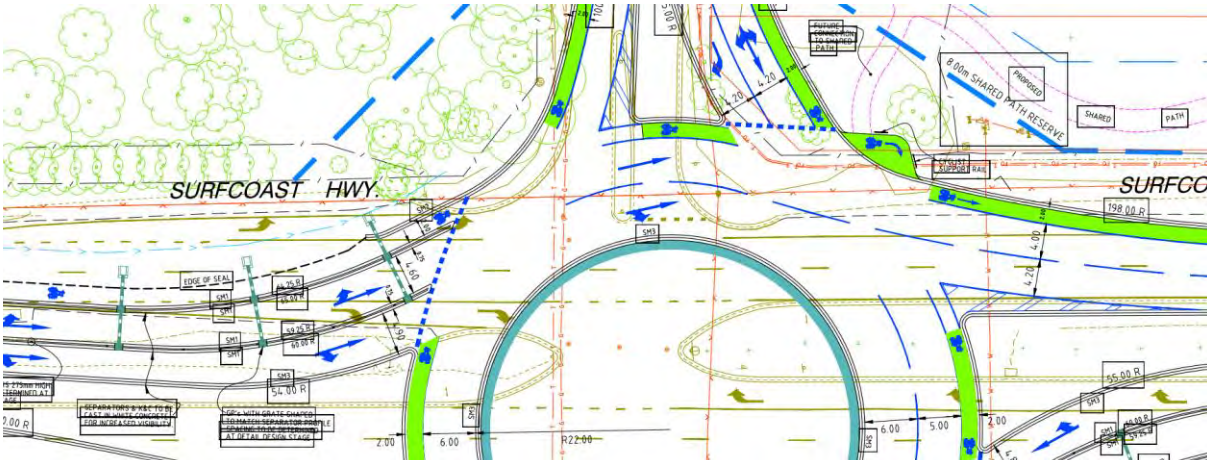
- The departure lane width for Motorists traveling South on Grahamvale road appears to be quite narrow which could result in large vehicles mounting the kerb at this location resulting in stability issues and crashes at this location. Consider checking vehicle turn templates for all intersection movements and ensure that all clearances to kerb and channel are being maintained.



- Refer to dot points 2&3 (centred option) and general comments as they apply for this layout also.

Appendix H: Examples

Example of a separation on the approach to a roundabout and catering for recreational cyclists:



Raised platform at a signalised intersection (Belmont, Victoria):

Catering for cyclists at roundabouts:

Pedestrian facilities close to a roundabout acting as metering

Appendix H: Crash Reduction Factor discussion

Two lane roundabout vs traffic signals:

Vehicle to vehicle collisions:

From Give Way/Stop to two lane roundabout:

Victorian crash reduction factors are 60% for an urban environment and 70% for a rural environment (VicRoads 2016).

NSW is more refined with the use of CRFs and attempts to disaggregate crash reduction by road user movements. NSW uses an 85% CRF for all crash types except u-turn, head on, rear end, lane change, parallel lanes turning and pedestrians. For these they use: u-turn (70%) head on (35%), a negative crash reduction factor for rear end (-20%), lane change (-20%), parallel lanes (-20%). Interestingly, NSW award a CRF of 65% for pedestrians at two lane roundabouts. 35% reduction in off carrigeway

Factoring in the expected road use (heavily dominated by passenger vehicles), the expected crash types, the urban fringe environment an overall crash reduction factor of 65% is considered conservatively appropriate.

The driver of the CRF for roundabout is actually the reduction in severity of crashes as opposed to the reduction in the frequency of crashes. This impacts on the severity outcome of crashes in the Safe System Assessment matrix.

As the subject area is in an urban fringe environment, a CRF of 65% has been assumed.

Sources:

Austroads 2010
Austroads 2012B
Turner et al. 2008
Elvik et al. 2009
ITE 2004
Daniels et al. 2008
Isebrands 2003
De Brabander and Vereeck (2007)
Teale 1984
Jensen 2013
Harkey et al. 2008
Isebrands 2012
Persaud et al. 2001

From Give Way/Stop to traffic signals:

Victorian crash reduction factors are 45% for all environments (VicRoads 2016).

NSW data backs up the Victorian data for most crash types, however the disaggregation of the data shows spectrum of estimated crash reduction factors from crash increases to 75%. At the more sever end of the spectrum there is lower CRFs of 20 – 40%

Hit pedestrians is a CRF of only 30% for all speed zones with traffic signals. If the FCRT is removed this reduces to 5%.

Sources:

Turner et al. (2010) - metro
Turner et al. (2010) - regional
Turner, B et al. (2012) (does not distinguish between turn controls)
Davis and Aul (2007) (major approach protected only)
Harkey et al. (2008) (rural - did not differentiate turn control)
Harkey et al. (2008) (urban, three leg - did not differentiate turn control)
Harkey et al. (2008) (urban, four leg - did not differentiate turn control)
AASHTO (2010) (rural - does not distinguish between turn controls)
AASHTO (2010) (urban, four leg - does not distinguish between turn controls)
Scully et al. (2006) (does not differentiate between turn control)
Teale et al. (1979) and Teale (1984) (does not differentiate between turn controls)
Pernia et al. (2002) (does not differentiate between turn controls)

Appendix B

Service Authority Consultation and Requirements Summary

DRAFT

Item No	Authorities/ Stakeholder	Services	Existing condition	Requirements during road widening or realigning	Need to relocate	Broad relocation cost
1	APA	Gas main	All gas mains within the vicinity of the existing road reserve are high pressure. There is no gas main along Wanganui Road. Gas main runs across the Goulburn Valley Highway within the intersection of Ford Road and Wanganui Road. The gas main mostly runs along the southern side of road.	There is potential for impact as part of any upgrading of to the Goulburn Valley Highway intersection, where relocation or protection may be required. This can be confirmed at the detailed design stage only. Gas main along the southern side of Ford Road is not expected to be impacted, as this service is mostly running along the title boundary. Some of the gas mains do cross Ford Road where other road intersect it, which will need to be verified on site during detailed design.	No major relocation expected (assuming road widening generally occurs on the northern side of the road). Wanganui Road needs to have a new gas main installed, ideally on the northern side to connect into the existing line that crosses the intersection with Goulburn Valley Highway.	It is hard to estimate at this stage. However, once the cross section and widening of road side is confirmed, then this can be estimated at a broad level.
2	Telstra	Telstra communication services	Most expensive infrastructure is located within the Goulburn Valley Highway / Ford Road / Wanganui Road intersection (southeast and northwest corners).	Widening the road on the northern side will avoid the majority of any potential clashes with the Telstra infrastructure. However, this will need to be confirmed on site with the service authority. The straightening of Wanganui Road at its intersection with Goulburn Valley Highway may avoid impact on the most expensive infrastructure (i.e. Telstra chambers). There are another 16 locations of Telstra crossings and need to be investigated further during detailed design for cover and protection measures. Some Telstra conduits run either side of Wanganui Road and Ford Road. These conduits may be impacted due to the proposed road widening or realignment. This needs to be investigated once the concept designs are prepared.	Some of the Telstra conduits on the northern side of Wanganui Road and Ford Road may need to be relocated as these services cannot be kept under asphalt pavement/kerbs in the following locations: ○ Wanganui Road between Rudd Road and Goulburn Valley Highway ○ Ford Road between Verney Road and Grahamvale Road	The green box relocation may cost in the range of $500 - 600K. (If there is no road widening works along southern side of Ford Road then this relocation can be avoided). 16 location crossing amendment may cost in the range of $500 to $800K). Other relocation costs need to be investigated based on the proposed cross section and existing road widening works.

Item No	Authorities/ Stakeholder	Services	Existing condition	Requirements during road widening or realigning	Need to relocate	Broad relocation cost
3	Nextgen	Nextgen communication services	Nextgen cable is running on Powercor poles along Ford Road between Goulburn Valley Highway and Verney Road.	Relocation of power poles will require relocation of Nextgen cable. Highly likely the power poles within the vicinity of the Goulburn Valley Highway/Ford Road/Wanganui Road intersection. There may well be other locations but require the concept designs to be prepared to identify.	Relocation of Nextgen cable is required at the Goulburn Valley Highway/Ford Road/Wanganui Road intersection. At this time, it has been assumed that there are no other electrical pole relocations required.	$10,000 - $30,000
4	Ausnet services	Very High Voltage Electric cables	This high voltage (220kV) cable is crossing Wanganui Road at an acute angle.	There is an Ausnet requirement to have an absolute minimum height clearance of 10.5m to the road. Currently, the high voltage cables are 13.5m above the existing road, so no adverse impact expected.	No relocation is required. Proposed road shouldn't be raised by more than 2m in order to keep the minimum clearance requirements from existing high voltage cable (220kv)	N/A
5	Powercor	High voltage Electrical cables and poles	High voltage (66kV) cable with electrical poles are running along either side of Wanganui Road and Ford.	There are some existing electrical poles that may need to be relocated based on the proposed road widening or realignment. Specially, the existing electrical pole within the Goulburn Valley Highway/Ford Road/Wanganui Road intersection. Further investigations based on the concept designs need to be carried out to identify the protection measures and/or relocation requirements.	If possible, it is recommended to only widen Ford Road along the northern side. This will minimise the relocation of electrical poles between Goulburn Valley Highway and Verney Road. Existing electrical poles along the northern side of Wanganui Road and Ford Road need to be relocated. It is also noted that High voltage (660kV) cables with electrical poles are located along the northern side of Wanganui Road between Freemans Road and Kittles Road.	This may cost in the range of $750K to $1,050K

DRAFT

Item No	Authorities/ Stakeholder	Services	Existing condition	Requirements during road widening or realigning	Need to relocate	Broad relocation cost
6	Goulburn-Murray Water (G-MW)	Irrigation and stormwater channel	There are minor drains running along both sides of Ford Road and Wanganui Road. There is one irrigation channel running along the northern side of Ford Road between Matilda Drive and Grahamvale Road, which then turns south and travels under Ford Road along the western side of Grahamvale Road. There is a drain running along the northern side of Ford Road between Goulburn Valley Highway and Verney Road. There is another drain crossing located west of Freeman Road across Wanganui Road.	The main irrigation channel between Matilda Drive and Grahamvale Road needs to be maintained, so would need to be relocated if impacted by road widening. Exact requirements regarding any road construction adjacent to GMW channel need to be obtained from them. Bridge widening/ culvert extension along the existing water ways need to be coordinated with GMW. It is also noted that the hydraulic capacity is to be maintained during all road construction and service relocation works. Road stormwater can be discharged into existing drains, but this needs to be confirmed with Council and GMW once volume is known.	Reconstruction of bridge along Ford Road at Grahamvale Road end will likely be required across the existing channel. GMW is not ready to advise what the crown reserve should be as part of any road widening, as they have a plan for future remodelling of the major supply channel. Further negotiation will be required, if the Ford Road widening works identifies that the major supply channel will be impacted.	Bridge construction cost may vary depending on the GMW requirements. Unable to identify at this stage.
7	Goulburn Valley Water (GVW)	Water and sewer assets	Water assets and gravity sewer assets are located either side of Wanganui Road and Ford Road in various locations. Sewer pump is located within the Goulburn Valley Highway/Ford Road/Wanganui Road intersection. Sewer rising main is located along the southern side of Wanganui Road up to Freeman Road.	Sewer pump may need to be relocated as part of the intersection works. Water and sewer rising mains may also be impacted due to road works, which will be identified based on the concept level designs. There is a proposal to upgrade the existing sewer rising main near Freemans Road along Wanganui Road (to be investigated further).	If there are no road widening works along the southern side of Wanganui Road, then minimal relocation of the sewer main will be required. Water main may need to be relocated in following locations: ○ Northern side of Ford Road between Verney Road and Grahamvale Road ○ Northern side of Wanganui Road between Rudd Road and Goulburn Valley Highway	Sewer pump \$300K – \$500K. Sewer rising main cost will be substantially high and can be in the order of \$500K - \$1,000K. Water main relocation also may cost in the range of \$300K to \$750K GVW has indicated that they will contribute to the cost of replacement/relocation of their assets based on the calculation of the remaining life expectancy of the assets.

Item No	Authorities/ Stakeholder	Services	Existing condition	Requirements during road widening or realigning	Need to relocate	Broad relocation cost
8	Public Transport of Victoria	Bus Stops and railway line	Number of Bus stops located along Wanganui Road and Ford Road. Railway line parallel to eastern side of Grahamvale Road, with at-grade level crossing.	PTV will advise the public transport requirement along these roads. PTV will have a meeting with Vic Track and V/line in order to determine effect on existing level crossing on the eastern side of Grahamvale Road.	There may be requirement for bus stops along at least Ford Road.	
9	V/Line	Railway line	There is a railway line on the eastern side of Grahamvale Road, with an at-grade level crossing.	PTV will have a meeting with Vic Track and V/line in order to determine effect on existing level crossing on the eastern side of Grahamvale Road.	No Relocation of track works required at this stage.	
10	Vic Track	Railway line	There is a railway line on the eastern side of Grahamvale Road, with an at-grade level crossing.	PTV will have a meeting with Vic Track and V/line in order to determine effect on existing level crossing on the eastern side of Grahamvale Road.	Relocation works are dependent on proposed intersection layout. Other communication assets may need to be relocated based on the proposed intersection layout.	Not able to be determined at this stage.
11	Greater Shepparton City Council	Storm water Drainage	There is no formal underground drainage along Wanganui Road and Ford Road. There are some shallow pipe crossings that exist across Ford Road and Wanganui Road.	Road surface flow needs to be directed to existing drains and these may need to be regraded to work effectively. Existing stormwater crossing pipe classes may need to be upgraded in order to support heavy vehicle movements.	Relocation is required. Existing swale needs to be regraded and reshaped.	$500K to $800K
12	Goulburn Broken Catchment Management Authority (GBCMA)	Flood and major stormwater infrastructure	Goulbourn Valley River and overflow flooding in Wanganui Road.	Wanganui Road is impacted by flood level of the Goulbourn Valley River. Overall area flooding needs to be assessed with GBCMA.	There may be some requirement to construct a flood barrier to avoid flooding of the western end of Wanganui Road. However, this has not been confirmed by GBCMA.	Not confirmed at this stage.

Appendix C

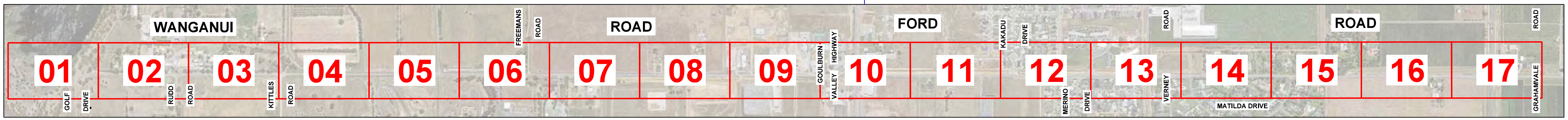
Concept Designs

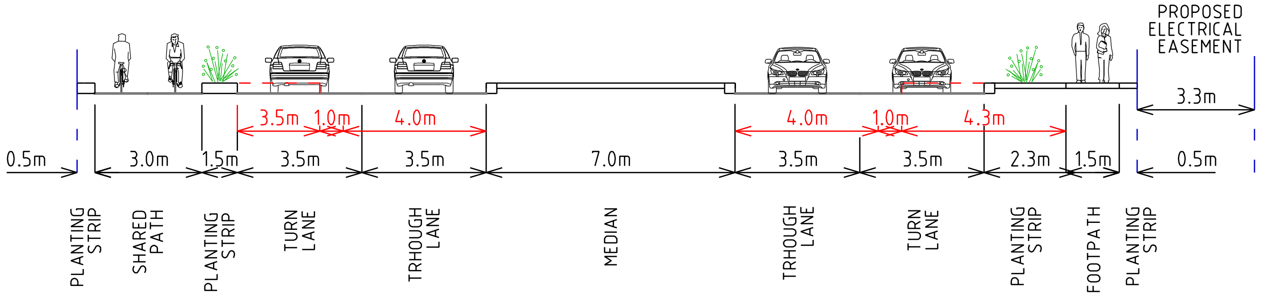
NOTE: LAND AQUISITION REQUIRED NORTH SIDE (TYPICAL).

WANGANUI ROAD AND FORD ROAD INVESTIGATION STUDY

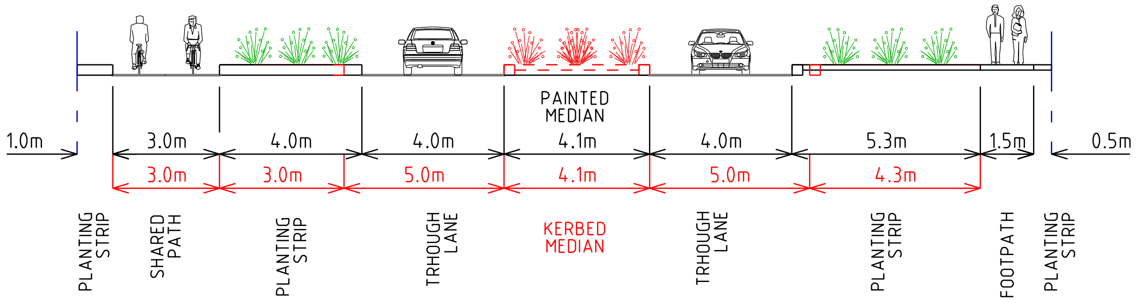
FROM GOLF DRIVE TO GRAHAMVALE ROAD CONCEPT FUNCTIONAL LAYOUT

VICROADS | GREATER SHEPPARTON COUNCIL

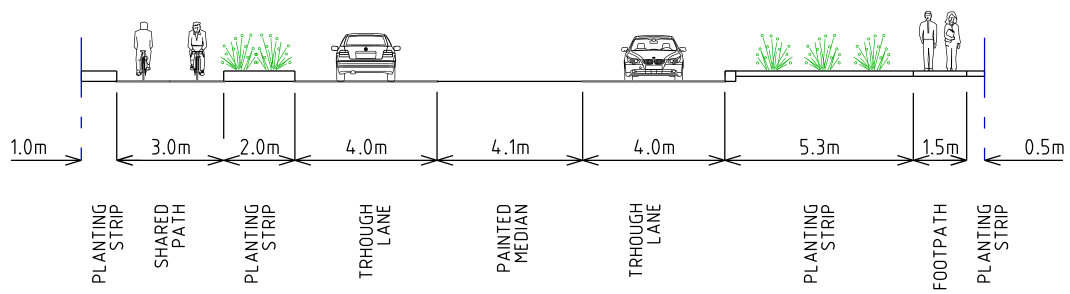




WANGANUI ROAD TYPICAL 30.3m CROSS-SECTION
CROSS SECTION
NOT TO SCALE



FORD ROAD TYPICAL 27.4m PAINTED/ RAISED KERB MEDIAN
CROSS SECTION
NOT TO SCALE



BETWEEN VERNEY ROAD ROAD & 197 FORD ROAD TYPICAL 27.4m MARKED MEDIAN
CROSS SECTION
NOT TO SCALE

SHEET SCHEDULE

SHEET 00	COVER SHEET
SHEET 01	WANGANUI ROAD AND GOLF DRIVE INTERSECTION
SHEET 02	WANGANUI ROAD AND RUDD ROAD INTERSECTION
SHEET 03	WANGANUI ROAD
SHEET 04	WANGANUI ROAD AND KITTLES ROAD INTERSECTION
SHEET 05	WANGANUI ROAD
SHEET 06	WANGANUI ROAD AND FREEMANS ROAD
SHEET 07	WANGANUI ROAD
SHEET 08	WANGANUI ROAD
SHEET 09	WANGANUI ROAD
SHEET 10	FORD ROAD AND GOULBURN VALLEY HIGHWAY INTERSECTION
SHEET 11	FORD ROAD
SHEET 12	FORD ROAD AND KAKADU DRIVE/ MERINO DRIVE
SHEET 13	FORD ROAD AND VERNEY ROAD INTERSECTION
SHEET 14	FORD ROAD AND MATLIDA DRIVE
SHEET 15	FORD ROAD
SHEET 16	FORD ROAD
SHEET 17	FORD ROAD AND GRAHAMVALE ROAD INTERSECTION

GENERAL NOTES

1. ALL DIMENSIONS AND RADII ARE IN METRES AND ARE TO THE FACE OF KERB AND CHANNEL.
2. BASE INFORMATION OBTAINED CARE OF GREATER SHEPPARTON COUNCIL AND CAD FILES OBTAINED FROM A NUMBER OF SOURCES. AS SUCH, GTA CONSULTANTS DOES NOT TAKE ANY RESPONSIBILITY FOR THE ACCURACY OF THE EXISTING CONDITIONS BASE ON WHICH THE DESIGN AND PROPOSED BOUNDARIES ARE BASED.
3. PROPOSED PROPERTY BOUNDARY INFORMATION HAS BEEN GENERALLY OFFSET FROM EXISTING BOUNDARIES AS SHOWN IN GREATER SHEPPARTON COUNCIL'S CAD FILE Aerial photo and Cadastral/Ford Road - Cadastral and Aerial Info.dwg AND MATCHES TO OTHER PROPOSED BOUNDARIES AS SHOWN IN CAD FILES FROM MULTIPLE SOURCES.
4. ALL OTHER DESIGN METHODOLOGY AS PER AUSTROADS DESIGN GUIDANCE AND VIC ROADS SUPPLEMENTS, UNLESS NOTED OTHERWISE IN THE ASSOCIATED DESIGN REPORT.
5. DECLARED MAIN ROAD
   - WANGANUI ROAD - SPEED ZONE 80km/h - DESIGN SPEED 90km/h
   - WANGANUI ROAD - SPEED ZONE 60km/h - DESIGN SPEED 70km/h
   - FORD ROAD - SPEED ZONE 60km/h - DESIGN SPEED 70km/h
6. SHARED PATH DETAILS ARE INDICATIVE ONLY FOR CONCEPT DEVELOPMENT. ALIGNMENT TO BE CONFIRMED AT DETAILED DESIGN.

LEGEND

- EXISTING PROPERTY BOUNDARY (CADASTRE)
- RESERVATION FOR ELECTRICITY RELOCATION
- LAND AQUISITION 53,500 Sq m
- SHEPPARTON BYPASS

SERVICES LEGEND*

- E — U/G ELECTRICITY
- X — O/H ELECTRICITY
- T — TELSTRA
- G — GAS
- W — WATER
- S — SEWER
- D — STORMWATER DRAINAGE

*NOTE: SERVICE INFORMATION OBTAINED FROM THE DIAL BEFORE YOU DIG INVESTIGATION IS INDICATIVE ONLY. SOME SERVICES HAVE BEEN OFFSET FROM THEIR ACTUAL LOCATIONS FOR CLARITY ON THE DRAWING SET.

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WARNING
BEWARE OF UNDERGROUND SERVICES
THE LOCATIONS OF UNDERGROUND SERVICES ARE APPROXIMATE ONLY AND THEIR EXACT POSITION SHOULD BE PROVEN ON SITE. NO GUARANTEE IS GIVEN THAT ALL EXISTING SERVICES ARE SHOWN.

00

DRAWN: H. STEVENSON
DESIGNER: A. PILLAI

DATE: 12-01-18

30/01/2018 4:35:52 PM V117720-02-00 V117720-02 P7.dgn

NOTE: LAND AQUISITION REQUIRED NORTH SIDE (TYPICAL).

FOR CONTINUATION REFER TO SHEET 02

01

PRELIMINARY PLAN
FOR DISCUSSION PURPOSES ONLY SUBJECT TO CHANGE WITHOUT NOTIFICATION

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SCALE OF METRES HOR 0 10 20

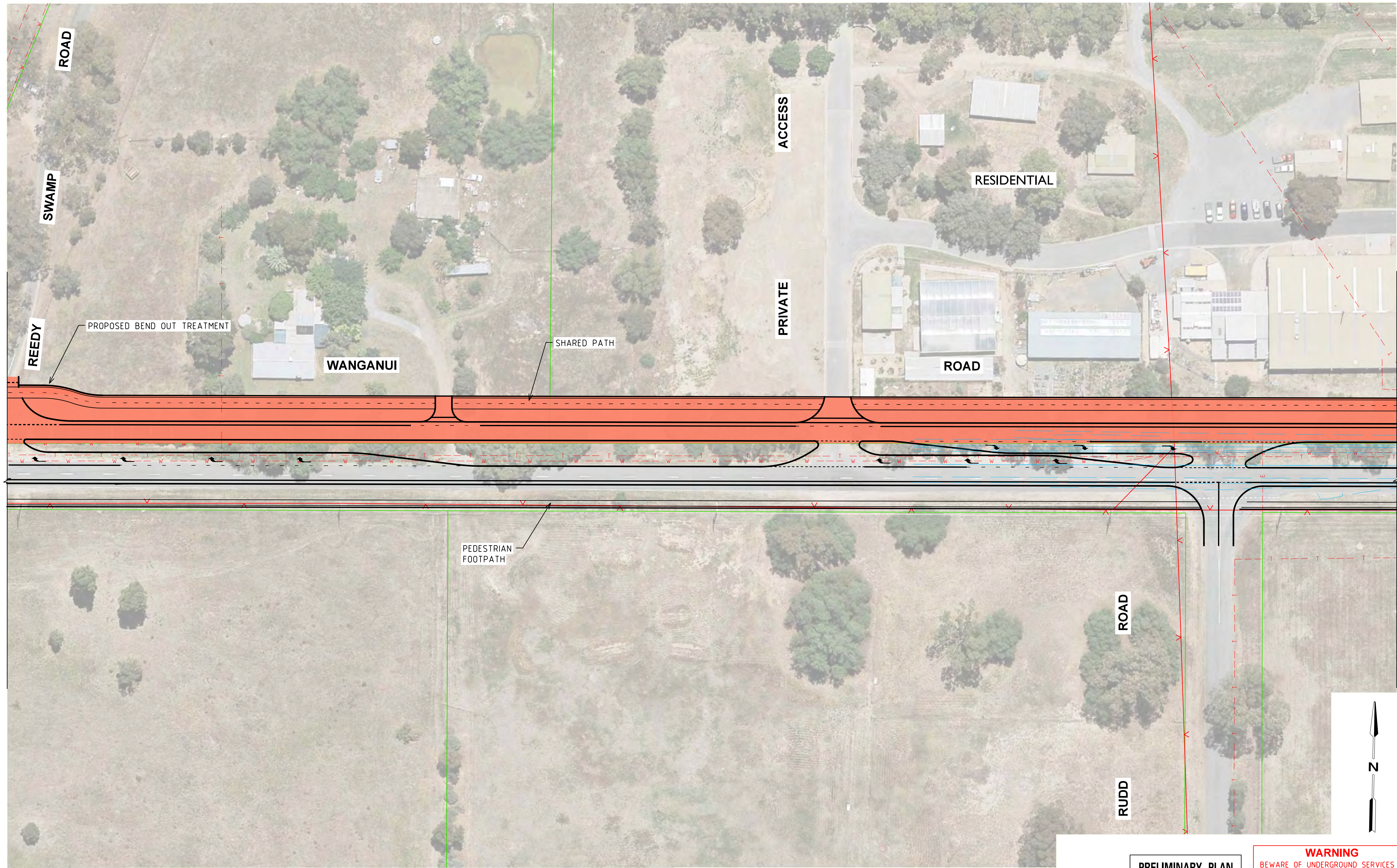
WANGANUI ROAD & FORD ROAD INVESTIGATION STUDY
BETWEEN GOLF DRIVE AND GRAHAMVALE ROAD
CONCEPT FUNCTIONAL ALIGNMENT
WANGANUI ROAD AND GOLF DRIVE

FILE NO.	CONTRACT NO.	SHEET NO.	DRAWING NO.	ISSUE
		01 OF 17		

30/01/2018 4:35:54 PM V117720-02-01 V117720-02 P7.dgn

NOTE: LAND AQUISITION REQUIRED NORTH SIDE (TYPICAL).

FOR CONTINUATION REFER TO SHEET 01



FOR CONTINUATION REFER TO SHEET 03

02

PRELIMINARY PLAN
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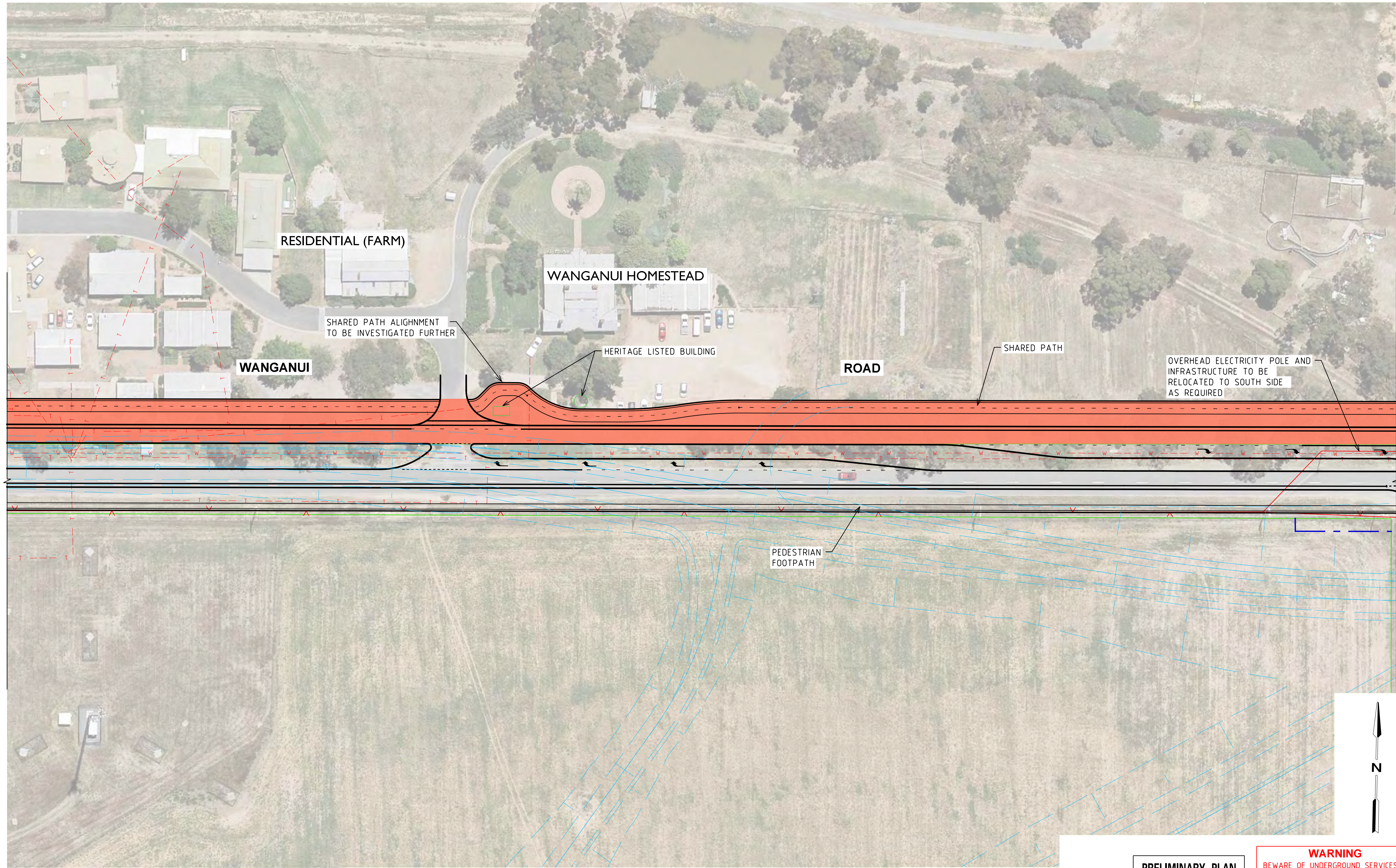
SCALE OF METRES
HOR 0 10 20

WANGANUI ROAD & FORD ROAD INVESTIGATION STUDY
BETWEEN GOLF DRIVE AND GRAHAMVALE ROAD
CONCEPT FUNCTIONAL ALIGNMENT
WANGANUI ROAD AND RUDD ROAD

FILE NO.	CONTRACT NO.	SHEET NO.	DRAWING NO.	ISSUE
		02 OF 17		

NOTE: LAND AQUISITION REQUIRED NORTH SIDE (TYPICAL).

FOR CONTINUATION REFER TO SHEET 02



FOR CONTINUATION REFER TO SHEET 04

03

PRELIMINARY PLAN
FOR DISCUSSION PURPOSES ONLY SUBJECT TO CHANGE WITHOUT NOTIFICATION

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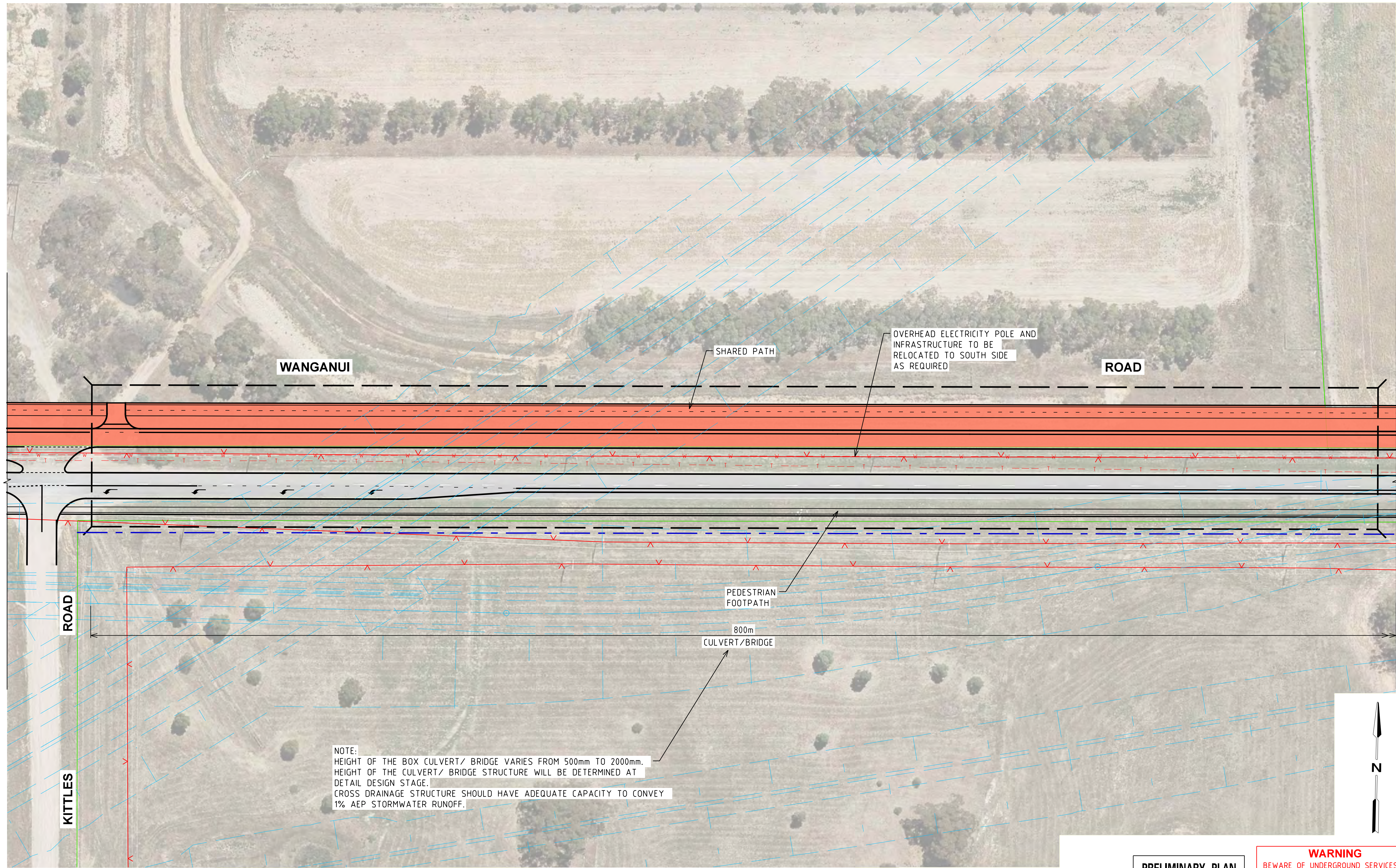
WANGANUI ROAD & FORD ROAD INVESTIGATION STUDY
BETWEEN GOLF DRIVE AND GRAHAMVALE ROAD
CONCEPT FUNCTIONAL ALIGNMENT
WANGANUI ROAD

FILE NO.	CONTRACT NO.	SHEET NO.	DRAWING NO.	ISSUE
		03 OF 17		

NOTE: LAND AQUISITION REQUIRED NORTH SIDE (TYPICAL).

FOR CONTINUATION REFER TO SHEET 03



FOR CONTINUATION REFER TO SHEET 05

04

PRELIMINARY PLAN

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SCALE OF METRES HOR 0 10 20

WANGANUI ROAD & FORD ROAD INVESTIGATION STUDY

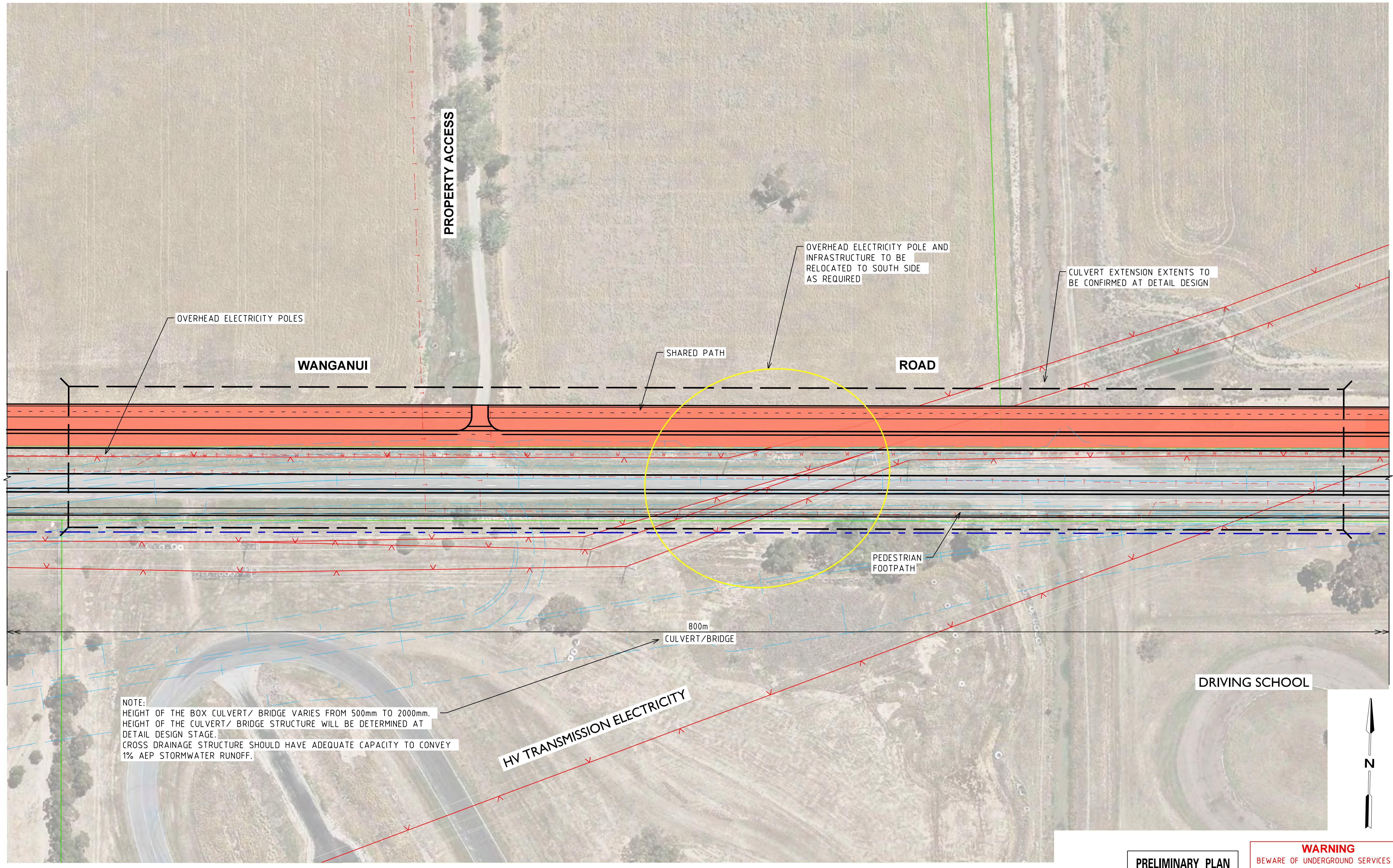
BETWEEN GOLF DRIVE AND GRAHAMVALE ROAD

CONCEPT FUNCTIONAL ALIGNMENT

WANGANUI ROAD AND KITTLES ROAD

FILE NO.	CONTRACT NO.	SHEET NO.	DRAWING NO.	ISSUE
		04 OF 17		

NOTE: LAND AQUISITION REQUIRED NORTH SIDE (TYPICAL).



05

PRELIMINARY PLAN
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SCALE OF METRES HOR 0 10 20

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BETWEEN GOLF DRIVE AND GRAHAMVALE ROAD
CONCEPT FUNCTIONAL ALIGNMENT
WANGANUI ROAD

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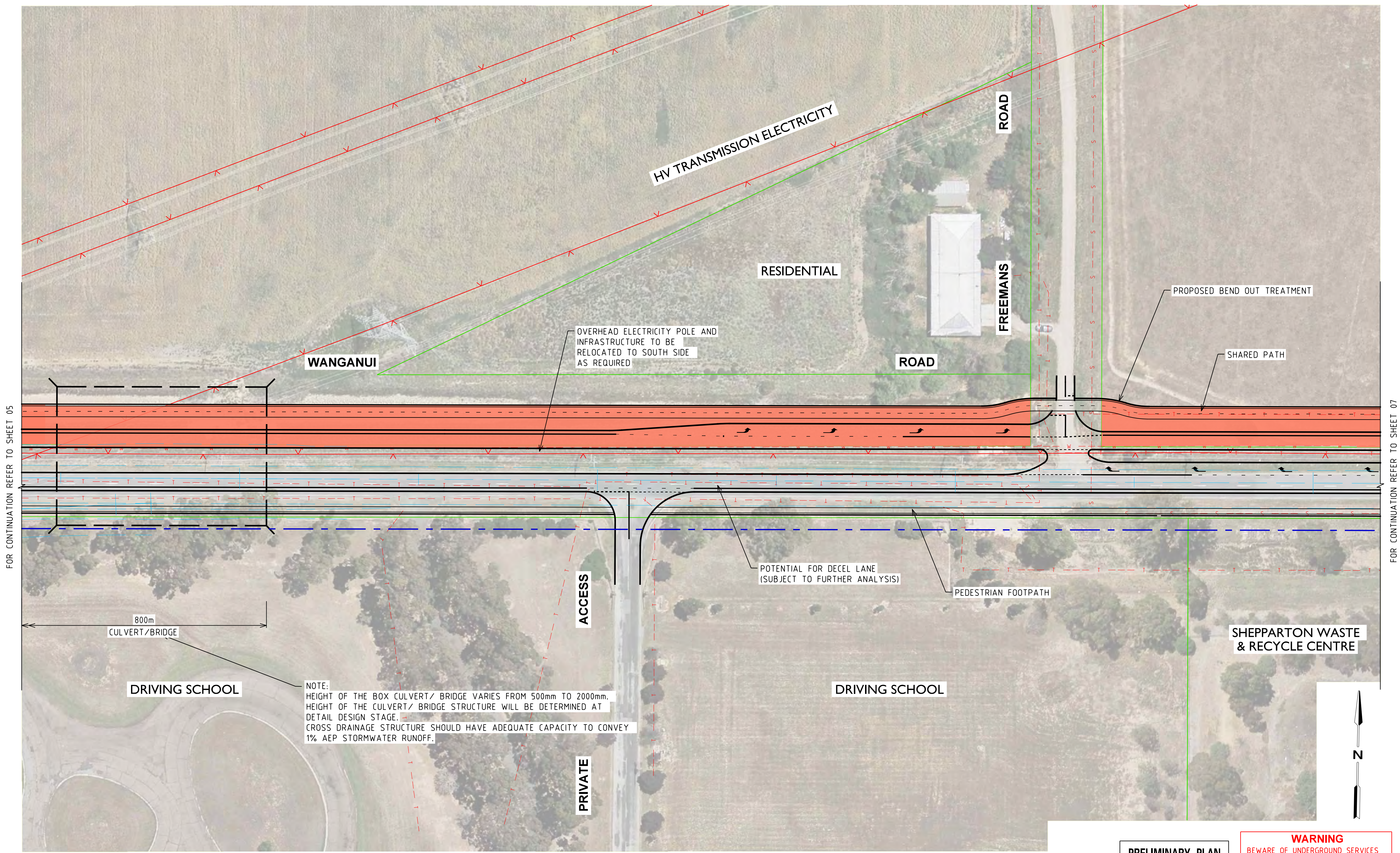
NOTE: LAND AQUISITION REQUIRED NORTH SIDE (TYPICAL).



NOTE:
HEIGHT OF THE BOX CULVERT/ BRIDGE VARIES FROM 500mm TO 2000mm.
HEIGHT OF THE CULVERT/ BRIDGE STRUCTURE WILL BE DETERMINED AT DETAIL DESIGN STAGE.
CROSS DRAINAGE STRUCTURE SHOULD HAVE ADEQUATE CAPACITY TO CONVEY 1% AEP STORMWATER RUNOFF.

06

PRELIMINARY PLAN
FOR DISCUSSION PURPOSES ONLY SUBJECT TO CHANGE WITHOUT NOTIFICATION

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BETWEEN GOLF DRIVE AND GRAHAMVALE ROAD
CONCEPT FUNCTIONAL ALIGNMENT
WANGANUI ROAD AND FREEMANS ROAD

SCALE OF METRES HOR 0 10 20

FILE NO.	CONTRACT NO.	SHEET NO.	DRAWING NO.	ISSUE
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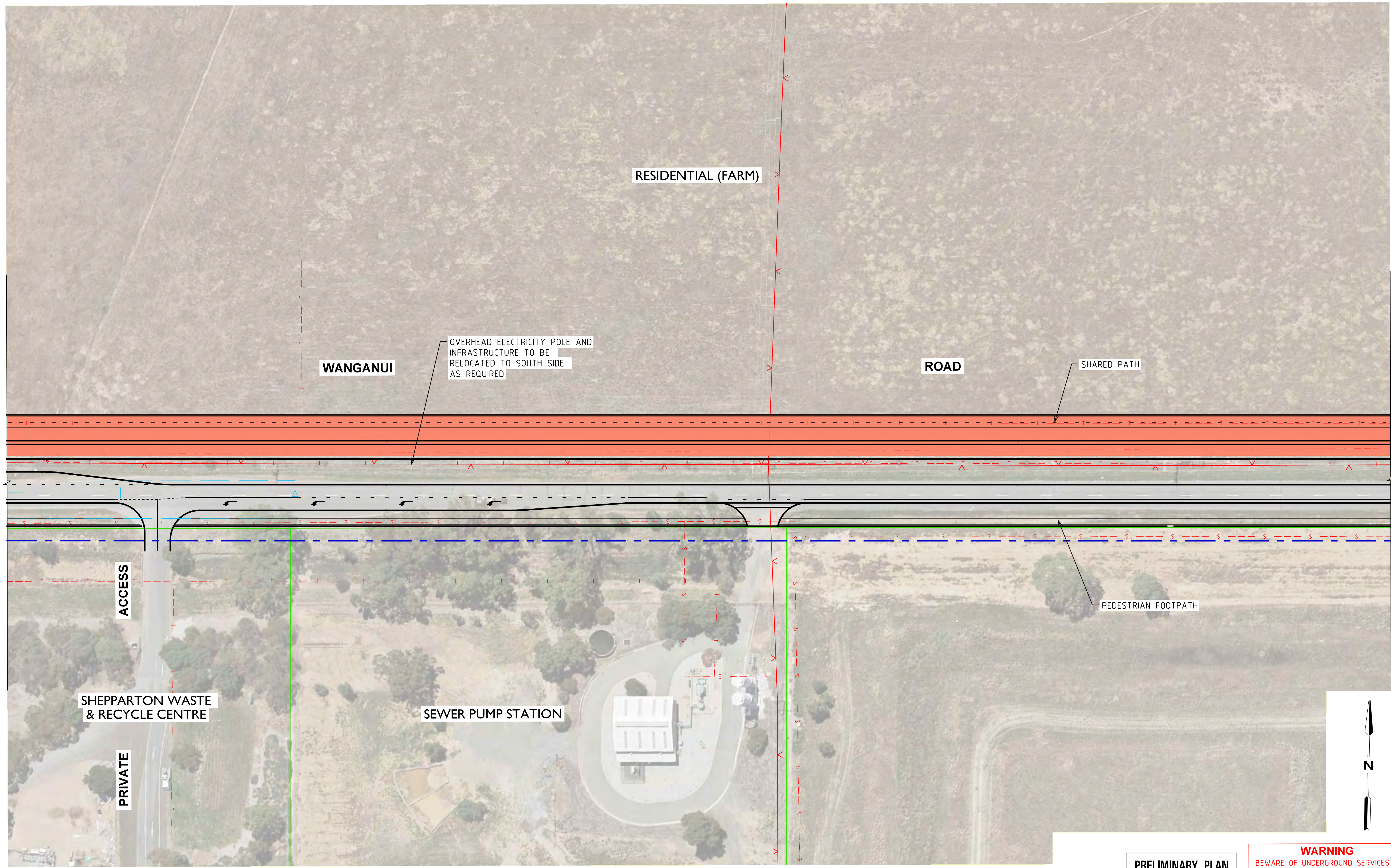
NOTE: LAND AQUISITION REQUIRED NORTH SIDE (TYPICAL).



FOR CONTINUATION REFER TO SHEET 06

FOR CONTINUATION REFER TO SHEET 08

07

PRELIMINARY PLAN
FOR DISCUSSION PURPOSES ONLY SUBJECT TO CHANGE WITHOUT NOTIFICATION

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SCALE OF METRES
HOR 0 10 20

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BETWEEN GOLF DRIVE AND GRAHAMVALE ROAD
CONCEPT FUNCTIONAL ALIGNMENT
WANGANUI ROAD

FILE NO.	CONTRACT NO.	SHEET NO.	DRAWING NO.	ISSUE
		07 OF 17		

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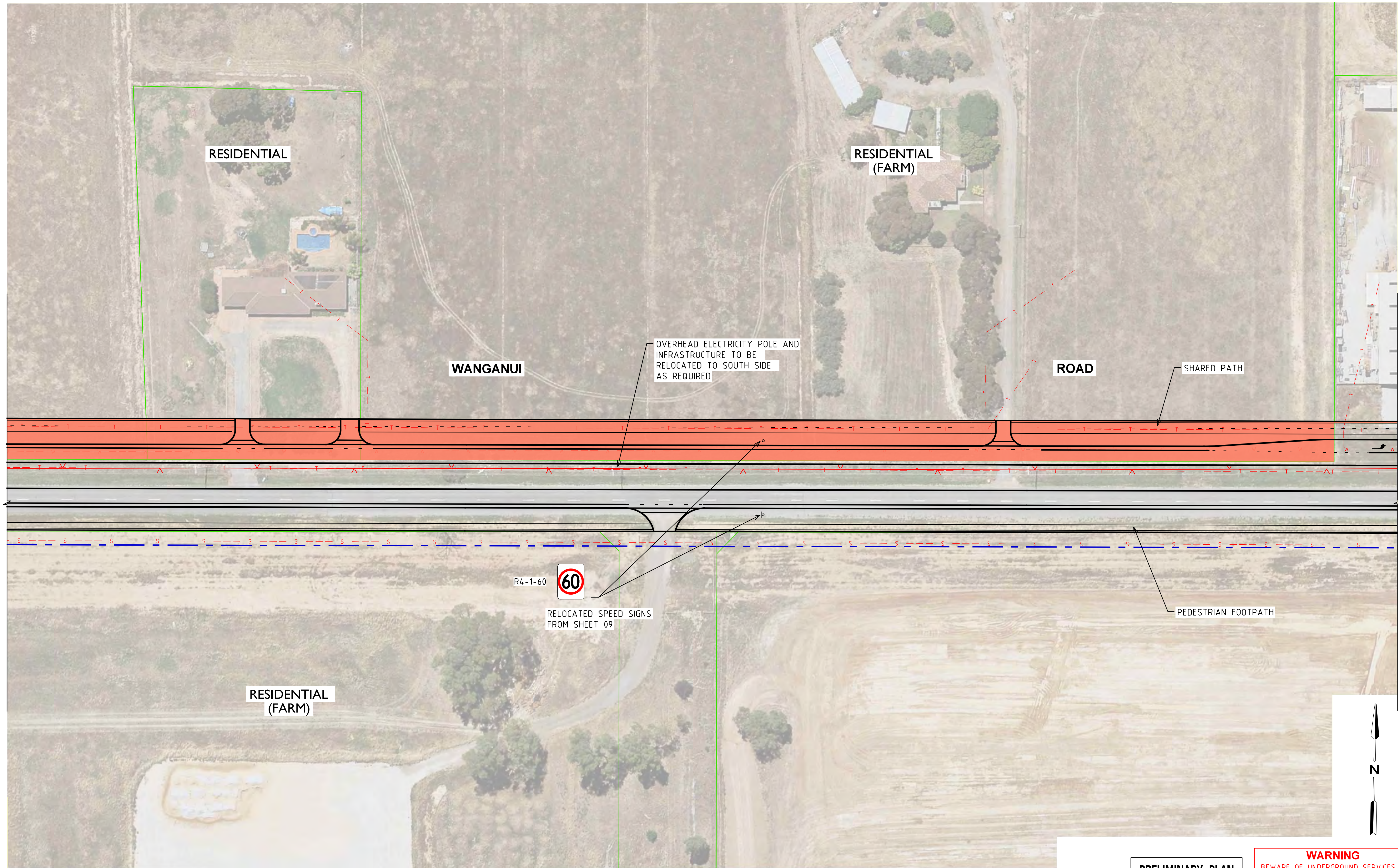
NOTE: LAND AQUISITION REQUIRED NORTH SIDE (TYPICAL).



FOR CONTINUATION REFER TO SHEET 07

FOR CONTINUATION REFER TO SHEET 09

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08

PRELIMINARY PLAN
FOR DISCUSSION PURPOSES ONLY SUBJECT TO CHANGE WITHOUT NOTIFICATION

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SCALE OF METRES
HOR 0 10 20

WANGANUI ROAD & FORD ROAD INVESTIGATION STUDY
BETWEEN GOLF DRIVE AND GRAHAMVALE ROAD
CONCEPT FUNCTIONAL ALIGNMENT
WANGANUI ROAD

FILE NO.	CONTRACT NO.	SHEET NO.	DRAWING NO.	ISSUE
		08 OF 17		

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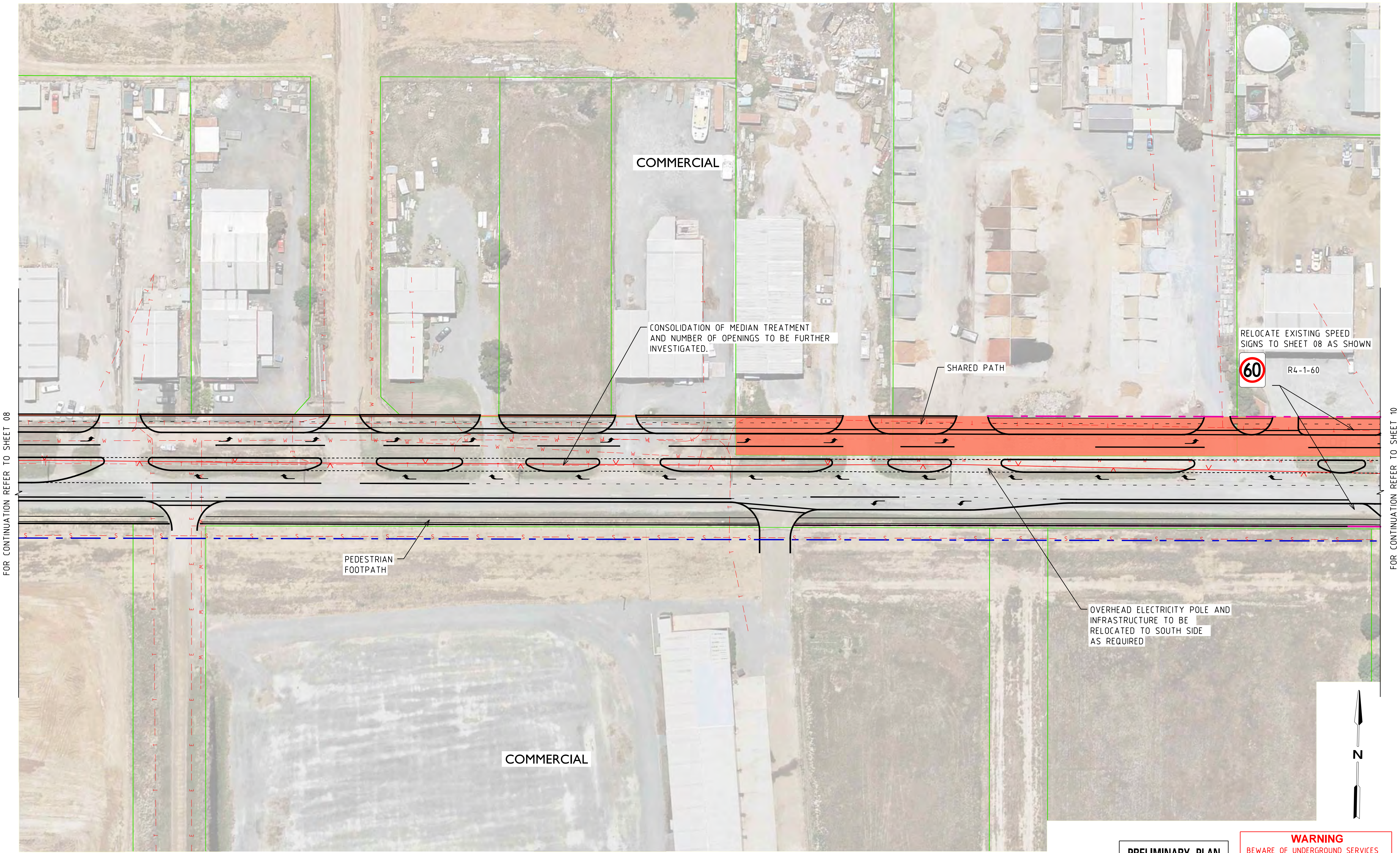
NOTE: LAND AQUISITION REQUIRED NORTH SIDE (TYPICAL).



09

PRELIMINARY PLAN
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SCALE OF METRES
HOR 0 10 20

WANGANUI ROAD & FORD ROAD INVESTIGATION STUDY
BETWEEN GOLF DRIVE AND GRAHAMVALE ROAD
CONCEPT FUNCTIONAL ALIGNMENT
WANGANUI ROAD

FILE NO.	CONTRACT NO.	SHEET NO.	DRAWING NO.	ISSUE
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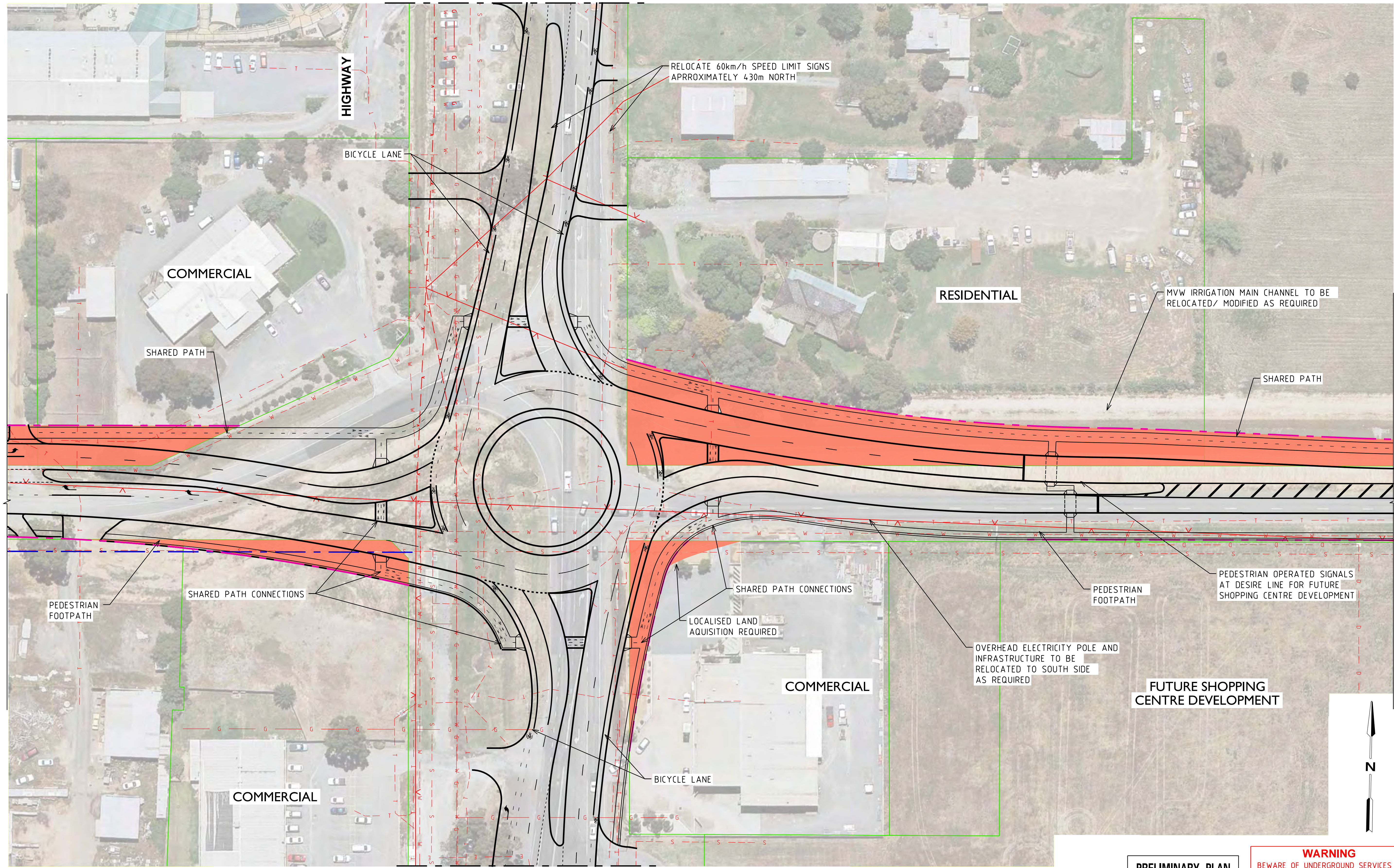
NOTE: LAND AQUISITION REQUIRED NORTH SIDE (TYPICAL).

LIMIT OF WORKS



FOR CONTINUATION REFER TO SHEET 09

FOR CONTINUATION REFER TO SHEET 11

LIMIT OF WORKS

NOTE: 60km/hr ALL APPROACHES

10

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SCALE OF METRES
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BETWEEN GOLF DRIVE AND GRAHAMVALE ROAD
CONCEPT FUNCTIONAL ALIGNMENT
GOULBOURNE VALLEY HIGHWAY

FILE NO.	CONTRACT NO.	SHEET NO.	DRAWING NO.	ISSUE
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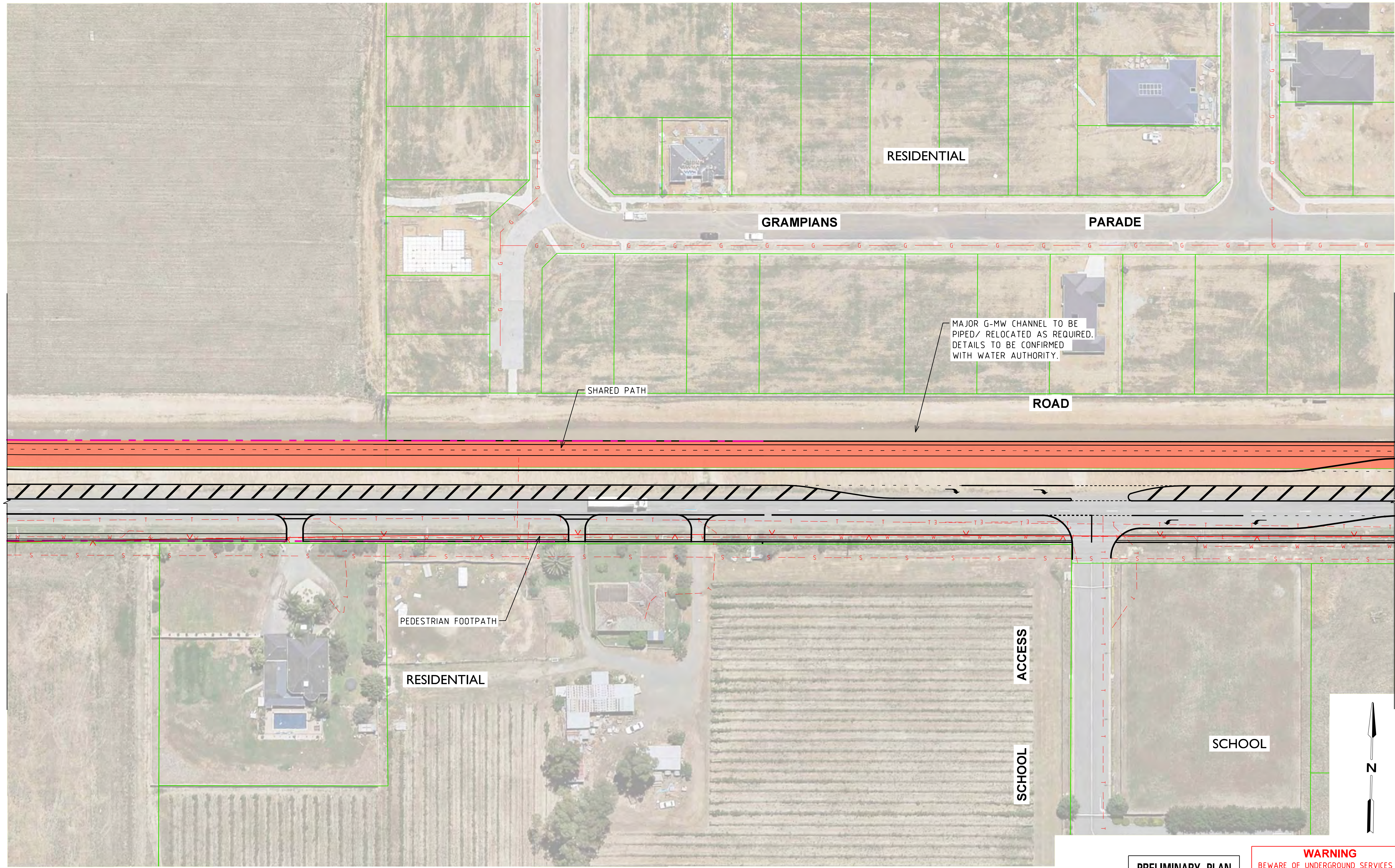
NOTE: LAND AQUISITION REQUIRED NORTH SIDE (TYPICAL).

FOR CONTINUATION REFER TO SHEET 10



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11

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SCALE OF METRES
HOR 0 10 20

WANGANUI ROAD & FORD ROAD INVESTIGATION STUDY
BETWEEN GOLF DRIVE AND GRAHAMVALE ROAD
CONCEPT FUNCTIONAL ALIGNMENT
FORD ROAD

FILE NO.	CONTRACT NO.	SHEET NO.	DRAWING NO.	ISSUE
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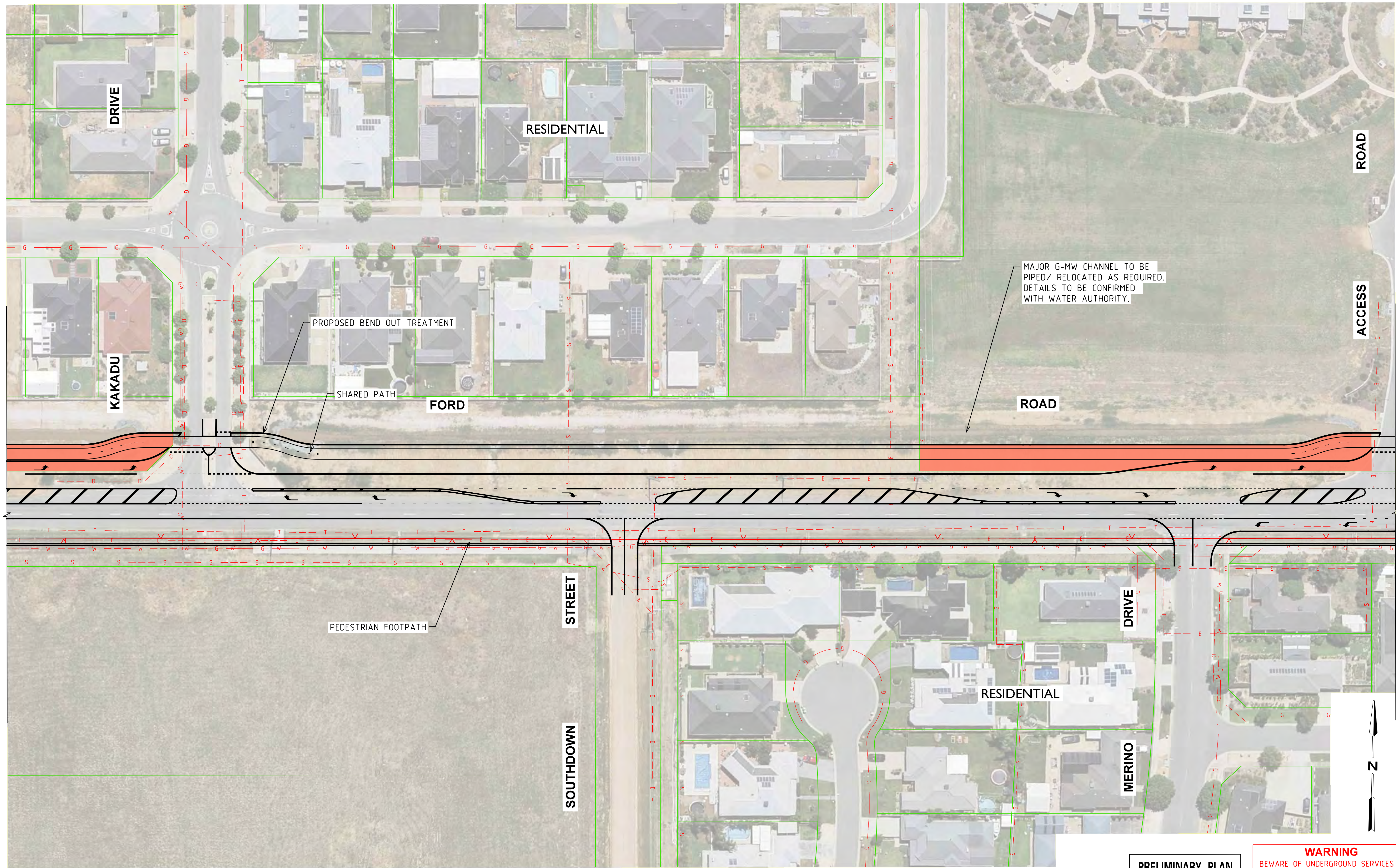
NOTE: LAND AQUISITION REQUIRED NORTH SIDE (TYPICAL).

FOR CONTINUATION REFER TO SHEET 11



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12

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NOTE: CONSIDERATION TO BE GIVEN TO RELOCATING ANY FUTURE ACCESS POINT ADJACENT LAND PARCELTO ALIGN WITH KAKADU DRIVE.

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SCALE OF METRES HOR 0 10 20

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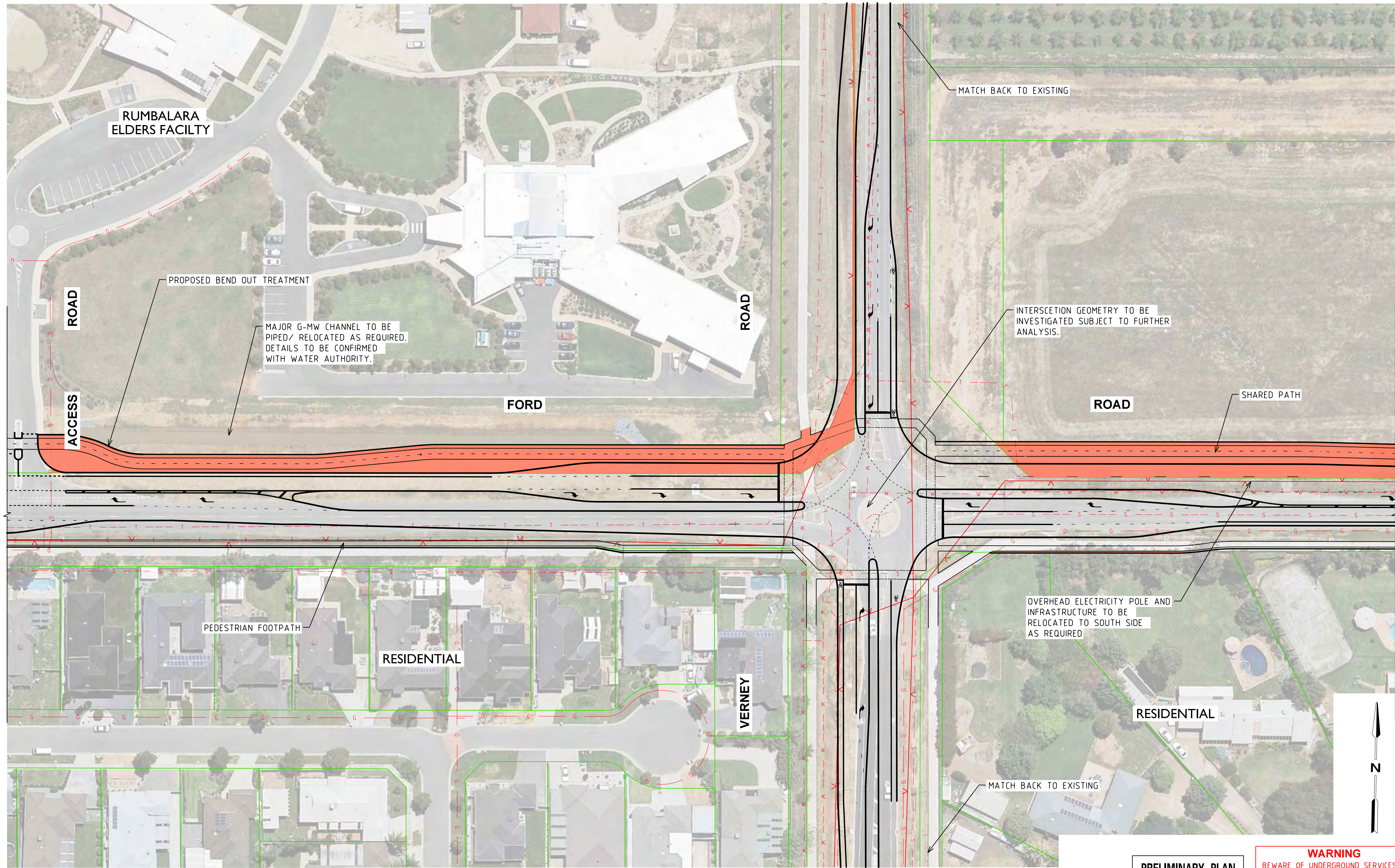
BETWEEN GOLF DRIVE AND GRAHAMVALE ROAD
CONCEPT FUNCTIONAL ALIGNMENT
FORD ROAD AND KAKADU DRIVE/ MERINO DRIVE

FILE NO.	CONTRACT NO.	SHEET NO.	DRAWING NO.	ISSUE
		12 OF 17		

NOTE: LAND AQUISITION REQUIRED NORTH SIDE (TYPICAL).



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FOR CONTINUATION REFER TO SHEET 14

13

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DESIGNED H. STEVENSON JANUARY '18
APPROVED
CAT:
PROJ:
FILE:

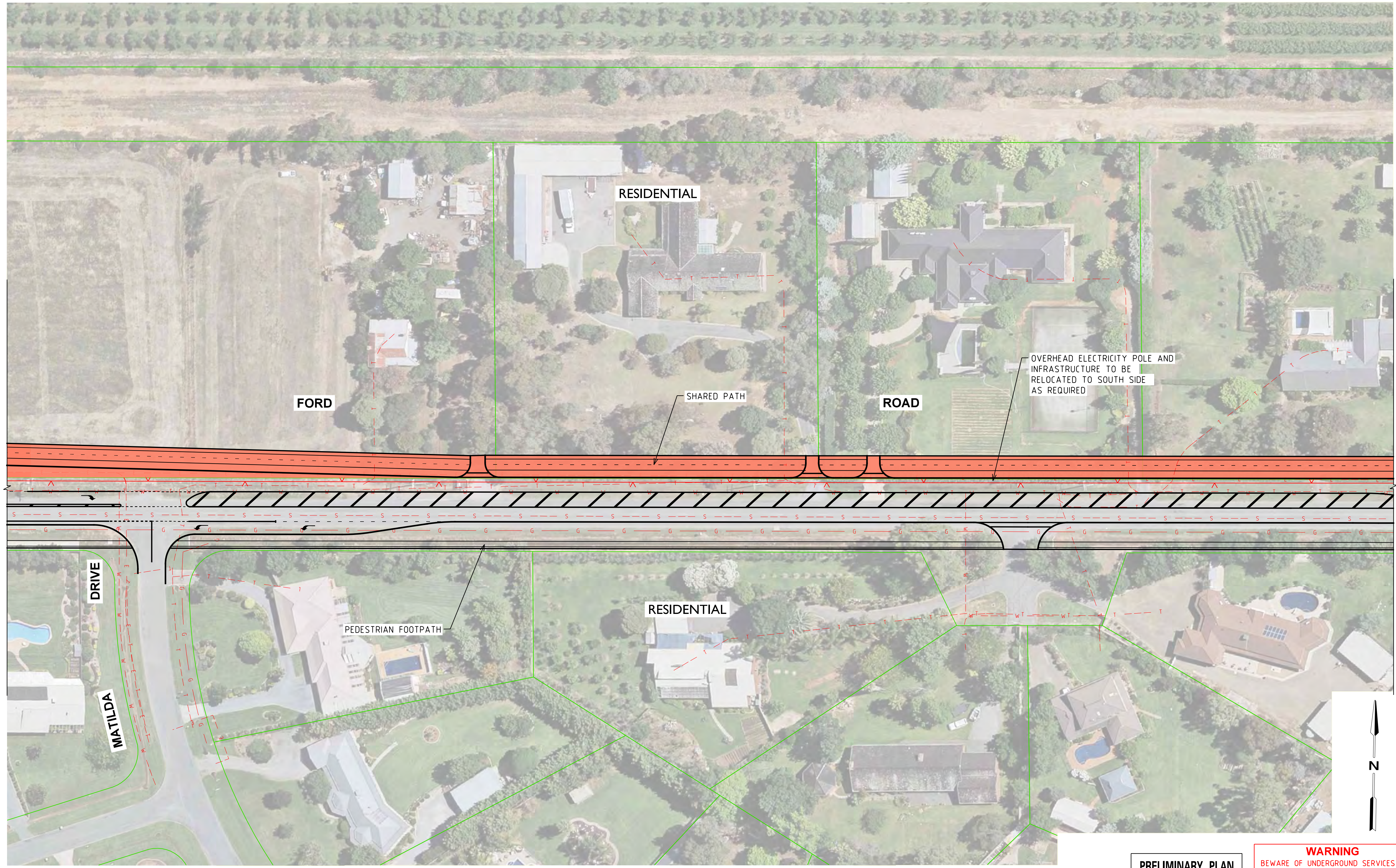
GREATER SHEPPARTON

SCALE OF METRES
HOR 0 10 20

WANGANUI ROAD & FORD ROAD INVESTIGATION STUDY
BETWEEN GOLF DRIVE AND GRAHAMVALE ROAD
CONCEPT FUNCTIONAL ALIGNMENT
FORD ROAD AND VERNEY ROAD

FILE NO.	CONTRACT NO.	SHEET NO.	DRAWING NO.	ISSUE
		13 OF 17		

NOTE: LAND AQUISITION REQUIRED NORTH SIDE (TYPICAL).



FOR CONTINUATION REFER TO SHEET 13

FOR CONTINUATION REFER TO SHEET 15

14

PRELIMINARY PLAN
FOR DISCUSSION PURPOSES ONLY SUBJECT TO CHANGE WITHOUT NOTIFICATION

WARNING
BEWARE OF UNDERGROUND SERVICES
THE LOCATIONS OF UNDERGROUND SERVICES ARE APPROXIMATE ONLY AND THEIR EXACT POSITION SHOULD BE PROVEN ON SITE. NO GUARANTEE IS GIVEN THAT ALL EXISTING SERVICES ARE SHOWN.

ISSUE	APP'D	DATE	AMENDMENT
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SCALE OF METRES
HOR 0 10 20

WANGANUI ROAD & FORD ROAD INVESTIGATION STUDY

BETWEEN GOLF DRIVE AND GRAHAMVALE ROAD

CONCEPT FUNCTIONAL ALIGNMENT
FORD ROAD AND MATILDA DRIVE

FILE NO.	CONTRACT NO.	SHEET NO.	DRAWING NO.	ISSUE
		14 OF 17		

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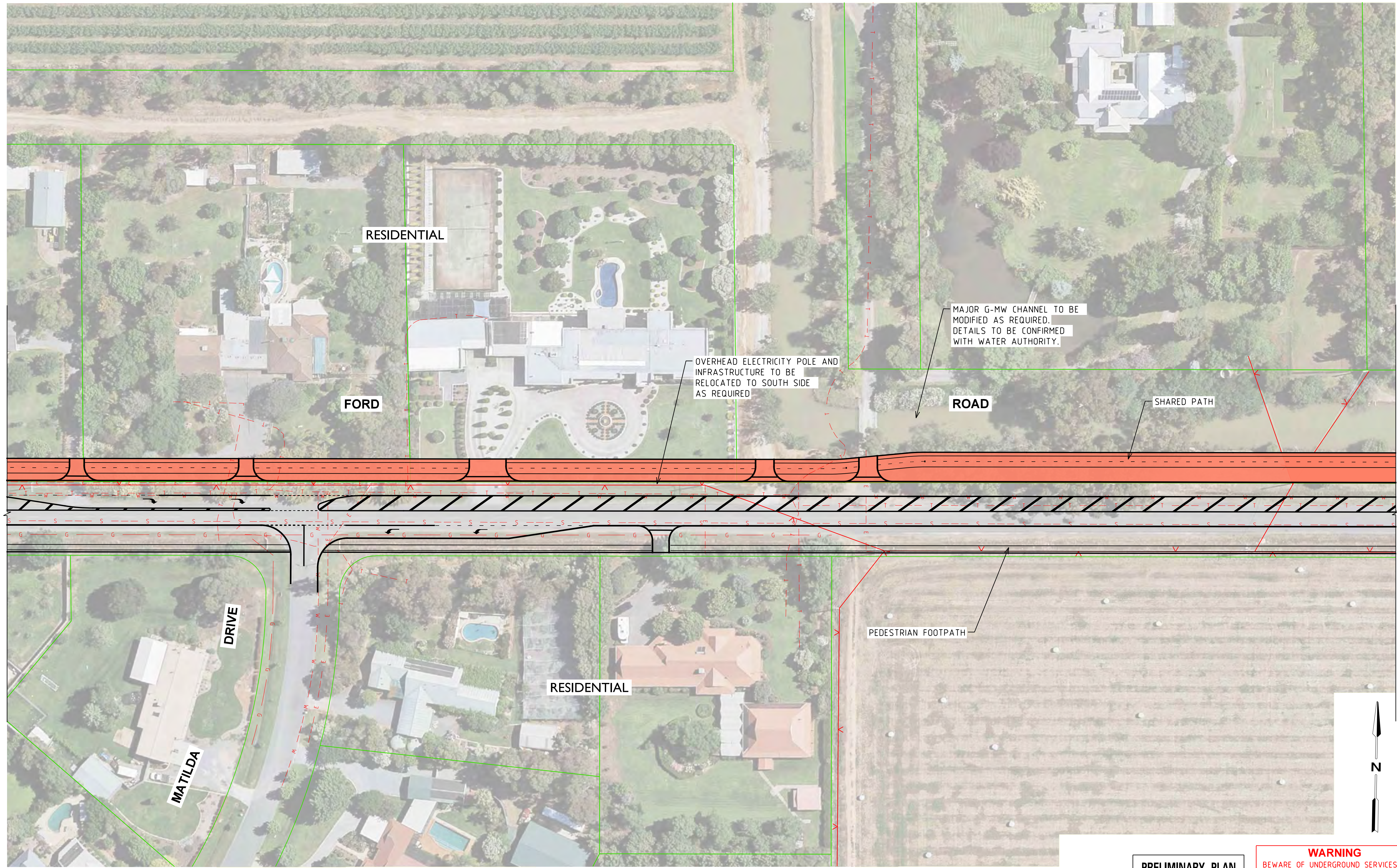
NOTE: LAND AQUISITION REQUIRED NORTH SIDE (TYPICAL).



FOR CONTINUATION REFER TO SHEET 14

FOR CONTINUATION REFER TO SHEET 16

15

PRELIMINARY PLAN

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SCALE OF METRES
HOR 0 10 20

WANGANUI ROAD & FORD ROAD INVESTIGATION STUDY

BETWEEN GOLF DRIVE AND GRAHAMVALE ROAD

CONCEPT FUNCTIONAL ALIGNMENT
FORD ROAD AND MATILDA DRIVE

FILE NO.	CONTRACT NO.	SHEET NO.	DRAWING NO.	ISSUE
		15 OF 17		

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NOTE: LAND AQUISITION REQUIRED NORTH SIDE (TYPICAL).

FOR CONTINUATION REFER TO SHEET 15

FOR CONTINUATION REFER TO SHEET 17

16

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SCALE OF METRES HOR 0 10 20

WANGANUI ROAD & FORD ROAD INVESTIGATION STUDY
BETWEEN GOLF DRIVE AND GRAHAMVALE ROAD
CONCEPT FUNCTIONAL ALIGNMENT
FORD ROAD

FILE NO.	CONTRACT NO.	SHEET NO.	DRAWING NO.	ISSUE
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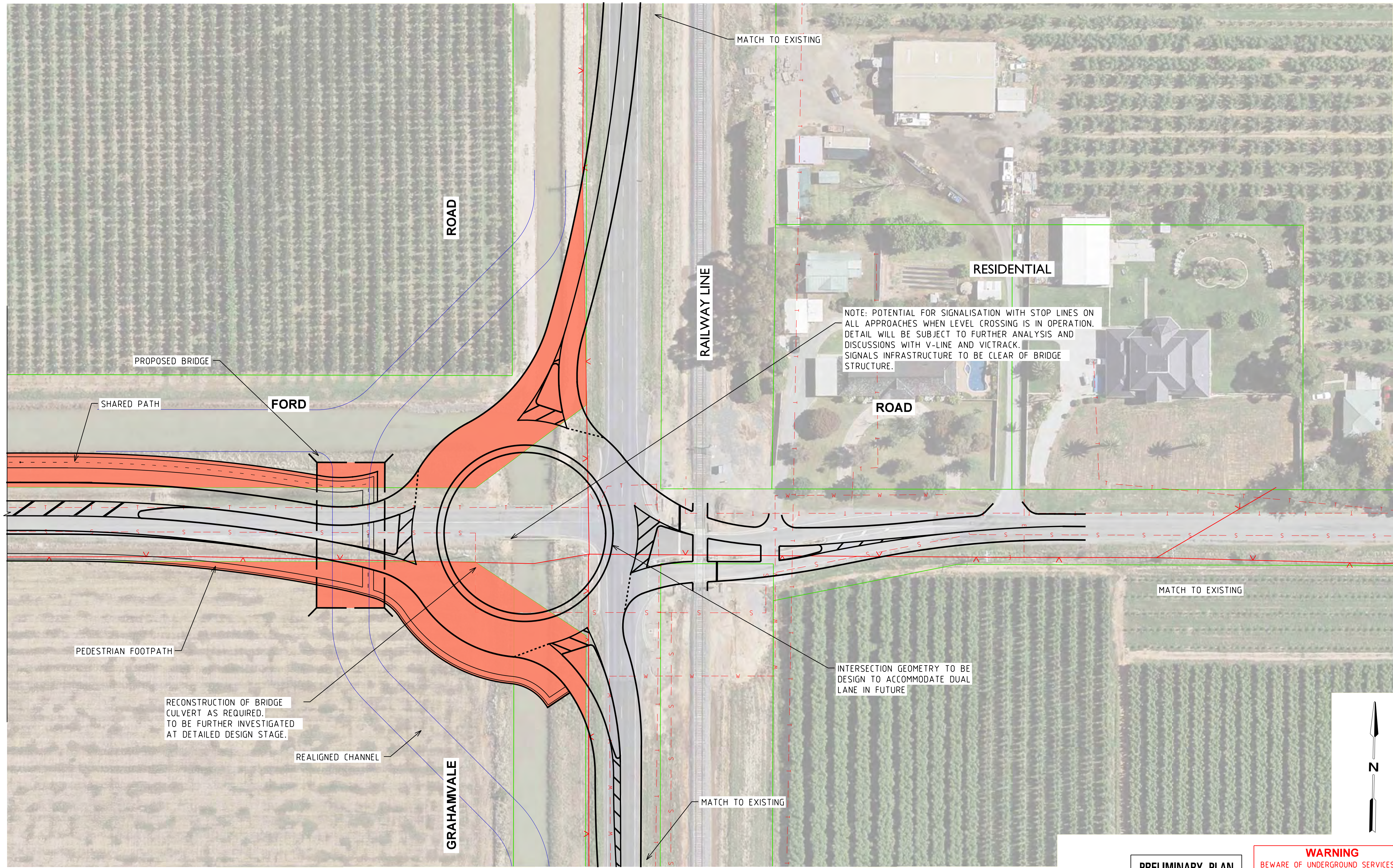
NOTE: LAND AQUISITION REQUIRED NORTH SIDE (TYPICAL).

FOR CONTINUATION REFER TO SHEET 16



17

PRELIMINARY PLAN
FOR DISCUSSION PURPOSES ONLY SUBJECT TO CHANGE WITHOUT NOTIFICATION

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WANGANUI ROAD & FORD ROAD INVESTIGATION STUDY
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CONCEPT FUNCTIONAL ALIGNMENT
FORD ROAD AND GRAHAMVALE ROAD

FILE NO.	CONTRACT NO.	SHEET NO.	DRAWING NO.	ISSUE
		17 OF 17		

Appendix D

Road Safety Audit - Concept Designs

22 YEARS OF EXCELLENCE

Road Safety Audit Report

Location: Wanganui Road / Ford Road, Shepparton

Project: Road and Intersection Upgrade

Stage: Functional Design

Client: GTA Consultants

Report Issue Date: 27/11/2017

Road Safety Audits
8/79 Manningham Rd
Bulleen, Victoria 3105
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Contact
Peter Harris
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FORENSIC

PRACTICAL

INDEPENDENT

Road Safety Audit Report

Wanganui Road / Ford Road, Shepparton

GTA Consultants

RSA Reference: RSA-06495

Document Record

Issue	Delivered	Senior Auditors	Technical Consultants	Contact
A	27/11/2017	Peter Harris Bob Cumming	Theo Niakolas	Peter Harris

Road Safety Audits
rsaudits.com.au

CONTENTS

INTRODUCTION

This is a road safety audit of a proposed road upgrade of Wanganiui and Ford Road, Shepparton, between Golf Drive and Grahamvale Road, undertaken by Road Safety Audits P/L, commissioned by GTA Consultants. It has been carried out in accordance with "Austroads Guide to Road Safety, Part 6: Road Safety Audit 2009" guidelines.

ROAD SAFETY AUDIT: OVERVIEW

A road safety audit is an independent examination of a design or condition to evaluate potential safety issues for all road user types. It is typically done by a team of suitably qualified people and often provides suggestions for consideration by the designer / client / project team.

A road safety audit is fundamentally a subjective qualitative process highly influenced by the experience and views of the individual team members. RSA P/L's quality assurance process utilises customised checklists designed for niche areas in traffic engineering/road design, in conjunction with a four-layer audit process: 1. on-site evaluation; 2. media and data capture and review; 3. specialist auditor input; and 4. secondary blinded reviews. In this case specialist auditor input was provided by Theo Niakolas, a road design engineer specialising in high speed roads and truck stability.

The purpose of a road safety audit is to raise potential safety issues, not to check compliance with guidelines and standards. However, at times this is done if the guideline or standard has a strong basis in safety and is highly relevant to the context of the issue being examined.

ROAD SAFETY AUDIT TEAM

The road safety audit was carried out by Peter Harris and Bob Cumming. Peter Harris and Bob Cumming both carry out road safety audits full-time in various states of Australia and have extensive experience in all stages of road safety audits leading or participating in several hundred audits and risk assessments every year.

Road Safety Audits Pty Ltd is accredited for the conduct of road safety audits under VicRoads' professional services register. Peter Harris and Bob Cumming are accredited Senior Road Safety Auditors under VicRoads pre-qualified senior road safety audit scheme.

CONDUCT OF THE SITE INSPECTION

A site visit was carried out during the day and night on 19 November 2017 in normal traffic conditions and clear and hot weather conditions. The site was driven many times, with walking around the key intersections and key points of interest.

PROJECT

The existing road has one lane in each direction and basic intersections, with an 80km/h speed limit west of Goulburn Valley Highway and 60km/h east of it. The land use is a mix of industrial, residential, commercial, and community services.

The project seeks to maintain one lane in each direction and the existing speed limits and add:

- A roundabout at GVH
- Traffic signals at Verney Road
- A roundabout at Grahamvale Road
- A constructed median west of GVH and a painted median east of it
- A shared path running along the northern side of the road, and a footpath to the south

Golf GVH Verney Grahamvale

DOCUMENTATION PROVIDED FOR AUDIT

The following documents were provided by the client to facilitate the audit:

- GTA Consultants *Concept Functional Alignment* Plans Set: 117720-02 1 to 17 inclusive, all issue P5
- GVH intersection Functional Layout Plan issue P1 sheet 1 and 2
- Safe System Solutions Safe System Assessment Issue 2

RISK RATINGS

RSA P/L does not typically use the Austroads risk rating method, mostly because it can only be applied to some points and therefore can skew the perceived risk of other points, and also due to it being a highly subjective approach, giving the false impression of objectivity.

- 'Urgent' / 'High-Risk': Needs immediate attention / changes as per RSA suggestion or similar.
- 'Recommend' / 'Serious' / 'Important': Must be robustly reviewed. Most likely requires a change to avoid a high-risk road environment for one or more user groups.
- 'Should' / 'Suggest' / 'Significant': Based on the view of the RSA team the suggestion should be done, but it concedes that there could be reasons why inaction or alternative action is equally correct. Must be robustly reviewed by contractor and where relevant key traffic engineering project stakeholders.
- 'Review' / 'Consider': RSA is raising an observation but has no *strong* opinion on the outcome and need for changes. Project should review because it's not an immediate and high risk and may not be immediately obvious to RSA the reasons for the practice / setup / behaviour. May need monitoring.
- 'Minor': Typically, a low road-safety consequence / compliance issues (to guidelines or plans) / administrative controls. Unlikely to increase risk of crash.
- 'Note': Little or no road safety significance. Typically added to give a complete picture of the design, site, context, analysis, auditors understanding.

SCOPE

Senior auditors at RSA P/L typically apply a high experience base and attempt to focus on 'big-picture' safety issues. These are issues that fundamentally affect road safety based on road user behaviour and expectations, not merely checking compliance to road design guidelines. "A Road Safety Audit is not a check of compliance to standards. Rather than checking for compliance, a road safety audit is checking fitness for purpose: will the road or treatment work safely for its expected road users?" (AGRS RSA 2009)

A functional design stage road safety audit tends to examine the broad design for more fundamental issues that can't be changed later by minor signs or linemarking changes. This includes intersection layouts and types, horizontal and vertical alignments, access points, and all road user groups.

The scope is generally limited to the safety effects of the proposed changes, and does not look beyond the limits of works to try to improve substandard conditions outside of the general scope of the works.

The scope does not include reviewing the Safe System Assessment and relating this road safety audit to that assessment. It assesses the design on its merits only.

AUDIT FINDINGS AND RECOMMENDATIONS

KEY ISSUES (SIGNIFICANT SAFETY COMPONENT)

1. Geometric design of Grahamvale Road roundabout

Based on the concept plan, it appears that the proposed roundabout arrangement will not meet Austroads design criteria.

Given the speed environment, it is suggested that the approach leg geometry be appropriately designed to accommodate the *operating speed (*realistic speed-shedding at intervals through the curves), superelevation, vehicle stability, and sight distances.

IMPORTANT — HIGH RISK

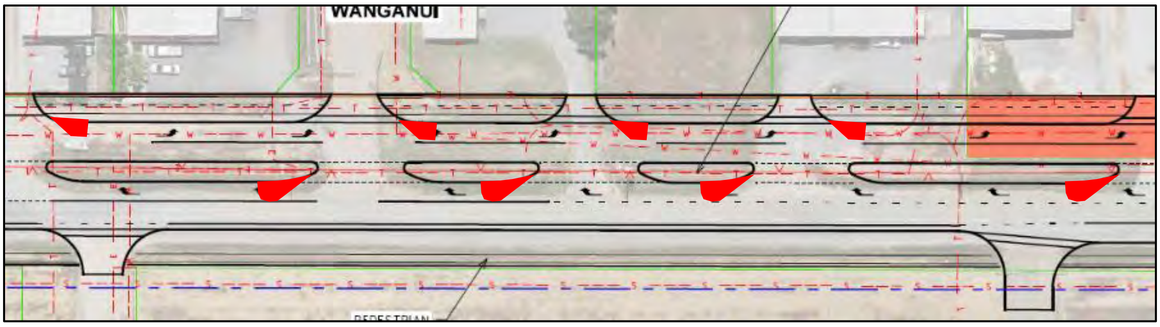
2. Continuing turn lanes

It is appreciated that auxiliary turn lanes generally reduce crash potential. However, the audit team is unconvinced that an un-channelised continuing lane is the right option through this industrial section.

Although it's legally a turn lane, drivers will find it ambiguous as to where to enter and how long to travel in it. It is suspected that it might end up functioning as a second *through* lane, without the safety benefits of sheltered auxiliary lanes and with a level of confusion and ambiguity that might lead to safety problems.

An alternative could be to formalise the predicted driver behaviour by changing the design to two through lanes. However, this would lose the benefit of the auxiliary turn facility.

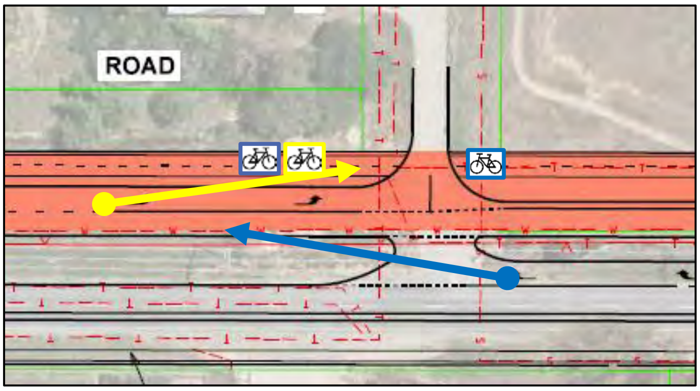
Therefore, taking into consideration the low speed limit through this section, it is strongly suggested that this aspect of the design be carefully reviewed with the option of channelised median formations carefully considered (in red below). This option seeks to gain the benefit of channelised auxiliary lanes without the operational ambiguity of the continuing turn lane.

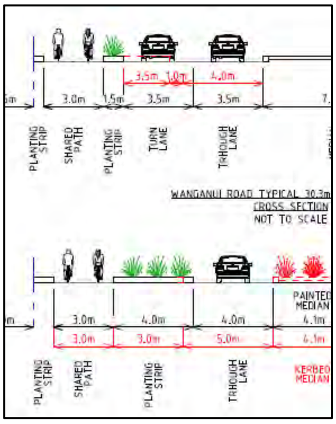


IMPORTANT

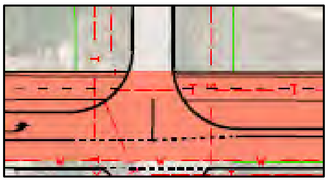
3. Shared path users (SPU)

The proposed landscaping gives rise to the significant risk of sight distance interference. For example, left turners (yellow) need sufficient distance to see oncoming SPU, particularly those travelling in the same direction. Right turners who are focussed on picking a gap in traffic (blue) need the ability to see oncoming SPU from both directions.





Furthermore, the proposed minor intersection layouts give the appearance of priority of vehicles over SPU.



For cyclists, the actual priority under the road rules is based on whether it's a side road or a driveway. However, this distinction is largely lost on road/path users, and from a safety perspective, it gives rise to ambiguity and erodes pathway continuity.

Continued next page

A.

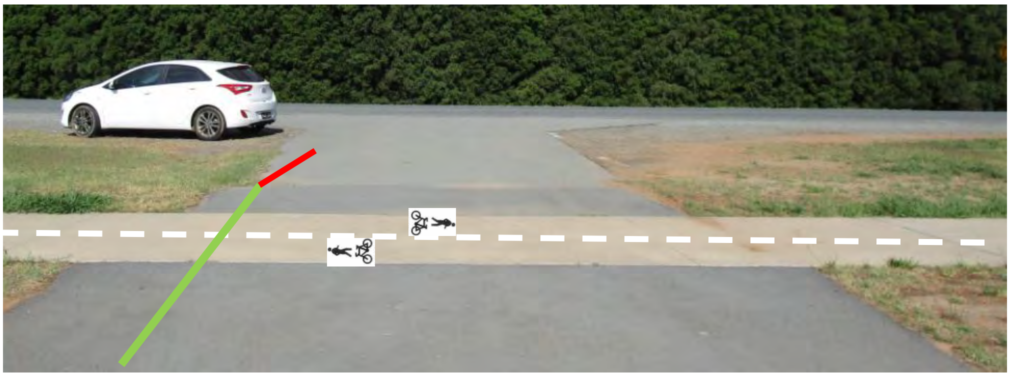
It is strongly suggested that the sight distance issue be designed-out by having no landscaping within a set distance of intersections (approximately 20m).

Note: The option of relying on low planting is considered to be inferior because, even if done correctly initially, in time plants might be replaced without full knowledge of the strategic issue. Also, the option of having no growth height restriction and relying on maintenance is strongly discouraged.

B.

Review the strategic approach to managing right of way priority with a consistent approach that will be understood by all road users. Minimise the need for signage.

One option that could achieve this, and, slow turning traffic, is to have the accessways and shared path at-grade (green line), the shared path contrasting in colour, then ramping down to road level (red), with routine shared path pavement markings.

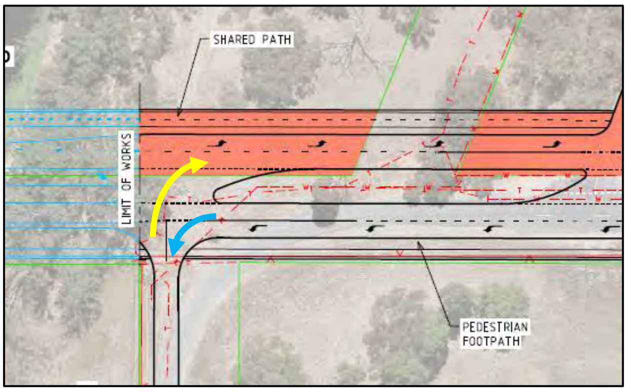


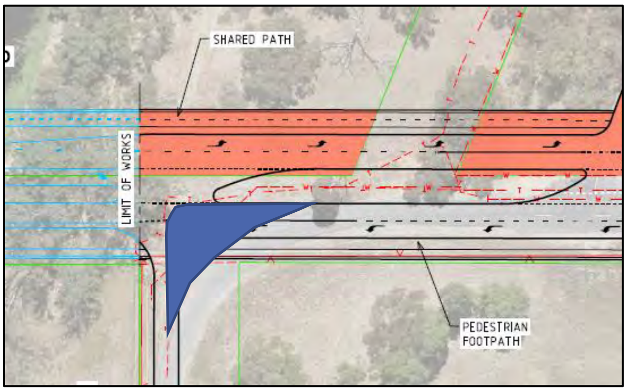
Example: View from a driveway looking towards a road.

IMPORTANT

4. Wanganui Road / Golf Drive medium to long term arrangement

Wanganui Road may not be extended beyond Golf Drive for years. The left-in / right-out movements might operate without issue if the 'ultimate' road is built as per the plans (image below-left). However, the ultimate road configuration will most likely give some drivers misleading visual cues and driving options. Also, drivers will get into the habit of not giving way, which could lead to manoeuvring conflicts from u-turns. Consideration should be given to other options such as utilising the existing road to separate the movements as per mock-up below-right.





This treatment would also mitigate the risk posed by an errant vehicle striking the junction pole (e.g. as a result of confused and speeding driver).

5. Wanganui Road Utility Poles

It appears that some light poles will be further from traffic such as those on the south side at the west end (below-left).

However, others on the north side of the road (e.g. at the west end east of Kittles Road) are currently located where the ultimate median will be (below-right). The offset of these poles 'within the median' might be similar to the existing offset, but only for through traffic, not turning traffic.

This aspect of the design (change in risk profile / treatment of hazards) will need to be carefully assessed as the project progresses.

IMPORTANT

6. Street lighting

Currently there is no street lighting.

With a road upgrade of this type and the likely future lane development, the basic safety and amenity of the shared path and footpath is considered to be congruent to the provision of street lighting. This is especially important due to the number of and type of abutting access points, and, to encourage *commuter* path usage.

This consideration is not limited to specific areas such as the looping around the heritage listed building at Wanganui Homestead, or major intersections, but to the whole road length.

IMPORTANT

7. Kerb type

The typical cross sections are highly schematic only but indicatively show barrier kerb. It's important that barrier kerb is not used on the high-speed section of road.

IMPORTANT

8. Existing pavement cross section

The existing road cross section appears to be 3%/3% or flatter.

If this existing pavement is retained to form the westbound carriageway, drivers will be crossing the crown to enter turn lanes. Nevertheless, the 'change in crossfall' tolerances should be within guidelines for a 90km/h design speed but will need to be reviewed if the pavement is retained.

9. Cyclists at the GVH roundabout

On-road bicycle lanes are shown at this roundabout.

On-road bicycle lanes within roundabouts are no longer supported by Austroads or VicRoads design supplements. This is due to the offset of cyclists to the vision of entering drivers.

IMPORTANT

MINOR ISSUES (MINOR SAFETY COMPONENT)

10. Cyclists at the GVH roundabout (notwithstanding point 9)

Provision for both on-road and off-road cyclist movements are proposed. However, some cyclists who are generally comfortable riding on the road will still find a large roundabout with high truck volumes intimidating and would prefer the option of exiting the road.

To cater to these cyclists, strong consideration should be given to providing ramp links on both approaches similar to the example shown below-right.

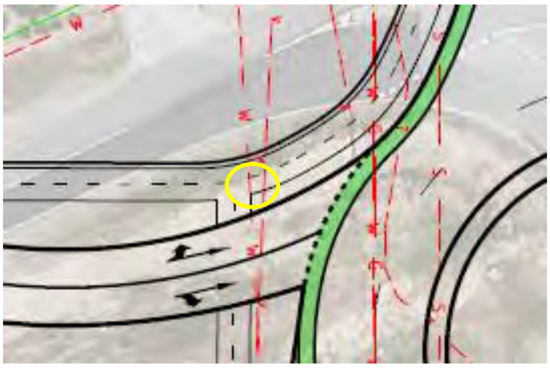
Note: It is the view of the audit team that the shared path crossing access does not serve this purpose.

---

11. Cyclists at the GVH roundabout

Negligible storage space is provided between the continuing shared path and the crossings area. Thus, cyclists waiting to cross are likely to obstruct continuing cyclists.

Consider adjusting the design to provide storage space.



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12. Cyclists at the Verney Road intersection

The shared path appears to constrict to a typical footpath through the intersection.

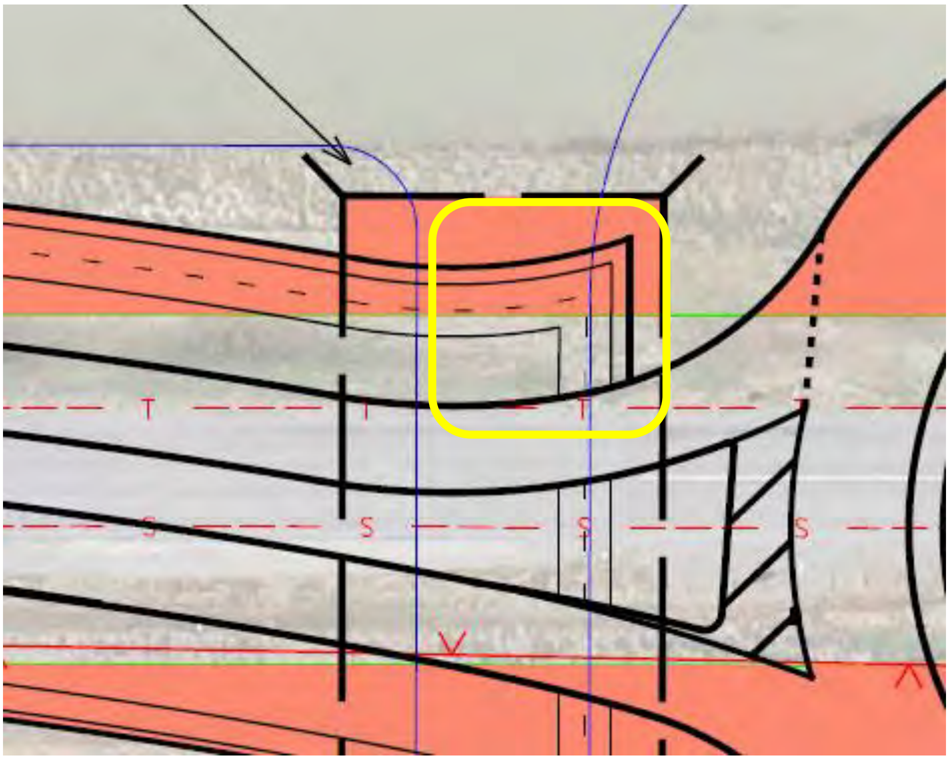
It would be expected that *cyclist continuity* would be a desirable outcome through the intersection.

Review the design options including bicycle lanterns and a path wide enough for two cyclists to safely pass.

13. Cyclists at the Ford Road / Grahamvale Road intersection

The shape of the shared path indicated below is not conducive to bicycle riding and would make it difficult for cyclists and pedestrians to use the path together.

It is suggested that it be redesigned in a more curved formation.

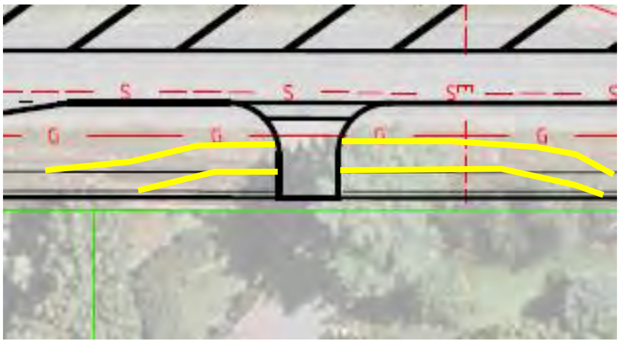


14. Footpath position

On Ford Road, there are several driveways that have vegetation hard up against the property boundary line.

The design shows the footpath hard up against the property boundary line. This might result in an unnecessary reduction in visibility between pedestrians (and young cyclists likely to be using the footpath), and drivers exiting driveways.

Consider localised adjustments to the footpath position.



15. Speed limit signs

Sheet 10 indicates that the 60km/h speed signs on Goulburn Valley Highway are to be relocated approximately 430m north.

At present, there are 80km/h signs attached to the rear of these signs facing northbound traffic. It is assumed that the intent is to relocate the 80km/h signs as well, so that the speed limit change is at the same locations for both carriageways.

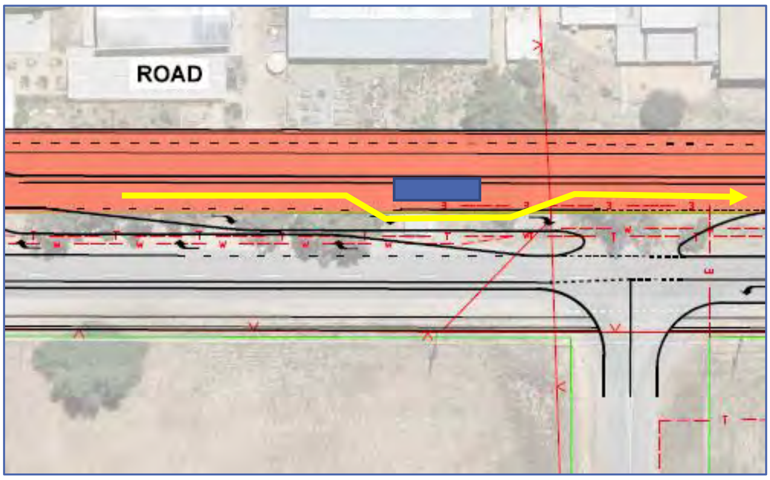
It's not essential to do this, particularly since the carriageway is divided. However, it would be a good measure so that northbound drivers don't view the 80km/h signs and speed up too soon. It is suggested that this be done.

GVH, looking north from Wanganui Road

16. Bus stop

There's an existing bus stop at the TAFE at the west end just west of Rudd Road.

If this is to be retained in its current position, drivers will probably overtake in the right turn lane. This is undesirable and confusion may arise with other motorists turning within the intersection.



It is suggested that this be reviewed with consideration to bus-bay indentation / other.

17. Abutting surfaces

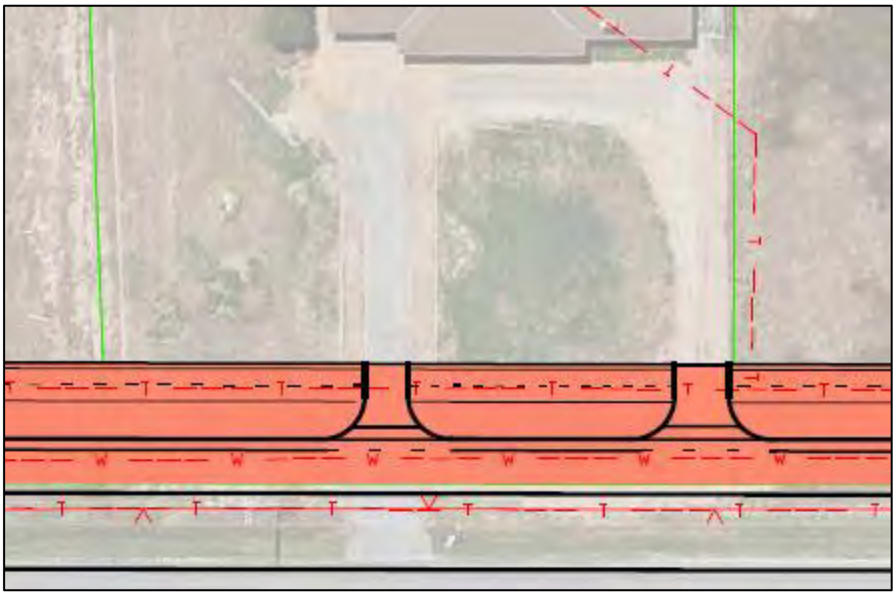
At driveways and other local accesses, it would be undesirable for unsealed surfaces to result in the migration of stones and debris onto the shared path. It is suggested that they be sealed for some distance.

Property number 190 Wanganui Road

Freemans Road

18. Number of intersections abutting shared path

A property on sheet 8 currently has one crossover but the plans indicate that a second will be provided.

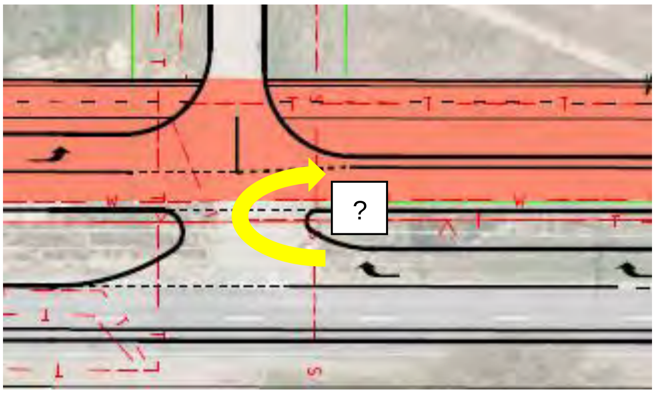


It's desirable to minimise the number of access points to minimise potential conflict with shared path users.

In the example above, the resident can easily turn around within their property.

19. Vehicle manoeuvring

It's unclear whether the design accommodates u-turns in the 2.8km section east from Golf Drive as indicated below.



If it does not, it could result in awkward manoeuvring such as 3-point turns with reversing into the deceleration lane.

It is suggested that this be thoroughly reviewed.

20. Access at Deca Driving School

The driving school (sheet 6) appears to specialise in truck driving training.

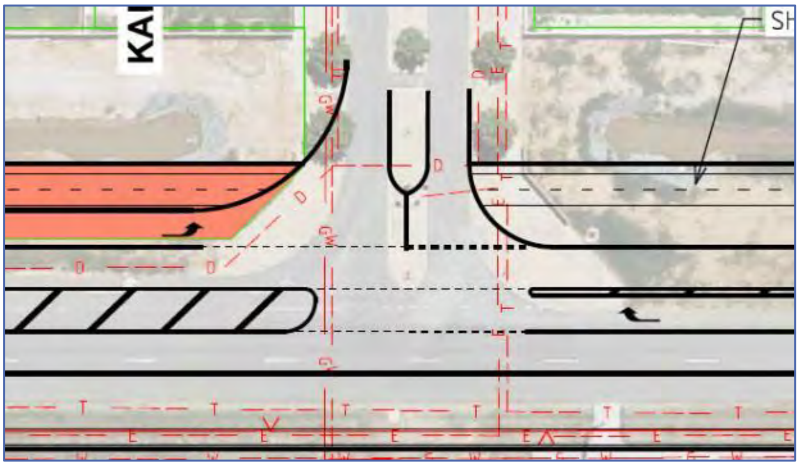
The plans indicate that the need for a deceleration lane is under review.

Further to that review and to point 19 above, it's unclear whether the training is fully on-site or whether drivers under instruction / training exit the site and drive on public roads. If the latter, it's unclear how they would exit the site and travel east. Review.

21. Splitter island at Kakadu Drive **and Sheet 13 'Access Road'**

The island is within the continuing alignment of the shared path which is not ideal for path continuity.

Review options such as terminating the island further away from the road or extending it towards the road but providing a refuge.



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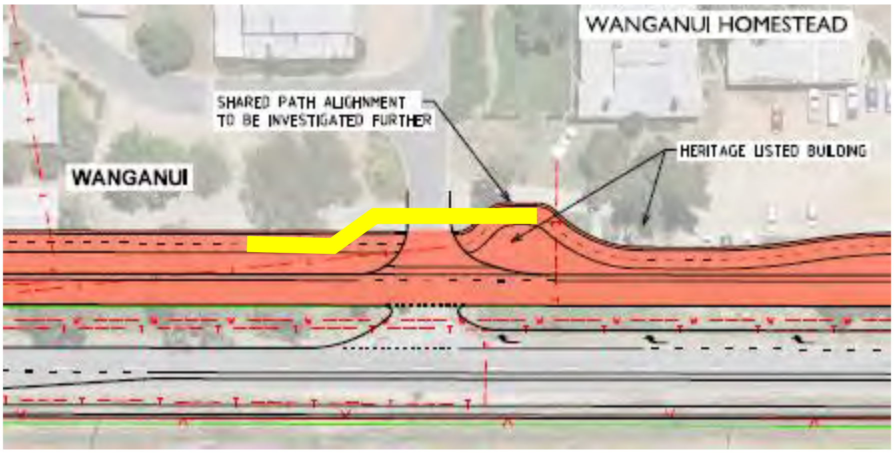
22. SUP alignment near Wanganui Homestead

The shared path alignment winds through the heritage site adjacent to the access road, but remains adjacent to Wanganui Rd across the access road. A sequence of tight turns is difficult to ride along and could mislead drivers into thinking cyclists are not crossing the access road.

Consider changing the path alignment across the access road to more like a typical 'bent out' crossing treatment.



OTHER ISSUES (NEGLIGEABLE SAFETY COMPONENT)

23. Existing signs

A significant proportion of the existing warning (and other) signage will become redundant under this project. This includes existing 'shared path' signage at Matilda Drive.

South side of Ford Road at Matilda Drive

24. Drafting

It's understood that an on-road bicycle lane is not proposed. However, the plans appear to indicate an on-road bicycle path. It is suggested that this be clarified as it has the potential to raise road safety audit / other issues.

25. Drafting

The scale on the main plan set is shown as 1:2000. However, the actual scale at A3 is 1:1000.

SUMMARY / RESPONSE TABLE

Point No.	Issue	Comment	GTA Consultants Response	
			Accept / Reject	Comment / Status
Key Issues				
1.	Geometric design of Grahamvale Road roundabout.	May require significant adjustment to accommodate realistic and safe speed-shedding.	Accept	The layout proposed is conceptual only and subject to further detailed design development. The general layout as shown has been prepared loosely based on applicable standards and requirements in order to better understand potential land acquisition.
2.	Continuing turn lanes could be problematic.	Channelised auxiliary lanes are preferred.	Accept	The arrangement will be reviewed during further design development. The audit findings are considered relevant and channelised turn lanes, configured in the manner proposed in the audit, will be given consideration.
3.	Sight distance to shared path users.	Omit vegetation on separators for ~20m.	Accept	Landscape design to taken on this recommendation
4.	Wanganui Road / Golf Drive medium to long term arrangement.	Separate movements.	Accept	The interim and ultimate layout has not been due consideration. Further consideration will be taken during design development.
5.	Wanganui Road Utility poles.	Review.	Accept	The concept layout did not take account of lighting upgrades. Further design development will address this
6.	Street lighting.	Provide lighting along shared path.	Accept	The concept layout did not take account of lighting upgrades. Further design development will address this
7.	Kerb type.	Review.	Accept	Kerb selection and application will be per VicRoads' road design guidelines and other applicable standards
8.	Existing pavement cross section.	Review.	Accept	This will be reviewed during detailed design.

Point No.	Issue	Comment	GTA Consultants Response	
			Accept / Reject	Comment / Status
9.	Cyclists at the GVH roundabout.	Not compliant with VicRoads design guidelines.	Accept	Cycle provisions will be reviewed during detailed design. The layouts developed are conceptual and based on determining footprint required with regard for design principles and traffic capacity assessment. The treatment eventually documented in detailed design will be based on current practice and applicable design standards.
Minor Issues				
10.	Cyclists at the GVH roundabout.	Provide ramp.	Accept	This will be reviewed and incorporated in further design development.
11.	Cyclist storage at the GVH roundabout	Provide space.	Accept	This will be reviewed and incorporated in further design development.
12.	Cyclists at the Verney Road intersection.	Review provision for cyclists.	Accept	This will be reviewed and incorporated in further design development.
13.	Cyclists at the Ford Road / Grahamvale Road Intersection.	Review shape of path.	Accept	This will be reviewed and incorporated in further design development.
14.	Footpath position.	Localised offset adjustments.	Accept	This will be reviewed and incorporated in further design development.
15.	Speed limit signs.	Relocate.	Accept	This will be reviewed and incorporated in further design development.
16.	Bus stop at the TAFE	Review possible indentation.	Accept	This will be reviewed and incorporated in further design development.
17.	Abutting surfaces.	Seal.	Accept	This will be reviewed and incorporated in further design development.
18.	Number of Intersections Abutting Shared Path.	Minimise.	Accept	This will be reviewed and amended as required in further design development.
19.	U-turn provision.	Review.	Accept	This will be reviewed and amended as required in further design development.
20.	Deca Driving School access to travel east.	Review.	Accept	This will be reviewed and amended as required in further design development.
21.	Splitter Island at Kakadu Drive and Sheet 13 'Access Road'.	Review.	Accept	This will be reviewed and amended as required in further design development.

Point No.	Issue	Comment	GTA Consultants Response	
			Accept / Reject	Comment / Status
22.	SUP alignment near Wanganui Homestead.	Change the crossing position.	Accept	This will be reviewed and incorporated in further design development.
Other Issues				
23.	Existing signs	Many signs will be redundant.	Accept	This will be reviewed and incorporated in further design development.
24.	Drafting: Bicycle lane	Clarify.	Accept	This will be reviewed and amended as required in further design development
25.	Drafting: Scale	Review.	Accept	Noted and will be amended as required.

CONCLUDING STATEMENT

The audit has attempted to balance the safety needs of all road users within the site/design constraints. As per Austroads guidelines, the suggestions provided have attempted to be realistic/feasible and commensurate with the actual risk posed. Although it attempts to raise all potential safety risks, this is generally not practicable due to a limited knowledge of the site and the design. Agreement to the issues and/or suggestions does not necessarily eliminate risk.

A road safety audit is fundamentally a subjective qualitative process highly influenced by the experience and views of the individual team members. It is expected that the project team has competence to incorporate any audit findings into the broader design-risk decision process and to ask the audit team further questions where necessary.

Bob Cumming

27/11/2017

Senior Road Safety Auditor
BE (Civil)

Peter Harris

27/11/2017

Senior Road Safety Auditor
CPEng, RPEQ, NER, BE (Civil), BB (Bus. Admin)

RESPONDING TO THE ROAD SAFETY AUDIT

Although the client receiving the report does not have to agree to the audit findings/suggestions, the issues and associated risks should be carefully considered. A written response should be made to all of the audit findings raised, then signed off by the responsible person from the project team.

RSA P/L does not change the audit findings or sign off on the project's responses. However, if a finalisation meeting has not been commissioned by the client, the client is encouraged to provide the responses to RSA P/L to check that each audit point has been fully understood. Also, the responses can be used by RSA P/L for their knowledge and possible use on future audits for this project.

REFERENCES

Relevant guidelines, standards, laws, and policy documents

Road Safety Audit

- Austroads Guide to Road Safety – Road Safety Audit - 2009

Traffic Engineering

- Austroads Guide to Road Design (AGRD)
- Austroads Guide to Traffic Management (AGTM)
- AS 1742 Manual of Uniform Traffic Control Devices, including:
  - Part 1 General Introduction and Index of Signs
  - Part 2 Traffic Control Devices for General Use
- VicRoads Supplement to Austroads Guides and AS1742

Appendix E

Sub-Consultant Reports

E.1 Appendix E1: Environment and Ecology

Draft Report

Desktop Flora and Fauna Assessment: Ford Road and Wanganui Road, Shepparton, Victoria

Prepared for

Greater Shepparton City Council

April 2017

Ecology and Heritage Partners Pty Ltd

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Contents

Document Control

Assessment	Desktop Flora and Fauna Assessment
Address	Ford Road and Wanganui Road, Shepparton, Victoria
Project number	9018
Project manager	Tom Wright (Senior Botanist)
Report reviewer	Tom Wright (Senior Botanist)
Other EHP staff	Janice Taylor (Botanist)
Mapping	Monique Elsley (GIS Coordinator)
File name	EHP_9018_Ford&WanganuiRd_DesktopF&F_16042017
Client	Greater Shepparton City Council
Bioregion	Victorian Riverina
CMA	Goulburn Broken
Council	Greater Shepparton City Council

1 INTRODUCTION

Ecology and Heritage Partners Pty Ltd was commissioned by Greater Shepparton City Council to conduct a Desktop Flora and Fauna Assessment for Ford Road and Wanganui Road, Shepparton, Victoria (the study area). The purpose of the assessment was to identify the potential presence of significant ecological constraints such as remnant vegetation, and threatened species and ecological communities within the study area, and to provide important background information and site context prior to a field assessment. This report presents the results of the desktop assessment and discusses potential implications under the following Commonwealth and State environmental legislation and policy:

- Commonwealth
  - *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).
- Victorian
  - *Environment Effects Act 1978* (EE Act);
  - *Flora and Fauna Guarantee Act 1988* (FFG Act);
  - *Planning and Environment Act 1987* (P&E Act);
    - Permitted clearing of native vegetation: biodiversity assessment guidelines 'the Guidelines' (DEPI 2013);
    - Local Planning Scheme;
  - *Catchment and Land Protection Act 1994* (CaLP Act);
  - *Wildlife Act 1975*; and
  - Victorian's advisory listed for rare and threatened (VROT) flora (DEPI 2014) and fauna (DSE 2013).

The study also assesses the potential requirement for targeted surveys to identify the presence of threatened species.

2 STUDY AREA

The study area is a 5 km linear section of Wanganui and Ford Roads terminating at the corner of Ford and Grahamvale Roads. The study area is located off the Goulburn Valley Highway in Shepparton North in north-central Victoria, approximately 200 kilometres north of Melbourne (Plate 1; Figure 1). The study area encompasses the road reserve intersecting various parcels of land along both Ford Rd and Wanganui Rd.

The study area occurs within the Victorian Riverina bioregion and is located within the jurisdiction of the Goulburn Broken Catchment Management Authority (GBCMA) and the Greater Shepparton City Council municipality.

Plate 1. Location of the study area

3 METHODS

3.1 Desktop Assessment

Relevant literature, online-resources and databases were reviewed to provide an assessment of flora and fauna values associated with the study area, including::

- The Victorian Department of Environment, Land, Water and Planning's (DELWP) Native Vegetation Information Management (NVIM) Tool (DELWP 2017a) and Biodiversity Interactive Map (BIM) (DELWP 2017b) for:
    - Modelled data for location risk, remnant vegetation patches, scattered trees and habitat for rare or threatened species; and,
    - The extent of historic and current EVCs.
- Ecological Vegetation Class (EVC) benchmarks (DELWP 2017b) for descriptions of EVCs within the relevant bioregion;
- The Victorian Biodiversity Atlas (VBA) for previously documented flora and fauna records within 10km radius of the project locality (DELWP 2017c);
- The Flora Information System (FIS) (Viridans 2014a) and Atlas of Victorian Wildlife (AVW) (Viridans 2014b) and Aquatic Fauna Database (AFD) for assistance with the distribution and identification of flora and fauna species within the study area or surrounding 10 kilometre radius;
- The Commonwealth Department of the Environment and Energy's (DoEE) Protected Matters Search Tool (PMST) for matters of National Environmental Significance (NES) protected under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (DoEE 2017);
- Relevant listings under the Victorian *Flora and Fauna Guarantee Act 1988* (FFG Act), including the latest threatened and protected lists (DELWP 2015b; DELWP 2015c);
- Victorian Water Resource Data Warehouse and Index of Stream Condition (ISC) reporting for water quality information for waterways in the vicinity of the study area;
- Biosites Register (DELWP 2017)
- The Planning Maps Online (DELWP 2017e) and Planning Schemes Online (DELWP 2017d) to ascertain current zoning and environmental overlays in the study area;
- Relevant environmental legislation and policies as required;
- Aerial photography of the study area; and
- Any relevant reports including the previous desktop flora and fauna assessment of the study (AECOM, 2012)

3.2 Assessment Qualifications and Limitations

Information used to inform this Desktop Assessment was collated from the most recent information available from relevant online resources. It should be noted that online resources do not provide a comprehensive record of all flora and fauna values, and are often a reflection of sampling effort, rather than actual presence or absence of any particular species. As such we cannot guarantee the accuracy of third-party data (i.e. NVIM, VBA, BIM and PMST) used for this assessment. We have considered the accuracy of such data when discussing the potential ecological implications of the project.

As no site assessments were undertaken, ground-truthing of information provided by the desktop assessment has not been confirmed, particularly in relation to the following:

- Assessing modelled data for remnant vegetation patches, scattered trees and habitat for significant flora and fauna species; and
- Identifying potential habitat for species and ecological communities listed under the Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and *Flora and Fauna Guarantee Act 1988* (FFG Act).

Nevertheless, information obtained from relevant desktop sources is considered adequate to provide an initial assessment of the ecological values present within the study area.

Spatial data was not supplied to identify the study area. For the purposes of mapping and database searches the study area was traced from a supplied pdf map. We cannot guarantee the accuracy of mapping, but have made reasonable effort to ensure it resembles the study area supplied in the pdf map.

4 RESULTS

4.1 Threatened Ecological Communities

4.1.1 *Environment Protection and Biodiversity Conservation Act 1999*

The PMST detected one threatened ecological community as known to occur in the study area:

- Buloke Woodlands of the Riverina and Murray-Darling Depression Bioregions (Endangered).

This community is listed as Endangered under the EPBC Act, and includes woodland or grassy woodland vegetation where Buloke *Allocasuarina luehmannii* is the dominant or co-dominant tree.

The PMST detected four threatened ecological communities as likely or may occur in the study area:

- Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia (Endangered);
- Natural Grasslands of the Murray Valley Plains (Critically Endangered);
- Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains (Critically Endangered); and
- White Box-Yellow Box-Blakey's Red Gum Grassy Woodland and Derived Native Grassland (Critically Endangered).

The BIM predicts the occurrence of the following EVCs to occur within or in close proximity to the study area (Figure 2):

- Plains Woodland (EVC 803);
- Riverine Grassy Woodland / Riverine Swampy Woodland Mosaic (EVC 1040);
- Plains Grassy Wetland (EVC 125); and
- Sand Ridge Woodland (EVC 264).

Patches of EVC 803 and EVC 1040 could qualify as Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia or White Box-Yellow Box-Blakey's Red Gum Grassy Woodland and Derived Native Grassland. Patches of EVC 803, 1040 and 264 could possibly qualify as Buloke Woodlands of the Riverina and Murray-Darling Depression Bioregions. Patches of EVC 125 may qualify as Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains.

4.1.2 *Flora and Fauna Guarantee Act 1988*

If present, the patches of the EVCs listed above and modelled to occur within the study area are likely to meet the definition of the one or more of the following FFG Act-listed ecological communities:

- Grey Box - Buloke Grassy Woodland Community
- Lowland Riverine Fish Community of the Southern Murray-Darling Basin

The FFG Act-listed Victorian Temperate-Woodland Bird Community also has potential to occur depending on the bird species detected during a field assessment.

4.2 Threatened Flora

4.2.1 *Environment Protection and Biodiversity Conservation Act 1999*

There are no VBA records for EPBC Act-listed flora within or directly adjoining the study area. One EPBC Act-listed flora species was identified through the VBA within a 10 kilometre radius of the study area:

- River Swamp Wallaby-grass *Amphibromous fluitans* (Figure 3).

The species is listed as Vulnerable under the EPBC Act. There are two records for the species, one is approximately 5.5 kilometres south of the study area, and the other records is 2.3 kilometres south-west of the study area.

In addition to River Swamp Wallaby-grass, Mueller Daisy *Brachyscome muelleroides,* Clover Glycine *Glycine latrobeana,* and Ridged Water-milfoil *Myriophyllum porcatum* were raised by the PMST as likely to occur in the study area, or in a 10 kilometre radius surrounding the study area. All are listed as Vulnerable under the EPBC Act.

4.2.2 *Flora and Fauna Guarantee Act 1988*

There are two records for the FFG Act-listed flora species Jericho Wire-grass *Aristida jerichoensis var. subspinulifera* within the study area or directly adjoining the study area at the western most site of Wanganui Rd. This species is listed as Endangered under the FFG Act. The following listed flora has been recorded within a 10 kilometre radius of the study area:

- Buloke *Allocasuarina luehmannii*;
- Small Scurf-pea *Cullen parvum;*
- Jericho Wire-grass *Aristida jerichoensis var. subspinulifera;*
- Yellow-tongue Daisy *Brachyscome chrysoglossa*;
- Grey Billy-buttons *Craspedia canens*;
- Striped Water-milfoil *Myriophyllum striatum*.

There are two other records for Jericho Wire-grass from 2015 along Reedy Swamp Rd, approximately 0.5 kilometres north of the study area (Figure 3). The remaining records for FFG Act-listed flora are more than two kilometres from the study area.

4.2.3 Advisory listed species

There are two records for VROT listed Jericho Wire-grass *Aristida jerichoensis var. subspinulifera* within the study area, as well as one record of Riverine Bitter-cress. A total of 18 VROT flora species have been recorded within a 10 kilometre radius of the study area. The closest records (year: post-2000) to the study area are those mentioned above and the following species which are located approximately 1 kilometres north of the study area, 4 kilometres south of the study area or in Reedy Swamp directly to the west of the study area (Figure 3):

- Short-awned Wheat-grass *Anthosachne kingiana subsp. multiflora* (listed as poorly known);
- Giant Honey-myrtle *Melaleuca armillaris subsp. armillaris* (rare);

- Plains Joyweed *Alternanthera sp. 1 (Plains)* (poorly known);
- Small Scurf-pea *Cullen parvum* (endangered);
- Chinese Lespedeza *Lespedeza juncea subsp. sericea* (rare);
- Late-flower Flax-lily *Dianella tarda* (vulnerable);
- Buloke *Allocasuarina luehmannii* (endangered);
- Yellow-tongue Daisy *Brachyscome chrysoglossa* (vulnerable); and,
- Floodplain Fireweed *Senecio campylocarpus* (rare).

4.3 Threatened Fauna

4.3.1 *Environment Protection and Biodiversity Conservation Act 1999*

There are no records for EPBC Act-listed species within the study area (Figure 4). Twelve EPBC Act-listed species have records within a 10 kilometre radius of the study area, with no species records within close proximity to the study area.

The Australasian Bittern has been recorded approximately 1km north of the study area, within Reedy Swamp as recently as 2009. In addition the PMST identified a further seven EPBC Act-listed fauna species as having potential to occur in the study area or surrounding 10 kilometre radius (Appendix 3), including:

- Four bird species;
- Two reptile species; and,
- One mammal species.

Given the proximity of waterbodies within or adjoining the study area, namely Reedy Swamp and the Goulburn River, it is possible that the four EPBC Act-listed fish species would be impacted by the development, including:

- Macquarie Perch *Macquaria australasica;*
- Murray Cod *Maccullochella peelii;*
- Bluenose Cod (Trout Cod) *Maccullochella macquariensis;* and,
- Flat-headed Galaxias *Galaxias rostratus.*

It is recommended that a targeted survey be undertaken to confirm the presence of these EPBC Act-listed species and to ensure best practice management guidelines are followed during on-site works (i.e., sediment control and erosion plans etc). If measures are put in place during construction (particularly for Wanganui Road), that minimise or avoid impacts to Reedy Swamp and the Goulburn River, than it would not be necessary to undertake targeted surveys for these species.

Iit is unlikely that the scattered vegetation within the road reserves along Ford Rd and for the majority of Wanganui Rd up to Rudd Rd would provide suitable habitat for EPBC Act-listed bird species.

4.3.2 *Flora and Fauna Guarantee Act 1988*

There are no VBA records for FFG Act-listed fauna within the study area (Figure 4). There are records for 38 FFG Act-listed fauna within a 10 kilometre radius of the study area (Appendix 3), of which the following two species have been recorded in close proximity to the study area:

- Baillon's Crake *Porzana pusilla palustris;*
- Blue-billed Duck *Oxyura australis;*

The nearby records for Baillon's Crake is from 2009 and located approximately one kilometres north of the study area on the edge of Reedy Swamp. The nearby record for the Blue-billed Duck is east of the study area located in Reedy Swamp where the species was recorded approximately 24 times in 2009.

4.3.3 Advisory listed species

No VROT listed fauna have been recorded within the study area (Figure 4). There are records for 66 VROT listed fauna within a 10 kilometre radius of the study area (Appendix 3), of which nine have been recorded in close proximity to the study area:

- White-bellied Sea-Eagle (Vulnerable);
- Baillon's Crake (Vulnerable);
- Eastern Great Egret (Vulnerable);
- Latham's Snipe (Near Threatened);
- Nankeen Night-Heron (Near Threatened);
- Royal Spoonbill (Near Threatened);
- Brown Toadlet (Endangered);
- Eastern Snake-necked Turtle (Data Deficient); and,
- Murray-Darling Rainbowfish (Vulnerable).

Most of these records occur from north of the study area, within Reedy Swamp and a few records to the south.

4.4 Remnant vegetation

4.4.1 Permitted clearing of native vegetation: biodiversity assessment guidelines 'the Guidelines' (DEPI 2013)

In accordance with the Guidelines, the study area occurs within Location Risk A.

The table below summarise the extent of remnant patches of native vegetation modelled to occur in the study area. The study area is modelled to support 32.12 hectares of remnant patches of native vegetation (Table 1), the majority of which is located within the road-reserve easements. Based on a review of aerial imagery, it is likely that several scattered remnant trees occur in the study area.

Given that Ford Road and Wanganui Road have been previously cleared for commercial purposes, any remnant vegetation that remains within these areas is likely to be heavily degraded. A previous ecological assessment of the study area that had the benefit of a brief site visit, concluded that any remnant vegetation within the study area is likely to be restricted to scattered remnant trees (AECOM 2012).

Table 1. Extent of remnant patches modelled to occur in the study area.

EVC#	EVC Name	Area (hectares)
803	Plains Woodland	13.74
1040	Riverine Grassy Woodland / Riverine Swampy Woodland Mosaic	2.56
125	Plains Grassy Wetland	2.4
264	Sand Ridge Woodland	13.42
	TOTAL	**32.12**

4.5 Wetlands

4.5.1 *Environment Protection and Biodiversity Conservation Act 1999*

There are no Wetlands of International Significance located within or in close proximity to the study area. The Barmah Forest and the NSW central murray state forests are Ramsar Sites located approximately 40-50 kilometres north of the study area. Both Ramsar sites are located on the Murray River floodplains, receiving most of their flows from the Murray River and contributing creeks.

Reedy Swamp is located in close proximity to the study area at the end of Wanganui Road. The swamp is a 130 hectare deep freshwater marsh on the Goulburn River and is listed under A Directory of Important Wetlands in Australia as part of the lower Goulburn River Floodplain listing, managed by Parks Victoria. Reedy Swamp is an important colonial nesting waterbird breeding site and drought refuge, as well as an important stopover site for migratory birds. Environmental water is delivered to this wetland via the central Goulburn channel, with deliveries of up to 20,000 ML/day to sufficiently inundate the site.

4.5.2 Permitted clearing of native vegetation: biodiversity assessment guidelines 'the Guidelines' (DEPI 2013)

For the purposes of assessing the loss of remnant native vegetation under the Guidelines, there is a current wetland mapped that intersects the study area at Wanganui Road and Kittles Road that has been modelled to contain Plains Grassy Wetland (EVC125) and a small patch of Plains Woodland (EVC803). Any impacts to this wetland would need to be assessed under the Guidelines, using the modelled condition score to determine offset requirements.

4.6 Waterways

There are no waterways located within the study area however the Goulburn River is located in close proximity to the east, running past Reedy Swamp. This section of the Goulburn River has been graded as being in a moderate to good condition as part of the Index of Stream Condition (ISC).Surface water flows from the study area along Ford Rd are unlikely to flow into the Goulburn River, however any works along the western extent of the Wanganui Road will need to ensure best practice management guidelines and a sediment and erosion plan.

5 LEGISLATIVE AND POLICY IMPLICATIONS

5.1 *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)

The EPBC Act establishes a Commonwealth process for the assessment of proposed actions likely to have a significant impact on any matters of NES. The proposed development has potential to impact listed threatened ecological communities and species under the EPBC Act, including Buloke Woodlands of the Riverina and Murray-Darling Depression Bioregions.

Patches of Plains Woodland (EVC 803) is modelled to occur along both Ford Road and Wanganui Road-reserve easement may meet the definition of the listed ecological community Buloke Woodlands of the Riverina and Murray-Darling Depression Bioregions. Other listed ecological communities raised by the PMST also have potential to occur.

One EPBC Act-listed flora species (River Swamp Wallaby-grass) has potentially suitable habitat within the study area.

The following EPBC Act-listed fauna species are likely to have suitable habitat within the study area:

- Regent Honeyeater;
- Superb Parrot;
- Swift Parrot; and,
- Growling Grass Frog.

Implications for the Project

If listed species or ecological communities are present within the study area, and if the proposed development is likely to lead to a 'significant impact' to any matters of NES under the Act, then an EPBC Act referral would be required (DoE 2013a).

A previous ecological assessment of the study area that had the benefit of a brief site assessment considered that an EPBC Act referral as unlikely (AECOM 2012). However, this assessment was undertaken five years' ago, and additional values have been listed under the EPBC Act since then, including Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains, which the PMST raised as potentially occurring in the study area.

5.2 *Environment Effects Act 1978* (Victoria)

The *Environment Effects Act 1978* provides for assessment of proposed actions that are capable of having a significant effect on the environment via the preparation of an Environment Effects Statement (EES). A project with potential adverse environmental effects that, individually or in combination, could be significant in a regional or State context should be referred. An action may be referred for an EES decision where:

- one of the following occurs:

- Potential clearing of 10 hectares or more of native vegetation from an area that:
  - is of an EVC identified as endangered by DELWP;
  - is, of Very High conservation significance; or,
  - is not authorised under an approved Forest Management Plan or Fire Protection Plan.
- Potential long-term loss of a significant proportion (1-5% depending on conservation status of species) of known remaining habitat or population of a threatened species within Victoria.

- or where two or more of the following occur:
  - Potential clearing of 10 hectares or more of native vegetation, unless authorised under an approved Forest Management Act or Fire Protection Plan;
  - Matters listed under the FFG Act:
    - Potential loss of a significant area of a listed ecological community;
    - Potential loss of a genetically important population of an endangered or threatened species;
    - Potential loss of critical habitat; or,
    - Potential significant effects on habitat values of a wetland supporting migratory birds.

Implications for the Project

All of the EVCs modelled to occur in the study area have a Bioregional Conservation Status of Endangered. Modelled EVC data also suggest that more than ten hectares of Endangered EVCs occurs in the study area. As such, the project has potential to trigger an EES referral.

5.3 *Flora and Fauna Guarantee Act 1988* (Victoria)

The FFG Act is the primary legislation dealing with biodiversity conservation and sustainable use of native flora and fauna in Victoria. Proponents are required to apply for an FFG Act Permit to 'take' listed and/or protected flora species, listed vegetation communities and listed fish species in areas of public land (i.e. within road reserves, drainage lines and public reserves). An FFG Act permit is generally not required for removal of species or communities on private land, or for the removal of habitat for a listed terrestrial fauna species.

The study area has potential to support one or more of the following listed ecological communities:

- Grey Box - Buloke Grassy Woodland Community;
- Lowland Riverine Fish Community of the Southern Murray-Darling Basin; and,
- Victorian Temperate-Woodland Bird Community.

There is potential for one listed flora species and two listed fauna species to occur in the study area. In addition, flora species listed as 'protected' under the FFG Act are likely to be present given the protected listing covers a range of common flora species (e.g. members of the Asteraceae and Mimosaceae families).

Implications for the Project

Any clearing of listed ecological communities or flora listed as threatened or protected within the road-reserve easement, would require a permit under the FFG Act. An FFG Act permit would not be require if any FFG Act-values on private land are proposed to be impacted.

5.4 *Planning and Environment Act 1987* (Victoria)

The *Planning and Environment Act 1987* outlines the legislative framework for planning in Victoria and for the development and administration of planning schemes. All planning schemes contain native vegetation provisions at Clause 52.17 which require a planning permit from the relevant local Council to remove, destroy or lop native vegetation on a site of more than 0.4 hectares, unless an exemption under clause 52.17-7 of the Victorian Planning Schemes applies or a subdivision is proposed with lots less than 0.4 hectares. Local planning schemes may contain other provisions in relation to the removal of native vegetation.

5.4.1 Local Planning Scheme

The study area is located within the Greater Shepparton City Council municipality. The study area is not subject to any Vegetation Protection Overlays (VPO), Significant Landscape Overlays (SLOs) or Environmental Significance Overlays (ESOs).

5.4.2 Permitted clearing of native vegetation: biodiversity assessment guidelines

The State Planning Policy Framework and the decision guidelines at Clause 52.17 (Native Vegetation) and Clause 12.01 require Planning and Responsible Authorities to have regard for the Permitted clearing of native vegetation: biodiversity assessment guidelines 'the Guidelines' (DEPI 2013).

The study area is modelled to support approximately 32.12 hectares of remnant patches of native vegetation while several scattered remnant trees are also likely to be present. The majority of remnant native vegetation is modelled to occur within the road-reserve easements along both Ford Road and Wanganui Road. The study area is located within Location Risk A. Council would assess a permit to remove native vegetation under the Low Risk-based Pathway if less than one hectare of remnant vegetation or 15 scattered remnant trees is proposed to be removed / disturbed. However, should more than one hectare of remnant vegetation or 15 scattered remnant trees proposed to be removed then the application would be assessed under the Moderate Risk-based Pathway. A permit application under the Moderate-risk Pathway would be referred to DELWP who will assess whether appropriate measures have been taken to minimise impacts to Victoria's biodiversity (DELWP 2015).

Any permitted remnant native vegetation removal would need to be offset in accordance with the Guidelines. A secured offset would need to be obtained before clearing can commence.

Table 2. Risk pathway triggers for planning permit applications (DEPI 2013)

Extent	Location

		A	B	C
Native Vegetation	< 0.5 hectares	Low	Low	High
	≥ 0.5 hectares and < 1 hectare	Low	Moderate	High
	≥ 1 hectare	Moderate	High	High
Scattered Trees	< 15 scattered trees	Low	Moderate	High
	≥ 15 scattered trees	Moderate	High	High

Implications for the Project

A Planning Permit would be required from Greater Shepparton City Council to remove any remnant native vegetation.

5.5 *Wildlife Act 1975* and Wildlife Regulations 2013 (Victoria)

The *Wildlife Act 1975* (and associated Wildlife Regulations 2013) is the primary legislation in Victoria providing for protection and management of wildlife. Authorisation for habitat removal may be obtained under the *Wildlife Act 1975* through a licence granted under the *Forests Act 1958*, or under any other Act such as the *Planning and Environment Act 1987*.

Implications for the Project

Fauna protected under the Act may be harmed or injured during removal of habitat, particularly large trees or shrubs. As such, it is recommended that a suitably qualified zoologist be on site during or immediately prior to clearing to remove and translocate a protected fauna. Any persons engaged to remove, salvage, hold or relocate native fauna during construction must hold a current Management Authorisation under the *Wildlife Act 1975*, issued by DELWP.

5.6 *Catchment and Land Protection Act 1994* (Victoria)

The *Catchment and Land Protection Act 1994* (CaLP Act) contains provisions relating to catchment planning, land management, noxious weeds and pest animals. Landowners are responsible for the control of any infestation of noxious weeds and pest fauna species to minimise their spread and impact on ecological values.

Implications for the Project

Due to the degraded nature of the study area, weeds listed as noxious under the CaLP Act are likely to occur. In addition, declared noxious species such as Red Fox, European Rabbit and Hare are also likely to be present. Any management plan(s) prepared for the construction phase of the project (e.g. a Construction Environmental Management Plan) should include measures to avoid the potential introduction or spread of species declared under the CaLP Act.

6 CONCLUSION AND RECOMMENDATIONS

This desktop assessment for the proposed development has identified several significant ecological constraints that have potential to be impacted, including:

- Suitable habitat for threatened ecological communities and species listed under the EPBC Act and FFG Act; and,
- Remnant native vegetation protected under the Victoria's P&E Act and that would require a planning permit under Clause 52.17 of the local planning scheme.

Based on the information reviewed as part of this desktop assessment, development of both Ford Road and Wanganui Road has potential to require approval under the Commonwealth EPBC Act, and Victorian FFG Act, EE Act and P&E Act. Demonstration of compliance with the CaLP Act and *Wildlife Act 1975* is also required.

To clarify what permits and approvals are required for the project, a field assessment will be required including a habitat hectares assessment (DSE 2004) within the study area, and a survey to collect other site-based information to support a planning permit application to remove native vegetation. Contextual information on the value of habitat for significant species and ecological communities identified as having potential to occur would also need to be obtained.

A list of species that may require further field assessment depending on the availability of habitat is provided below (Table 3). This list will be revised after the field assessment is completed. Survey effort should concentrate on the Wanganui Rd section of the study area, which is likely to support more sensitive ecological values due its proximity to Reedy Swamp.

Table 3. Targeted surveys that may be required

Species	Methods	Habitat
Regent Honeyeater	Area search. Twenty hours of survey over 10 days in early to mid-morning (sunrise to 10 am) using call playback and visual searches preferably outside the breeding season when the species is more likely to be found in suitable habitat (DEWHA 2010a).	Woodland (Box-Ironbox *E. leucoxylon* dominated or associated)
Superb Parrot	Area search. Twelve hours of survey over 4 days in early to mid-morning (sunrise to 10 am) and evening (4pm to sunset). Using call playback and visual searches. Vehicle-based transects appropriate in areas where most habitat is restricted to roadside remnants. Survey effort will need to be increased outside the breeding season (DEWHA 2010a).	Nests in loose colonies in riparian woodland of river red gum *Eucaluptus camaldulensis*. Forages in box eucalypt woodland particularly that dominated by yellow box *E. melliodora* or grey box *E. microcarpa*.
Swift Parrot	Area search. Twelve hours of survey over 8 days in early to mid-morning (sunrise to 10 am) and evening (4pm to sunset). Using call playback and visual searches. Vehicle-based transects appropriate in areas where most habitat is restricted to roadside remnants. Survey effort will need to be increased outside the breeding season (DEWHA 2010a).	Flowering eucalypts during the species' migratory period from Tasmania to Box Gum Woodland vegetation north of the study area, from March to June.
Growling Grass Frog	Call-playback, spot-lighting and active searches on two non-consecutive nights between October and	Ponds, dams, drainage-lines or natural waterbodies preferably with fringing

Species	Methods	Habitat
	February when night-time temperatures are greater than 12˚C and there is moderate or no wind.	aquatic and semi-aquatic vegetation, and terrestrial habitat around these features.
River Swamp Wallaby-grass	Flowering and fruiting occurs mainly between November and March. As such surveys should occur during first flowering period (Summer). A detailed habitat assessment should be undertaken to determine the likelihood of the species presence.	Permanent swamps and also lagoons, billabongs, dams and roadside ditches.

Practical measures should be made where possible to reduce the ecological footprint of the study area. The footprints along Ford Road and Wanganui Road largely avoids modelled patches of native vegetation, although may impact scattered remnant trees. The proposed road-reserve easements are likely to impact contiguous patches of remnant native vegetation that may also support habitat for significant species (e.g. Regent Honeyeater, Superb Parrot and significant flora species).

A planning permit is required if areas supporting remnant native vegetation are proposed to be impacted. This includes scattered remnant trees where greater than 10% of the Tree Retention Zone is proposed to be impacted (DSE 2011).

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FIGURES

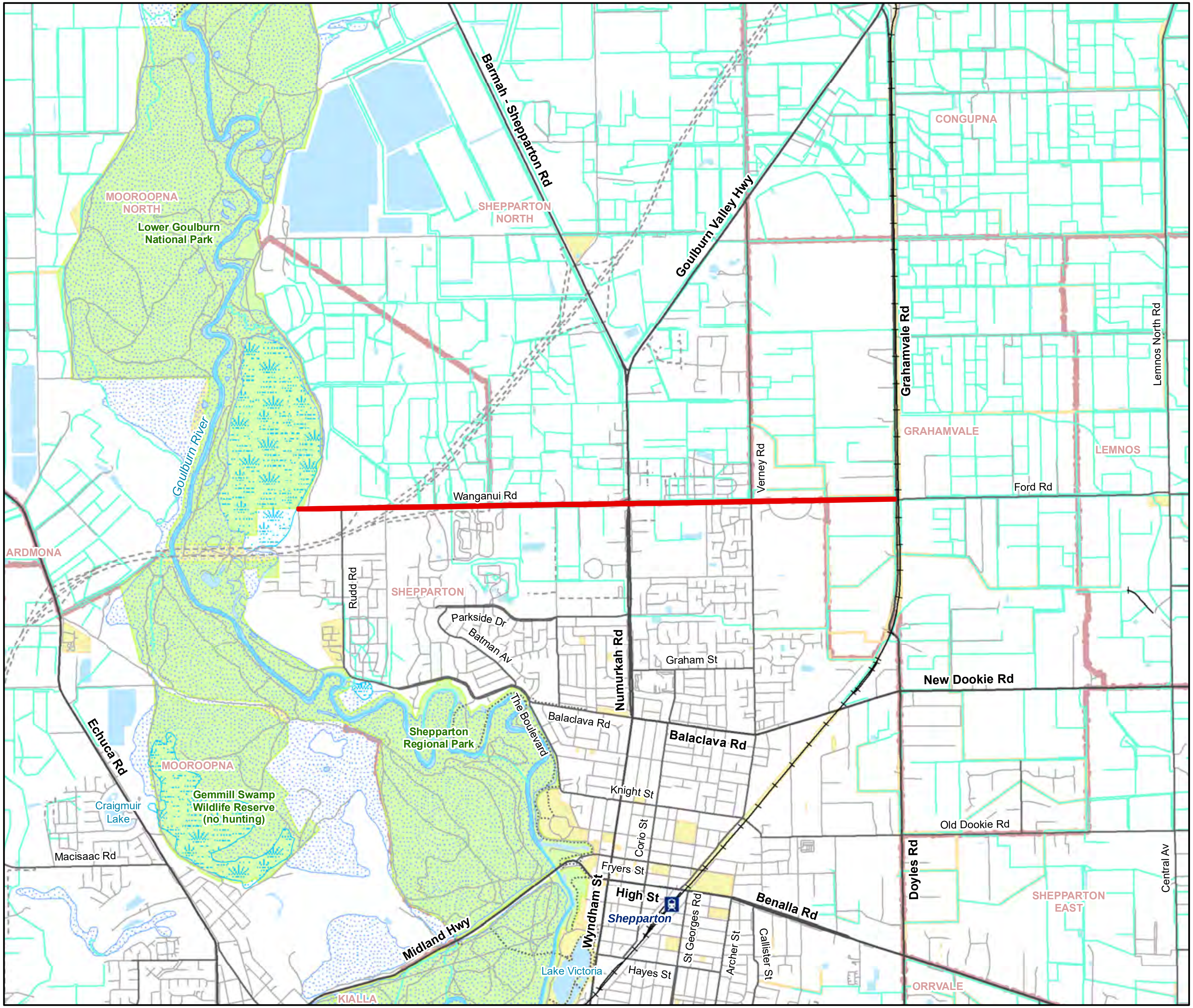


Figure 1

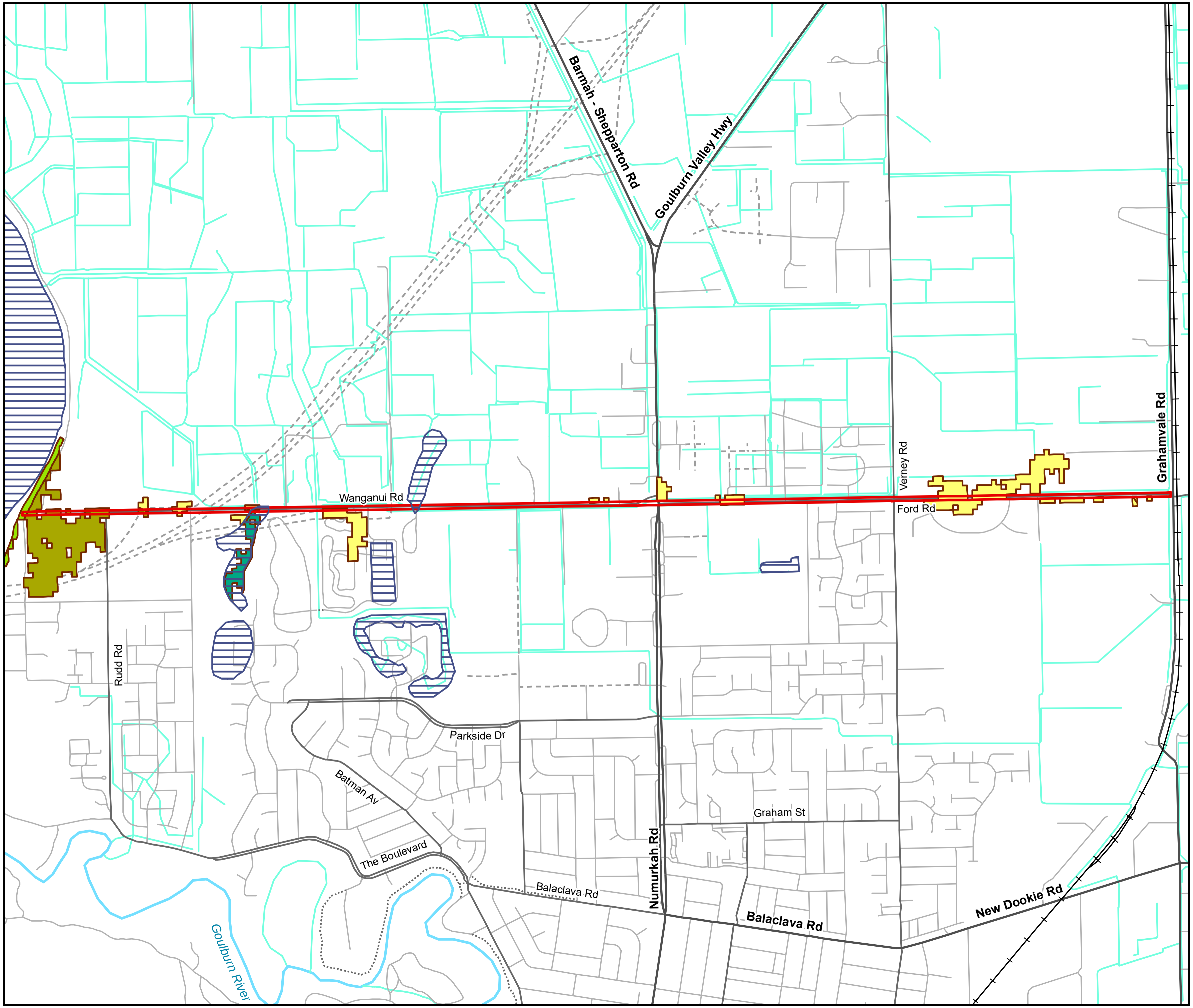
Location of the study area

Desktop flora and fauna study for Ford Road, Shepparton Investigation

0 600 1,200
Metres

ecology & heritage partners

9018_Fig01_StudyArea 22/03/2017 melsley



Legend

- Study Area
- Current Wetlands

Ecological Vegetation Classes (DELWP 2005)

- Plains Grassy Wetland
- Plains Woodland
- Riverine Grassy Woodland/Riverine Swampy Woodland Mosaic
- Sand Ridge Woodland

Figure 2

Ecological features

Desktop flora and fauna study for Ford Road, Shepparton Investigation

N

0 300 600

Metres

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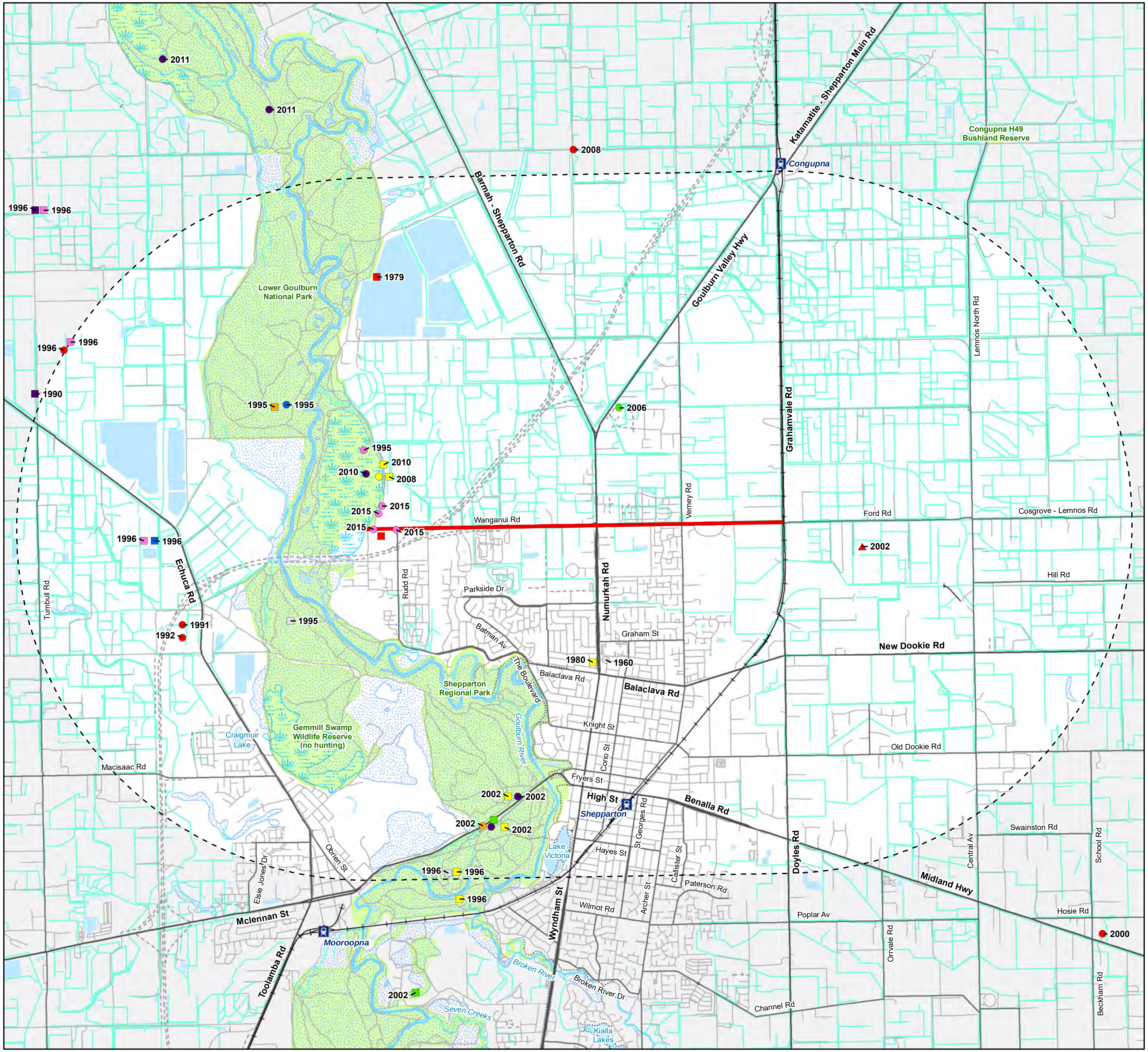


Legend

Study Area

Significant flora

- Bent-leaf Wattle
- Buloke
- Chinese Lespedeza
- Floodplain Fireweed
- Giant Honey-myrtle
- Grey Billy-buttons
- Jericho Wire-grass
- Plains Joyweed
- River Swamp Wallaby-grass
- Riverina Bitter-cress
- Sand Rush
- Short-awned Wheat-grass
- Small Scurf-pea
- Striped Water-milfoil
- Twiggy Sida
- Waterbush
- Yellow-tongue Daisy

Figure 3

Previously documented significant flora within 5km of the study area

Desktop flora and fauna study for Ford Road, Shepparton Investigation

N

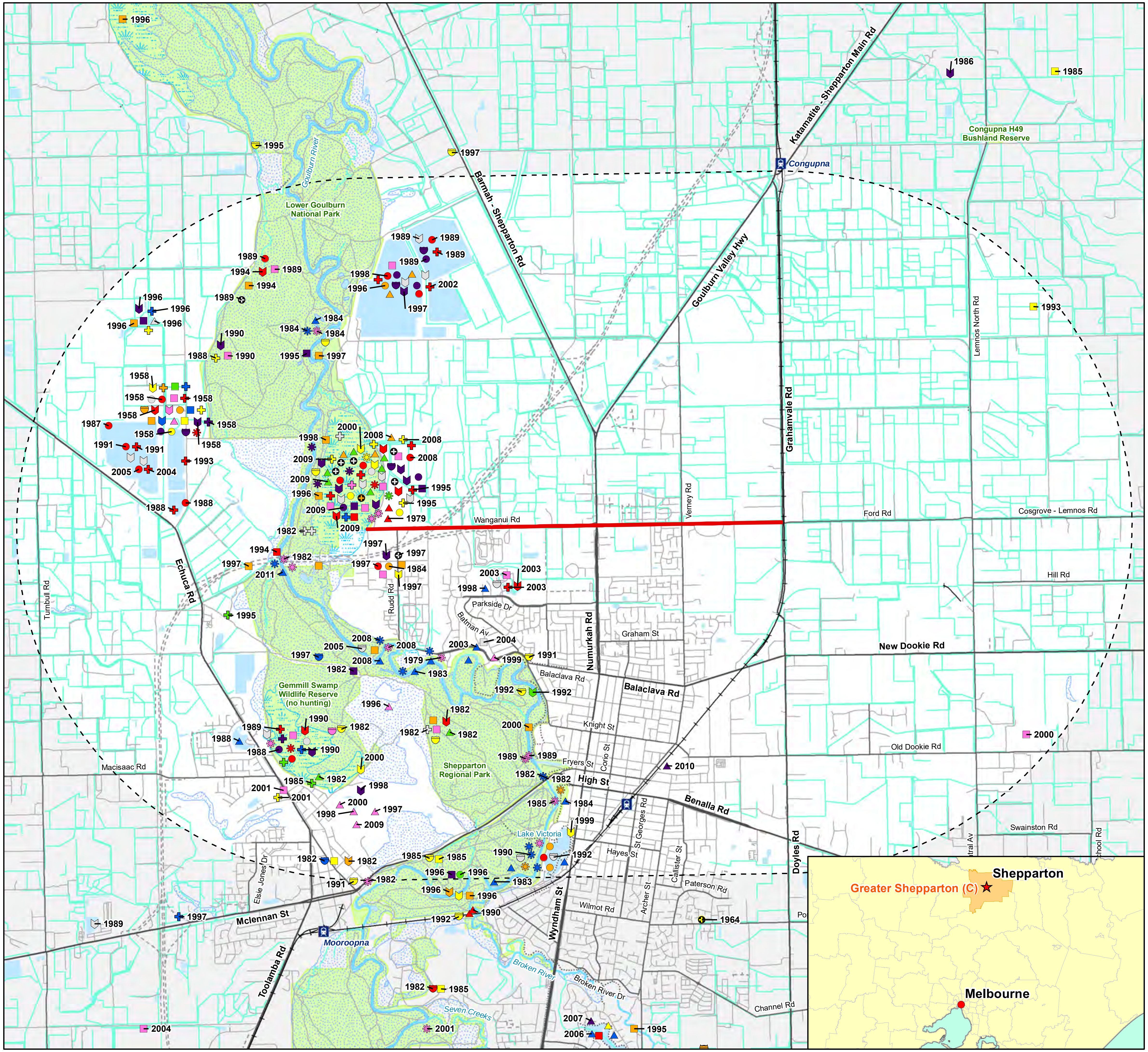
0 1.25 2.5

Kilometres

ecology & heritage partners

VBA 2017. Victorian Biodiversity Atlas. // Sourced from: 'VBA_FLORA25' and 'VBA_FLORA100', February 2017 © The State of Victoria, Department of Environment, Land, Water and Planning. Records prior to 1949 not shown.

9018_Fig03_SigFlora 22/03/2017 melsley



Legend

Study Area

Significant fauna

- Australasian Bittern
- Australasian Shoveler
- Azure Kingfisher
- Baillon's Crake
- Barking Owl
- Black Falcon
- Black-eared Cuckoo
- Blue-billed Duck
- Broad-shelled Turtle
- Brown Toadlet
- Brown Treecreeper (south-eastern ssp.)
- Bush Stone-curlew
- Diamond Dove
- Diamond Firetail
- Eastern Great Egret
- Eastern Snake-necked Turtle
- Emu
- Flat-headed Galaxias
- Freckled Duck
- Freshwater Catfish
- Glossy Ibis
- Golden Perch
- Grey-crowned Babbler
- Grey-headed Flying-fox
- Growling Grass Frog
- Hardhead
- Hooded Robin
- Intermediate Egret
- Lace Monitor
- Latham's Snipe
- Lewin's Rail
- Little Bittern
- Little Button-quail
- Little Egret
- Macquarie Perch
- Magpie Goose
- Marsh Sandpiper
- Murray Cod
- Murray River Rainbowfish
- Murray River Turtle
- Musk Duck
- Nankeen Night Heron
- Painted Honeyeater
- Pied Cormorant
- Powerful Owl
- Red-backed Kingfisher
- Regent Honeyeater
- Royal Spoonbill
- Silver Perch
- Speckled Warbler
- Spotted Harrier
- Squirrel Glider
- Superb Parrot
- Swift Parrot
- Turquoise Parrot
- Whiskered Tern
- White-bellied Sea-Eagle
- White-throated Needletail
- Wood Sandpiper
- Woodland Blind Snake

Figure 4

Previously documented significant fauna within 5km of the study area

Desktop flora and fauna study for Ford Road, Shepparton Investigation

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VBA 2017. Victorian Biodiversity Atlas. // Sourced from: 'VBA_FLORA25' and 'VBA_FLORA100', February 2017 © The State of Victoria, Department of Environment, Land, Water and Planning. Records prior to 1949 not shown.

9018_Fig04_SigFauna 23/03/2017 melsley

APPENDIX 1 - FLORA

Table A1.2 Significant flora recorded within 10 kilometres of the study area

1	Known occurrence	Recorded within the study area recently (i.e. within ten years)
2	High Likelihood	Previous records of the species in the local vicinity; and/or, The study area contains areas of high quality habitat.
3	Moderate Likelihood	Limited previous records of the species in the local vicinity; and/or, The study area contains poor or limited habitat.
4	Low Likelihood	Poor or limited habitat for the species however other evidence (such as a lack of records or environmental factors) indicates there is a very low likelihood of presence.
5	Unlikely	No suitable habitat and/or outside the species range.

Scientific name	Common name	Total # of documented records	Last documented record	EPBC	FFG	DEPI	Likely occurrence in study area
NATIONAL SIGNIFICANCE							
Amphibromus fluitans	River Swamp Wallaby-grass	2	1996	VU	X	-	3
Brachyscome muelleroides #	Mueller Daisy	-	#	VU	L	e	4
Glycine latrobeana #	Clover Glycine	-	#	VU	L	v	4
Myriophyllum porcatum #	Ridged Water-milfoil	-	#	VU	L	v	4
STATE SIGNIFICANCE							
Acacia flexifolia	Bent-leaf Wattle	1	1960	-	-	r	4
Allocasuarina luehmannii	Buloke	13	2008	-	L	e	2
Alternanthera sp. *1 (Plains)*	Plains Joyweed	8	2011	-	-	k	3
Anthosachne kingiana subsp. *multiflora*	Short-awned Wheat-grass	12	2011	-	-	k	3
Aristida jerichoensis var. *subspinulifera*	Jericho Wire-grass	5	2015	-	L	e	3
Brachyscome chrysoglossa	Yellow-tongue Daisy	1	2002	-	L	v	3

Scientific name	Common name	Total # of documented records	Last documented record	EPBC	FFG	DEPI	Likely occurrence in study area
Cardamine moirensis	Riverina Bitter-cress	2	1985	-	-	r	3
Craspedia canens	Grey Billy-buttons	1	1995	-	L	e	3
Cullen parvum	Small Scurf-pea	2	2002	-	L	e	3
Dianella tarda	Late-flower Flax-lily	2	2011	-	-	v	3
Eleocharis pallens	Pale Spike-sedge	1	2011	-	-	k	3
Geranium sp. *6*	Delicate Crane's-bill	1	2011	-	-	v	3
Juncus psammophilus	Sand Rush	1	1995	-	-	r	3
Lespedeza juncea subsp. *sericea*	Chinese Lespedeza	1	2002	-	-	r	3
Melaleuca armillaris subsp. *armillaris*	Giant Honey-myrtle	1	2006	-	-	r	4
Myoporum montanum	Waterbush	7	1996	-	-	r	3
Myriophyllum striatum	Striped Water-milfoil	1	1996	-	L	v	3
Senecio campylocarpus	Floodplain Fireweed	6	2008	-	-	r	3
Sida intricata	Twiggy Sida	5	1996	-	-	v	3

Notes: EPBC = Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act), FFG = Flora and Fauna Guarantee Act 1988 (FFG Act), DEPI= Advisory List of Rare or Threatened Plants in Victoria (DEPI 2014), L = Listed, # = Records identified from EPBC Act Protected Matters Search Tool, Data source: Victorian Biodiversity Atlas (DELWP 2017c); Protected Matters Search Tool (DoEE 2017). Order: Alphabetical.

APPENDIX 2 – FAUNA

Table A2.1. Significant fauna within 10 kilometres of the study area

1	High Likelihood	• Known resident in the study area based on site observations, database records, or expert advice; and/or, • Recent records (i.e. within five years) of the species in the local area (VBA 2011); and/or, • The study area contains the species' preferred habitat.
2	Moderate Likelihood	• The species is likely to visit the study area regularly (i.e. at least seasonally); and/or, • Previous records of the species in the local area (DSE 2011b); and/or, • The study area contains some characteristics of the species' preferred habitat.
3	Low Likelihood	• The species is likely to visit the study area occasionally or opportunistically whilst en route to more suitable sites; and/or, • There are only limited or historical records of the species in the local area (i.e. more than 20 years old); and/or, • The study area contains few or no characteristics of the species' preferred habitat.
4	Unlikely	• No previous records of the species in the local area; and/or, • The species may fly over the study area when moving between areas of more suitable habitat; and/or, • Out of the species' range; and/or, • No suitable habitat present.

Common Name	Scientific Name	Last Documented Record (VBA)	# Records (VBA)	EPBC Act	FFG ACT	DSE (2013)	National Action Plan	Likelihood
NATIONAL SIGNIFICANCE								
Greater Glider	*Petauroides volans*	#	-	VU	-	VU	VU	3
Grey-headed Flying-fox	*Pteropus poliocephalus*	2010	2	VU	L	VU	VU	3
Australasian Bittern	*Botaurus poiciloptilus*	2011	4	EN	L	EN	VU	2
Plains-wanderer	*Pedionomus torquatus*	#	-	CR	L	CR	EN	3
Australian Painted Snipe	*Rostratula australis*	#	-	VU	L	CR	VU	3
Eastern Curlew	*Numenius madagascariensis*	#	-	CR	-	VU	-	3

Common Name	Scientific Name	Last Documented Record (VBA)	# Records (VBA)	EPBC Act	FFG ACT	DSE (2013)	National Action Plan	Likelihood
Curlew Sandpiper	*Calidris ferruginea*	#	-	CR	-	EN	-	3
Superb Parrot	*Polytelis swainsonii*	1977	1	VU	L	EN	VU	2
Swift Parrot	*Lathamus discolor*	1997	6	CR	L	EN	EN	2
Regent Honeyeater	*Anthochaera phrygia*	1957	1	CR	L	CR	EN	2
Painted Honeyeater	*Grantiella picta*	1995	3	VU	L	VU	NT	2
Pink-tailed Worm-Lizard	*Aprasia parapulchella*	#	-	VU	L	EN	-	3
Striped Legless Lizard	*Delma impar*	#	-	VU	L	EN	VU	3
Growling Grass Frog	*Litoria raniformis*	1982	6	VU	L	EN	VU	2
Flat-headed Galaxias	*Galaxias rostratus*	1990	5	CR	-	VU	RA	3
Bluenose Cod (Trout Cod)	*Maccullochella macquariensis*	1970	1	EN	L	CR	EN	3
Murray Cod	*Maccullochella peelii*	2011	32	VU	L	VU	-	3
Macquarie Perch	*Macquaria australasica*	1970	4	EN	L	EN	DD	3
STATE SIGNIFICANCE								
Squirrel Glider	*Petaurus norfolcensis*	2004	22	-	L	EN	NT	2
Magpie Goose	*Anseranas semipalmata*	1990	3	-	L	NT	-	3
Musk Duck	*Biziura lobata*	2011	75	-	-	VU	-	2
Freckled Duck	*Stictonetta naevosa*	2009	9	-	L	EN	-	2
Australasian Shoveler	*Anas rhynchotis*	2009	104	-	-	VU	-	2
Hardhead	*Aythya australis*	2009	111	-	-	VU	-	2
Blue-billed Duck	*Oxyura australis*	2009	24	-	L	EN	-	2
Diamond Dove	*Geopelia cuneata*	1957	1	-	L	NT	-	2
White-throated Needletail	*Hirundapus caudacutus*	1981	9	-	-	VU	-	2

Common Name	Scientific Name	Last Documented Record (VBA)	# Records (VBA)	EPBC Act	FFG ACT	DSE (2013)	National Action Plan	Likelihood
Little Bittern	*Ixobrychus minutus dubius*	1988	8	-	L	EN	-	2
Eastern Great Egret	*Ardea modesta*	2011	101	-	L	VU	-	2
Intermediate Egret	*Ardea intermedia*	2009	26	-	L	EN	-	2
Little Egret	*Egretta garzetta nigripes*	2008	8	-	L	EN	-	2
White-bellied Sea-Eagle	*Haliaeetus leucogaster*	2009	22	-	L	VU	-	3
Black Falcon	*Falco subniger*	1978	1	-	-	VU	-	2
Lewin's Rail	*Lewinia pectoralis pectoralis*	2009	1	-	L	VU	NT	2
Baillon's Crake	*Porzana pusilla palustris*	2009	7	-	L	VU	-	2
Bush Stone-curlew	*Burhinus grallarius*	1993	29	-	L	EN	NT	3
Marsh Sandpiper	*Tringa stagnatilis*	1995	2	-	-	VU	-	3
Wood Sandpiper	*Tringa glareola*	2009	3	-	-	VU	-	3
Turquoise Parrot	*Neophema pulchella*	1980	2	-	L	NT	NT	2
Powerful Owl	*Ninox strenua*	1992	1	-	L	VU	-	2
Barking Owl	*Ninox connivens connivens*	2000	2	-	L	EN	NT	2
Brown Treecreeper (south-eastern ssp.)	*Climacteris picumnus victoriae*	2000	51	-	-	NT	NT	2
Speckled Warbler	*Chthonicola sagittatus*	1982	1	-	L	VU	NT	2
Grey-crowned Babbler	*Pomatostomus temporalis temporalis*	2009	8	-	L	EN	NT	2
Hooded Robin	*Melanodryas cucullata cucullata*	1977	2	-	L	NT	NT	2
Diamond Firetail	*Stagonopleura guttata*	1981	5	-	L	NT	NT	2
Murray Short-necked Turtle	*Emydura macquarii*	2009	5	-	-	VU	-	3
Lace Goanna	*Varanus varius*	1995	3	-	-	EN	-	2

Common Name	Scientific Name	Last Documented Record (VBA)	# Records (VBA)	EPBC Act	FFG ACT	DSE (2013)	National Action Plan	Likelihood
Brown Toadlet	*Pseudophryne bibronii*	2009	3	-	L	EN	DD	2
Freshwater Catfish	*Tandanus tandanus*	1992	1	-	L	EN	-	2
Crimson-spotted Rainbowfish	*Melanotaenia fluviatilis*	2011	48	-	L	VU	-	2
Silver Perch	*Bidyanus bidyanus*	2011	7	-	L	VU	-	2
REGIONAL SIGNIFICANCE								
Pied Cormorant	*Phalacrocorax varius*	2008	9	-	-	NT	-	2
Nankeen Night Heron	*Nycticorax caledonicus hillii*	2009	25	-	-	NT	-	2
Glossy Ibis	*Plegadis falcinellus*	2009	24	-	-	NT	-	2
Royal Spoonbill	*Platalea regia*	2011	70	-	-	NT	-	2
Spotted Harrier	*Circus assimilis*	1978	2	-	-	NT	-	2
Latham's Snipe	*Gallinago hardwickii*	2009	29	-	-	NT	-	3
Little Button-quail	*Turnix velox*	1981	1	-	-	NT	-	2
Whiskered Tern	*Chlidonias hybridus javanicus*	2008	6	-	-	NT	-	2
Black-eared Cuckoo	*Chrysococcyx osculans*	1981	3	-	-	NT	-	2
Azure Kingfisher	*Alcedo azurea*	2000	9	-	-	NT	-	2
Red-backed Kingfisher	*Todiramphus pyrropygia pyrropygia*	1979	5	-	-	NT	-	2
Woodland Blind Snake	*Ramphotyphlops proximus*	1992	2	-	-	NT	-	3
Golden Perch	*Macquaria ambigua*	2011	67	-	-	NT	-	2

Notes: EPBC = *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), FFG = *Flora and Fauna Guarantee Act 1988* (FFG Act), DSE = Advisory List of Threatened Vertebrate Fauna in Victoria (DSE 2013) , # = Records identified from EPBC Act Protected Matters Search Tool, L = Listed. Data sources: Victorian Biodiversity Atlas (DELWP 2017c); Victorian Fauna Database (Viridans 2014b); Protected Matters Search Tool (DoE 2017). Taxonomic order: Mammals (Strahan 1995 in Menkhorst & Knight 2004); Birds (Christidis & Boles, 2008); Reptiles and Amphibians (Cogger *et al.* 1983 in Cogger 1996); Fish (Nelson 1994); Mussels & Crustaceans (Alphabetical); Invertebrates (Alphabetical)

E.2 Appendix E2: Cultural and Heritage

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Draft Report

Preliminary Cultural Heritage Study:

Road Upgrade, Ford and Wanganui Roads, Shepparton, Victoria

Prepared for:

GTA Consultants

08 February 2018

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- Aboriginal Victoria, for access to ACHRIS; and
- Heritage Victoria, for access to HERMES.

Cover Photo: Ford and Wanganui Roads, courtesy NearMap 2017

(Photo by Ecology and Heritage Partners Pty Ltd)

Protocols for Handling Sensitive Information

Some of the information contained within this Preliminary Cultural Heritage Study (PCHS) is culturally sensitive. Before releasing the contents of this PCHS to the public, permission should be sought from the relevant authorities and communities.

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DOCUMENT CONTROL

Activity	Road Upgrade
Address	Ford and Wanganui Roads, Shepparton
Project number	9019
Project manager	Caiti Holzheimer
Report author(s)	Caiti Holzheimer and Ilona Bartsch
Report reviewer	Oona Nicolson
Other EHP staff	Christopher Ingle and Claire St. George
Mapping	Monique Elsley
File name	9019_Ford and Wanganui Roads, Shepparton_PCHS_Client Draft_CH_070417
Client	City of Greater Shepparton
RAP	Yorta Yorta Nation Aboriginal Corporation
Bioregion	Victorian Riverina
CMA	Goulburn Broken
Council	City of Greater Shepparton

Report versions	Comments	Comments updated by	Date submitted
Draft v1	Draft for QA Review	Caiti Holzheimer	06.04.2017
Draft v2	Draft to Client for Comment	Caiti Holzheimer	07.04.2017
Final	Final Report to Client	Ilona Bartsch	08.02.2018

EXECUTIVE SUMMARY

Introduction

Ecology and Heritage Partners was commissioned by GTA Consultants, on behalf of City of Greater Shepparton, to prepare this Preliminary Cultural Heritage Study (PCHS) for the proposed Road Upgrade in Shepparton, Victoria (City of Greater Shepparton). The purpose of the assessment was to identify Aboriginal and historical cultural heritage values that may be present within the study area. Information gathered throughout the assessment was used to determine potential legislative implications (associated with cultural heritage values) for the proposed Road Upgrade.

Conclusions

The following conclusions are made regarding the likely presence of Aboriginal and/or historical heritage within the study area:

Following the results of the desktop assessment, the following conclusions are made regarding Aboriginal cultural heritage within the study area:

- There are no previously registered Aboriginal places within the study area, however two registered Aboriginal places are located within 100 m of the study area. These are:
  - VAHR 7925-0621 (Reedy Swamp Road Pipeline AS1) - an artefact scatter comprised of 15 stone artefacts with raw materials including chert and quartz, generally located between 600-1100 mm depth in a sandy matrix (Barker 2013 CHMP #12617); and
  - VAHR 7925-0489 (Wanganui Rd 1) – an artefact scatter consisting of a singular surface artefact of hornfels raw material, located on the north side of Wanganui Road on a vehicle access track (Tulloch and Vines 2001 AV#1950)
- The study area is located within multiple *mapped* areas of cultural heritage sensitivity, being:
  - Being within 200 m of a named waterway, Reedy Swamp (r.23); and
  - Being within 200 m of a prior waterway, Goulburn River (r.24)
- Previous archaeological investigations within close proximity to the study area have indicated that ground disturbing works, such as pastoral and agricultural activities, utility installations, vegetation clearance and road construction, have occurred across the wider Shepparton area. Previous investigations addressing past proposed alignments for the Goulburn Highway-Shepparton Bypass (Long 1995; Brown 1996; Debney 2000; Tulloch and Vines 2001) have all identified this disturbance. Additionally, a review of recent aerial photography indicates that the study area wholly comprises of existing roadways, road reserves and associated installations and infrastructure.
- All previous investigations for the study area were able to re-identify previously registered Aboriginal places, in addition to recording both new Aboriginal and historical places. Recent subsurface archaeological investigations including Barker's (2013), for the proposed water reticulation

extension for Reedy Swamp, which intersects the study area, identified 14 *in situ* stone artefacts in a sandy matrix on the crest of a sand dune.

- Kiddell (2011) undertook a cultural heritage due diligence assessment for the current study area, and formulated the following conclusions regarding Aboriginal cultural heritage:
    - Works associated with redesigning the Grahamvale and Wanganui Road intersection would require further archaeological investigation, given that this portion of the study area was located within an area of sensitivity;
    - Two areas of significant ground disturbance were identified, south of Wanganui Road owing to pipeline construction works, and north of Ford Road due to residential subdivision; and
    - The preparation of a mandatory cultural heritage management plan (CHMP) for any road construction works involving the upgrading, realignment or duplication of the Wanganui-Ford Road corridor will be required, given that the study area is located in an area of Aboriginal cultural heritage sensitivity and the proposed works are regarded as a high impact activity.
- Kiddell (2011) determined that it was unclear whether the entire study area had been subject to ground disturbing works, and whether the study area could retain artefact bearing sediments. As such, the potential for *in situ* subsurface Aboriginal cultural material to be identified within the study area is moderate.
- Given that a singular instance of subsurface testing has previously occurred within the study area, and little other archaeological work has been undertaken within 2 km, the archaeological character of the site is relatively undetermined. Recent archaeological investigations have identified both Aboriginal cultural heritage and undisturbed landforms north of the study area at the westernmost point of Wanganui Road. This indicates that undisturbed landforms and *in situ* Aboriginal cultural material may be present in areas of mapped cultural heritage sensitivity.

Historical Heritage

There are no historical heritage places within the study area; however, two historical heritage places are located within 100 m of the study area:

- VHI H7925-0040 (Wanganui Road Farm Complex), is located approximately 20 m north of Wanganui Road, west of Rudd Road; and
- HO93 (Former Wanganui Homestead, 260 Wanganui Road, Shepparton), directly abuts Wanganui Road, east of Rudd Road

Should the proposed works impact on either of these historic heritage places, consultation with the relevant authority will be required. In the case of H7921-0040 (Wanganui Road Farm Complex), a Consent from Heritage Victoria will be required if impacts to the site cannot be avoided. For HO93 (Former Wanganui Homestead), if impacts to the site cannot be avoided a Permit from City of Greater Shepparton will be required.

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Recommendations

Aboriginal Cultural Heritage

Recommendation 1: Requirement for a mandatory CHMP

A mandatory CHMP may be required for the study area, given that the current proposed works are a high impact activity. Given that the study area is located in multiple areas of Aboriginal cultural heritage sensitivity as defined by the *Aboriginal Heritage Act 2006*, a mandatory CHMP **will be** required. However, a mandatory CHMP will not be required by the *Aboriginal Heritage Regulations* if the following can be determined:

- Part of a waterway or part of the land within 200 m of a waterway has been subject to significant ground disturbance, that part is not an area of cultural heritage sensitivity (r.23 [2]); and/or
- Part of a prior waterway or part of the land within 200 m of a prior waterway has been subject to significant ground disturbance, that part is not an area of cultural heritage sensitivity (r.24 [2])

Due to the potential for significant ground disturbance (SGD) to be present within these areas of sensitivity, a mandatory CHMP may not be required. A Preliminary Aboriginal Heritage Test (PAHT) can be used to verify SGD, which, if certified by AV, would remove the requirement for a mandatory CHMP, as outlined as Recommendation 2 below.

Recommendation 2: Preliminary Aboriginal Heritage Test

The Preliminary Aboriginal Heritage Test (PAHT) provides sponsors with certainty about whether a cultural heritage management plan (CHMP) is required for a proposed activity. The PAHT is a voluntary process, which allows for the Secretary to the Department of Premier and Cabinet (Secretary) to certify whether a CHMP is required for a proposed activity.

A person may be unclear whether an approved CHMP is required for a proposed activity in accordance with the requirements of the *Aboriginal Heritage Act* 2006 (Act) and the *Aboriginal Heritage Regulations* 2007 (Regulations). For instance, a sponsor may be unclear as to whether their proposed activity area has been subject to significant ground disturbance (see Practice Note: Significant Ground Disturbance which is available on the Aboriginal Victoria website and in Appendix 3).

In such cases, a person is able to prepare a PAHT to establish whether a CHMP is required for the activity. The PAHT can then be submitted to the Secretary, who must decide whether to certify the PAHT as correct within a 21 day evaluation period. The preparation of a PAHT for the study area may be able to utilise the results of this desktop assessment.

Recommendation 3: Proceed with a voluntary CHMP

Given that two previously registered Aboriginal places are located within 100 m of the study area in addition to multiple areas of Aboriginal cultural heritage sensitivity, should future proposed works not be regarded as a high impact activity it is strongly recommended that the client undertake a voluntary CHMP. The preparation of a voluntary CHMP has the following advantages:

- *No requirement for Cultural Heritage Permits at a later stage*: there are no cultural heritage permit requirements in relation to a CHMP as long as you are acting in accordance with the CHMP. There is no requirement for an excavation permit or a permit to harm, or any of the other permit requirements. In effect, the approved CHMP is a permit. If Aboriginal cultural heritage is unexpectedly discovered during the activity, there is therefore no permit requirement if a CHMP has in place. Any unexpected Aboriginal cultural heritage is dealt with through contingency plans in the CHMP, already signed off and agreed to by RAP in the CHMP process;

- *Increased certainty for your project*: as there are no Cultural Heritage Permit requirements at a later stage, there is more certainty for the project. This certainty is provided during the planning phase, allowing the activity to remain unimpeded by cultural heritage legislation. A CHMP removes the activity from the harm provisions of the *Aboriginal Heritage Act 2006*, as long as the proponent acts in accordance with the CHMP; and
- *Good Risk Management*: rises and elevated areas and the margins of water courses are well documented as areas that retain Aboriginal cultural heritage sites in the general region. A voluntary CHMP could effectively investigate the area for any evidence of Aboriginal sites and minimise the risk that any significant Aboriginal sites would be impacted by the activity, which would cause delays and added expense to the construction process.

In the event that the client elects to pursue a voluntary CHMP, this must be undertaken by a qualified Heritage Advisor in association with relevant RAP. Any voluntary CHMP undertaken for the study area may be able to utilise the results of this desktop assessment.

Historical Heritage

To avoid potential impacts to historical heritage, the following recommendations are made:

- Conducting a HHA to determine the nature and extent of H7921-0040 (Wanganui Road Farm Complex), including an archaeological survey and further detailed historical research in addition to detailed design plans;
- If impacts to the site cannot be avoided, Consent to Excavate from Heritage Victoria will be required prior to the commencement of works. The preparation of a Consent to Excavate will require consultation with Heritage Victoria in order to formulate the methodology of the initial investigation;
- Consultation with Heritage Victoria should occur following the initial test excavation in order to determine any requirement for further archaeological works at the study area, i.e. open area excavation; and
- If impacts to HO93 (Former Wanganui Homestead) cannot be avoided, a Permit from City of Greater Shepparton will be required

These works should be undertaken by a suitably qualified Heritage Advisor in association with Heritage Victoria and/or the City of Greater Shepparton.

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1 INTRODUCTION

1.1 Preamble

Ecology and Heritage Partners was commissioned by GTA Consultants, on behalf of City of Greater Shepparton, to prepare this Preliminary Cultural Heritage Study (PCHS) report for the proposed Road Upgrade in Shepparton, Victoria (City of Greater Shepparton), hereafter referred to as the 'study area'.

The purpose of the assessment was to identify Aboriginal and historical cultural heritage values that may be present within the study area. Information gathered throughout the assessment was used to determine potential legislative implications (associated with cultural heritage values) for the proposed development works. Additionally, this report presents a gap analysis on a previously prepared cultural heritage due diligence report for the study area (Kiddell 2011) by Dr Vincent Clark & Associates.

1.2 The Study Area

The study area is located in Shepparton, Victoria (City of Greater Shepparton). The activity area is a linear corridor of approximately 11.82 ha, and is bounded to the north and south by private residential and agricultural properties, to the east by Grahamvale Road and to the west by Golf Drive. The study area is bisected centrally by Numurkah Road which separates Wanganui and Ford Roads.

The study area comprises of the existing roadways and road reserves of both Ford Road and Wanganui Road (Map 1). The land surrounding the study area is generally comprised of agricultural property in addition to some residential development. A number of channelised drains bisect or run alongside the study area, such as the Number 12 Main Channel which crosses the study area at the junction of Wanganui Road, Ford Road and Goulburn Valley Highway.

A review of recent aerial photography indicates that the study area is wholly comprised of the existing Wanganui and Ford Roads roadways and road reserves, including pedestrian footpaths, utility installations and introduced vegetation.

1.3 The Activity

The Greater Shepparton City Council is proposing the upgrade of the Goulburn Valley Highway in order to accommodate its growing role as a key freight route between Melbourne and Brisbane. As part of this upgrade, Council is proposing Stage 1 of the Goulburn Valley Highway Shepparton Bypass in order to improve options for east-west movement of traffic, with particular regard for heavy vehicles. Ford Road and Wanganui Roads offer the most effective east-west alignment for heavy traffic, by connecting the Goulburn Valley Highway Shepparton Bypass to the Shepparton Alternate Route, thereby reducing heavy traffic flow within central Shepparton.

1.4 Details of Authors

1.4.1 Ecology and Heritage Partners Pty Ltd Cultural Heritage Division

Ecology and Heritage Partners is a professional cultural heritage and ecological consultancy providing high quality technical services in the field of Aboriginal and historical cultural heritage assessment, Cultural Heritage Management Plans (CHMPs), ecological assessment, research and management. The business provides effective and innovative cultural and natural heritage advice to a range of state and local government authorities/agencies, corporate and private clients.

Ecology and Heritage Partners has an established heritage team of ten people led by Oona Nicolson (Director and Principal Heritage Advisor). All of the team are qualified Heritage Advisors, specialising in Australian archaeology (including Aboriginal, Historical and Maritime). Three members of the team are based in our Geelong office.

1.4.2 Authors

The author and Heritage Advisor of this PCHS is Caiti Holzheimer. The quality assurance review was undertaken by Oona Nicolson (Director/Principal Heritage Advisor). Mapping was provided by Monique Elsley (GIS Coordinator).

Details of the project team are provided in Appendix 1.

1.5 Heritage Legislation

Legislation relevant to the preparation of this PCHS includes the *Aboriginal Heritage Act 2006*, the Commonwealth *Native Title Act 1993*, the Victorian *Planning and Environment Act 1987* and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*. This legislation is subordinate to the Victorian *Coroners Act 2008* in relation to the discovery of human remains.

2 PROJECT METHODS

2.1 Scope of Works

The following tasks were undertaken as part of the PCHS:

1. A review of available literature was undertaken using resources such as the Aboriginal Victoria (AV) and Heritage Victoria (HV), and the Ecology and Heritage Partners library of reports and knowledge of the area. A desktop study, with all relevant cultural heritage databases and mapping programs, was examined including:
    - the Victorian Aboriginal Heritage Register (VAHR);
    - the Victorian Heritage Register (VHR);
    - the Victorian Heritage Inventory (VHI);
    - the Heritage Overlay of the Greater Shepparton Planning Scheme;
    - the National Trust (Victoria) Register;
    - National, Commonwealth and International Heritage Lists; and
    - relevant Commonwealth and State legislation and policies.
2. Provide a brief review of land use for the study area;
3. Conduct a site inspection of the subject site by a qualified cultural heritage advisor to identify any Aboriginal and/or historical cultural heritage within the study area;
4. Provide information in relation to any implications of Commonwealth and State environmental legislation and Government policy associated with the proposed development;
5. Discuss any opportunities and constraints associated with the study area; and
6. Presentation of the results in this PCHS report.

2.2 Limitations

The cultural heritage information used to inform this PCHS is limited to that obtained through desktop assessment.

Consultation with the local Aboriginal community was not part of the scope of works for this project. This level of assessment is appropriate for determining the broader potential for Aboriginal and/or historical heritage values to be present in the study area and for making recommendations regarding the need or otherwise for further more detailed investigations.

This report is an opportunity to provide a historical context for understanding the study area and to identify potential areas that may contain Aboriginal or historical sites and to identify relevant legislative implications (Section 6). Aboriginal cultural heritage may occur anywhere in the landscape and it is important to note that the assessment of likelihood is based on the balance of probability; it is our opinion based on an assessment of landforms and the extent of previous ground disturbance, compared to the general archaeological character of the region as assessed via desktop review. It is not a categorical statement that Aboriginal cultural heritage will or will not be present.

3 ENVIRONMENTAL CONTEXT

3.1 Geographic Region

The geographic region for this PCHS is defined on the basis of catchment areas and geomorphological units, in order to reflect a similar geographic region defined in Kiddell's (2011) assessment of the study area.

The geographic region is defined by Goulburn River to the west, Broken River to the south, East Goulburn Main Channel to the east, and to the north and east by the boundary of the 'plains with leveed channels, sometimes source bordering dunes' geomorphological unit (GMU 4.2.1). The geographic region is arbitrarily capped to the north by Congupna Road, in order to capture the specific vegetation history and resource availability that would have characterised the study area and influenced Aboriginal occupation of the wider Shepparton area. Thus the geographic region relates specifically to the tangible and intangible values of the landscape and is highly relevant to any Aboriginal cultural heritage that may be present within the study area.

More generally, the region (and the study area itself) forms a part of the Victorian Riverina (VRiv) Bioregion (DELWP 2017). This geographic region is relevant to any Aboriginal cultural heritage that may be present within the study area.

3.2 Geology, Geomorphology and Soils

Geology

The study area forms a part of northern Victoria's Riverine Plain, on which many parallel streams head northerly across the flat plain to the River Murray. The Riverine Plain of Victoria is an extensive and complex alluvial plain associated with the River Murray and its tributaries, which developed following the retreat of the Neogene (Pliocene) sea from the Murray Basin. Although the plain is predominantly alluvial in origin, episodes of windblown deposition did occur during arid times. The climate of the Northern Riverine Plains is semi-arid in the northwest. Most of the area originally contained eucalypt woodlands, but there were substantial areas of treeless plain. Changing climate, vegetation, runoff and evaporation during the Quaternary have produced palaeochannels of different ages. Many of the present lakes in the Murray Basin are ephemeral or relict features, dating to the Neogene (Middle and Late Pleistocene). Most are now either permanently dry or episodically filled by floodwaters.

Geomorphology and Soils

The study area comprises the 'Plains with Leveed Channels, sometimes source-bordering dunes (Tatura, Naneella)' geomorphological unit (GMU 4.2.1) (DEDJTR 2017).The modern alluvial terraces and floodplains carry young soils of varied texture and are part of the most recent alluvial landform complex, the late Quaternary Coonambidgal Formation. Source-bordering dunes are found along these channels, generally on their north eastern sides. Several former but young courses of the Murray are marked by inset terraces and extensive flood-plain meander belts with scrolls and oxbow lakes, which can be seen at Mooroopna and

Wangaratta. The terraces and floodplains are defined as being un-confined in the sense that they are not surrounded by upland and formed on alluvial material.

The soils of 4.2.1 vary from sands, loams, and to clays where finer material has accumulated. Major soils include sodic, grey texture contrast soils (grey Sodosols) and cracking clay soils (Vertosols). The texture contrast soils have cracking sandy clay loam surfaces over grey light clays changing to heavy clay subsoils with depth. Minor carbonate occurs in the subsoil, decreasing with depth. Soil depths are generally in excess of 2 m (DEDJTR 2017).

3.3 Landforms and Hydrology

Within the geographic region there are two main landform types present:

- Older alluvial plains; and
- Modern alluvial terraces and floodplains

The landforms present within the geographic region reflect the movements of the Goulburn River, with older alluvial plains representing the prior stream deposition predating the present flood plains and location of the river system. The Goulburn River is approximately 400 m west of the study area. Additionally, various artificial channels characterise Shepparton and surround the study area, with the No. 12 Main Channel bisecting the study area at the junction of Ford and Wanganui Roads and Goulburn Valley Highway.

3.4 Vegetation

Prior to European settlement, the alluvium deposits of the study area would have historically supported grasslands, open eucalyptus woodlands and wetlands associated with the Murray River drainage system. According to the Department of Environment, Land, Water and Planning's (DELWP) mapping of vegetation prior to European colonisation (Pre-1750 EVCs, the majority of the study area would have contained vegetation classified as Plains Woodland (EVC55_62), with small areas of Plains Grassy Wetland (EVC125) and Sand Ridge Woodland (EVC264) in areas close to the former and current flood plains of the Goulburn River (DELWP 2017).

Vegetation within the woodlands would have consisted of open, eucalypt woodland with an understorey of sparse shrubs over a species-rich grassy and herbaceous ground layer. Additionally, vegetated areas would also have included pen pine-box woodland with a small or medium shrub layer of variable density and including a range of annual herbs, grasses and geophytes, in the dense ground layer.

4 ABORIGINAL CONTEXT

The section reviews the Aboriginal context of the study area and includes an examination of historical and ethnohistorical sources, previously recorded Aboriginal archaeological site types and locations in the geographic region of the study area, and previous archaeological studies undertaken in the area. Together, these sources of information can be used to formulate a predictive statement concerning what types of sites are most likely to occur in the study area, and where these are most likely to occur.

4.1 Ethnohistory

Archaeological evidence suggests that Aboriginal peoples had occupied all of Australia's environmental zones by 40,000 years BP. The oldest dated archaeological site in Victoria occurs at Keilor in Melbourne. Charcoal from a hearth excavated in 1973 has been dated to 31,000 years BP (uncalibrated) (Flood 1995: 286). More recently, Richards et al. (2007) obtained dates from the Box Gully site of 32,000 years BP (calibrated). However, as this date is calibrated, it should be noted that the uncalibrated age of the Box Gully site is approximately 27,000 years BP.

The rapid settlement in Victoria by European settlers had a devastating effect upon the local Aboriginal populations. The ethnohistorical records on Aboriginal culture from this period are largely incomplete due to the disruptive nature of colonisation and the circumstances under which they were recorded; the observations of European men over short periods of time. These factors, along with the less detailed records regarding the pre-contact Aboriginal people of the north eastern region of Victoria, mean that the pre-contact history of the Aboriginal groups in the study area is limited. Furthermore, the north east region of Victoria has proven to be the most unresolved contradictions in regard to Aboriginal territories, group and language names (Wesson 2000: 57). However, it is still useful to discuss the available records of the Aboriginal activity in the area.

The study area, at the time of European contact was within the Waveroo (*Way wurru, Waveru, Way.you.rong, Way.you.roo*) (Clark 1996: 17) language group (Clark 1990: 20). The primary sources of information for the study area come from the journals of George Augustus Robinson, Chief Protector of Aborigines from 1839 to 1849, and from personal observations or information received from Aboriginal informants written by R.B. Smyth, Edward Curr and A.W. Howitt (all cited in Ellis and Greenwood 2009: 11) .

George Augustus Robinson's journal (1840) is the earliest primary reference to this language group (Clark 1996: 17). Robinson (1840) made several journeys to the northeast of Victoria and observed, what he concluded to be, at least five tribal groups occupying the region; the *Bangerang, Duduroa, Jaitmathang, Waveroo* and *Kwat Kwat* (Clark 1998: 157 in Ellis and Greenwood 2009: 11-12). Robinson associated the *Waveroo* tribe with the Ovens River, which he described as made up of four clans; the *Ballingo-yallum*, the *Trrer-mittung*, the *Worarer-mittung* and the *Peer.ing.ile* (Clark 1998: 157 in Ellis and Greenwood 2009: 12).

The *Bangerang* tribal group was collectively described as the people living east of Echuca by Edward Curr (1883: 103-106 in Ellis and Greenwood 2009: 12). Howitt (1904) wrote that the *Balung-karak-mittung* clan was based around the Ovens River at Wangaratta (Clark 1998: 157 in Ellis and Greenwood 2009: 12), which may be in contradiction to the descriptions in Robinsons' journal (1840).

The *Yorta Yorta* and *Bangerang* clans were both classified by Curr (1883) and Tindale (1974) as distinct groups occupying separate territories (in Ellis and Greenwood 2009: 12). However, Dixon (1980) identified the Yorta Yorta (*Jodajoda*) as the language spoken by a group of neighbouring clans that were known as the *Bangerang* (Clark 1990: 398). Clark (1990: 398-401) also suggests that the *Yorta Yorta/ Bangerang* were the associated group of the area, who could be divided into more than 15 clans.

Wesson (2000: 57) suggests that the *Mogullumbidj* group utilised the areas of the Buffalo, Buckland, Ovens and Upper King Rivers, and the Mt. Buffalo Plateau, the area within which the study area is located. This group had alliances with central Victorian groups, attending ceremonies as far away as Merri Creek near Melbourne and had access to bogong moths at Mt. Howitt and the Howitt Plains (Wesson 2000: 57).

The depopulation of the Aboriginal groups in the north-east of Victoria was associated with the absence of any long-term reserves with permanent buildings to provide the Aboriginal people with a safety net against cold, hunger and angry pastoralists (Wesson 2000: 59). As a result, a rapid and catastrophic decline in population, of 97% by 1877, with the remaining north-east families moving to places where strong Aboriginal communities now exist (Wesson 2000: 59-60).

4.2 Archaeological Character

Archaeological evidence suggests that Aboriginal peoples had occupied all of Australia's environmental zones by 40,000 years BP. Pleistocene archaeology of the Port Phillip Bay and Hinterland area documents human occupation dating back at least 40,000 years. The oldest dated archaeological site in Victoria occurs at Keilor in Melbourne. Charcoal from a hearth excavated in 1973 has been dated to 31,000 years BP (Flood 1995: 286). More recently research at the Bend Road site in Melbourne's southeast has dates extending back to 30–35,000 BP (Hewitt and Allen 2010). However, the majority of the site is associated with the late Holocene backed artefact period – the site has now yielded hundreds of asymmetric points and geometric microlith forms. The site points to more common resource orientation patterns relevant to many greater Melbourne Aboriginal Places. Notably, the site is located on an undulating sand promontory jutting out into the northern end of Carrum Swamp. Such land was likely subject to irregular inundation and periodic drying, as such, "Aboriginal use of this resource was also likely to have been seasonal. Ethnographic accounts suggest that birds, eggs, fish, yabbies, shellfish, eels and edible swamp plants, together with the focus the swamp provided for foraging terrestrial marsupials, would have made the area an important resource for Aborigines, especially in spring" (Hewitt and Allen 2010: 3).

The archaeological record of Melbourne and wider areas includes a rich record of artefact scatters, scarred trees and stone arrangements that documents Aboriginal life dating from the Pleistocene through to the immediate pre-European past. Most of these sites point to important relationships between sites and landscapes and resources within the immediate area.

4.3 Register Searches

4.3.1 Victorian Aboriginal Heritage Register

A search of the Victorian Aboriginal Heritage Register (VAHR) was conducted on 27 March 2017 for Aboriginal places within a 2 km radius of the study area. Searching this area ensured that a relevant and representative sample of information was obtained, and provided a comparative dataset to the register search undertaken as part of Kiddell's (2011) assessment of the study area.

The search identified a total of 32 registered Aboriginal places within the search area (Appendix 2). These sites consist of a total of five site component types (Table 1). The difference between the number of sites and number of site components is because multiple sites contain two or more site component types.

No Aboriginal places are located within the study area, however two previously registered places are located within 100 m of the study area:

- VAHR 7925-0621 (Reedy Swamp Road Pipeline AS1) - an artefact scatter comprised of 15 stone artefacts with raw materials including chert and quartz, generally located between 600-1100 mm depth in a sandy matrix (Barker 2013 CHMP #12617); and
- VAHR 7925-0489 (Wanganui Rd 1) – an artefact scatter consisting of a singular surface artefact of hornfels raw material, located on the north side of Wanganui Road on a vehicle access track (Tulloch and Vines 2001 AV#1950)

One Aboriginal Historical Place was identified within the search area, VAHR 7925-0593 (Bangerang Cultural Centre). This site is not located within the study area.

None of these sites are located within the study area (see Appendix 2 for details).

Table 1: Summary of Previously Identified Aboriginal Place Component Types within the Search Area.

Site/Component Type	Quantity	Percentage (%)
Artefact Scatter	16	50
Scarred Tree	12	38
Earth Feature	2	6
Low Density Artefact Distribution	1	3
Aboriginal Historical Place	1	3
Total	**32**	**100**

4.3.2 Local Council

The study area is located within the City of Greater Shepparton and is governed by the Greater Shepparton Planning Scheme. Planning schemes set out policies and provisions for the use, development and protection of land.

The Heritage Overlay of the City of Greater Shepparton Planning Scheme was examined. No Aboriginal heritage places listed on the Heritage Overlay are present within the study area.

4.3.1 Previous Aboriginal Archaeological Investigations

Gap Analysis of Previous Cultural Heritage Due Diligence

As per GTA Consultant's request, a summary of the previous cultural heritage due diligence assessment undertaken by Dr Vincent Clark & Associates in 2011 is presented below, in order to formulate a gap analysis given changes to the *Aboriginal Heritage Act 2006* and the *Aboriginal Heritage Regulations 2007* in August 2016.

Kiddell (2011) prepared a cultural heritage due diligence assessment for AECOM for the current study area. The report reviewed the proposed east-west link for the Shepparton Bypass and the Shepparton Alternative Route, and included a brief site inspection of the proposed alignment. The historical findings of the due diligence assessment are detailed in Section 5. The desktop assessment identified that numerous archaeological assessments had been undertaken as part of the proposed Shepparton Bypass, and had identified a number of Aboriginal and historical heritage places within the proposed alignments. Within a 2 km search radius of the study area, 15 previously registered Aboriginal places were identified. No Aboriginal places were identified as being located within the study area, with the closest Aboriginal place, VAHR 7925-0489, located 125 m north of western end of Wanganui Road. The search identified that the majority of previously registered Aboriginal places were located west and south-west of the study area, along the Goulburn River and associated swampland. Additionally, the desktop assessment identified that one area of Aboriginal cultural heritage sensitivity was located within the study area, being land within 200 m of a prior waterway which cross the east of the study area. No site prediction model was prepared as part of the desktop assessment.

A field inspection was undertaken as part of the assessment, so to contextualise and verify the findings of the desktop assessment. The site inspection identified the following features, significant to understanding the potential for Aboriginal cultural heritage within the study area:

- Overhead powerlines running through the northern road reserve along Wanganui Road near the intersection of Freemans Road;
- Irrigation channel along north side of the above road reserve, crossing through to the south at the Freemans Road intersection;
- East of Freemans Road an area subject to significant ground disturbance was observed;
- On the south side of Wanganui Road within the road reserve, trenching for an underground pipeline was occurring, with significant ground disturbance to the reserve observed;
- The road reserve west of the above was observed as being less disturbed, and it was identified that further archaeological investigation may be required;
- An irrigation channel south of Numurkah Road crosses underneath the road and into the north side of Ford Road;
- A secondary smaller irrigation channel additionally runs parallel to the main channel within the north side road reserve on Ford Road, between Numurkah and Verney Roads. This section of the study area was observed as having been significantly disturbed by recent housing development and footpath construction;

- Roundabout intersection at Ford and Verney Roads, with a drainage ditch running along the southern road reserve;
- Further east to the above, an established housing subdivision was observed;
- No curbed areas were observed along Ford Road, with road bitumen directly abutting grassed areas; and
- No evidence of a prior waterway at Grahamvale and Ford Road intersection was observed

The assessment concluded that no previously registered Aboriginal places were located within the study area. One area of Aboriginal cultural heritage sensitivity, being land within 200 m of a prior waterway, was located within the study area. It was highlighted that Long's (1995) investigation had determined that prior waterways associated with the Goulburn River likely to contain Aboriginal cultural material, and that it may be located it deeper sediments beneath more recently deposited soils. The assessment determined that works associated with redesigning the Grahamvale and Wanganui Road intersection would require further archaeological investigation, given that this portion of the study area was located within an area of sensitivity. The site inspection concluded that two areas of significant ground disturbance were identified, south of Wanganui Road owing to pipeline construction works, and north of Ford Road due to residential subdivision. The extent of disturbance in other areas was deemed indeterminable without further investigation. The assessment provided the following recommendations for future works in the study area:

- The preparation of a mandatory cultural heritage management plan (CHMP) for any road construction works involving the upgrading, realignment or duplication of the Wanganui-Ford Road corridor, given that the study area is located in an area of Aboriginal cultural heritage sensitivity and the proposed works are regarded as a high impact activity;
- Consultation with the Registered Aboriginal Party (RAP), Yorta Yorta Nation Aboriginal Corporation, during the preparation of the CHMP; and
- Where possible, works should be restricted to the road reserve in order to minimise harm to previously unidentified Aboriginal cultural heritage

Localised and Regional Archaeological Investigations within the Search Area

Localised and regional archaeological investigations have established the general character of Aboriginal sites located within the same geographic region as the study area. This information, together with an environmental context, histories of land use and, historical and ethnohistorical sources, can be used to form the basis for a site prediction statement. Below is a summary of relevant previous archaeological investigations in proximity to the study area:

Long (1995) undertook an archaeological survey (AV #879) for the Shepparton Bypass Planning Study Phase 2, addressing two proposed corridor options for the Shepparton Bypass Planning Study. The survey was designed to target and assess the archaeological sensitivity of the proposed corridor options. During the survey, 63 new Aboriginal sites were identified and comprised of both stone artefact scatters (n=38) and scarred trees (n=25). Of the six previously registered Aboriginal places within the study area, four could not be relocated. As such, a total of 65 Aboriginal places were located and inspected as part of the study. In addition to these, 13 historical archaeological sites were identified. A number of landform types within the study area were identified as having high Aboriginal archaeological sensitivity:

- The slopes defining the edges of the Goulburn River and Broken River flood plains;
- Source bordering sand dunes adjacent to the flood plain corridors;
- Sand drifts on the flood plain floors;
- Silt ridges, levee banks and the raised edges of minor billabongs and creeks on the flood plain floor;
- The Seven Creeks flood plain;
- Raised ridges on flatland adjacent to, or at a distance from, the flood plains; and
- Prior and ancestral channels of the Goulburn River and Broken River

During the survey, a total of 13 historical archaeological sites were identified and recorded, and included both structural and non-structural places. The following landform types in the study area were considered to be likely to contain historical heritage sites:

- The slopes defining the edges of the Goulburn River and Broken River flood plains; and
- Raised ridges on flatland adjacent to, or at a distance from, the flood plains

Brown (1996) completed an additional survey (AV #931) for the Shepparton Bypass Planning Study Phase 2, drawing on a comparative analysis of all proposed corridor alignments. During the survey, 16 new stone artefact scatters and eight scarred trees were identified, in addition to one Aboriginal historic sites 'The Flat' and 'Daish's Paddock'. Additionally, nine historic sites were located and were considered to have local significance. The comparative analysis of proposed corridors highlighted a number of development constraints, associated with the high sensitivity for Aboriginal cultural heritage to occur within the western and central corridors. It was determined that all corridors contain specific locations of high Aboriginal cultural heritage sensitivity, owing to the presence of prior stream channels, source bordering dunes (lunettes), sand drifts on the flood plain floors and other sand deposits. A review of all alignments showed four having a limited or 'manageable' impact, including the inner and outer Eastern Alignment in addition to the Goulburn Valley Highway upgrade.

Debney et al. (2000) prepared a review (AV #3996) of the Western Route Planning Study for the Goulburn Valley Highway-Shepparton Bypass. The study area had previously been assessed by a number of reports (Long 1995; Brown 1996), and comprised a number of alignments for the proposed Western route. The desktop assessment identified that whilst the study area continued to contain section of State Forest, the majority of the landscape had been extensively altered by previous forest clearance and intensive agricultural works. The survey identified eight new Aboriginal places, including scarred trees and isolated stone artefacts. The survey was hindered by poor GSV across the study area, owing to dense ground coverage in addition to post-depositional processes associated with frequent flooding. Archaeologically sensitive landforms previously identified were confirmed, with specific areas of archaeological potential identified in the study area as:

- Within Daunts Bend State Forest;
- Within the riparian corridor bordering the Goulburn River;

- Within the riparian corridor bordering Castle Creek;
- Within the Reedy Swamp State Forest;
- Riparian fringe along Carters Road
- Prior stream channels;
- Source bordering dunes and lunettes; and
- Alluvial terraces south of Goulburn River

The assessment determined that further archaeological testing in the form of subsurface excavation should be undertaken, in order to determine the presence or absence of sites within the flood plain landform of the study area. In addition to the identified Aboriginal places, 13 historical sites were identified within the study area with no identified areas of historical archaeological potential.

Tulloch and Vines (2001) completed an archaeological survey (AV #1950) for the proposed freeway alignment options for the Shepparton Bypass, Shepparton. During the survey, visibility was generally <5% owing to thick grass coverage. Areas of exposure such as vehicle or animals tracks and around trees and dams had increased GSV (100%). The survey identified 13 previously unrecorded Aboriginal sites comprising of scarred trees, isolated artefact scatter in addition to four non-Aboriginal historical archaeological sites. Nine historical sites were identified, with most commonly occurring site type being farm complexes. Archaeologically significant landform identified during previous investigations for the bypass (Long 1995; Brown 1996) were reviewed, three areas of archaeological potential were identified:

- Sandy soil area on Verney Road North and Wanganui Road;
- Road reserve along Verney Road North; and
- Previously registered Aboriginal archaeological sites

Bell (2006) undertook a cultural heritage assessment (AV #3631) for three parcels of land on Ford and Verneys Roads, Shepparton, for proposed residential subdivision. During the survey, varying degrees of GSV were observed, owing to juvenile crop areas with increased GSV as compared to unploughed fields with reduced GSV. The study area was observed as having been highly disturbed by agricultural practices and the construction of irrigation channels along the boundaries of the study area. No Aboriginal or historical cultural heritage was identified during the assessment. The assessment concluded that there were no areas of archaeological potential or sensitivity within the study area, and that there were no historic or Aboriginal cultural heritage constraints regarding development.

Chamberlain and Myers (2007) prepared a standard CHMP (#10050) for the proposed residential subdivision and development in Shepparton North. The desktop assessment identified no previously registered Aboriginal places within the activity area. The desktop concluded that areas adjacent to Goulburn and Broken Rivers have a number of previously recorded Aboriginal places, with scarred trees and artefact scatters found in both areas however Aboriginal cultural heritage was not generally identified on the plains away from rivers. The activity area was determined as having low Aboriginal cultural heritage sensitivity, given that previous archaeological assessments had not identified any areas of sensitivity. The standard assessment recorded generally high GSV, especially along access tracks and around vegetation. Ground disturbance in the form of introduced vegetation, above and underground irrigation pipes and excavation works for utilities was observed. Given the observed and known disturbance associated with the land use of the activity area, it was considered unlikely that Aboriginal cultural heritage would be present. Management conditions as part of the CHMP include a cultural heritage induction.

Sutherland (2010) completed a standard CHMP (#11112) for the proposed extension of the Yarna Gurtji shared pathway, along the Goulburn River between Howitt Road and Kittels Road, Shepparton. The desktop assessment identified no previously registered Aboriginal places within the activity area. The desktop determined that the activity area had been subject to ground disturbing works associated with pastoral and agricultural practices, as well as subdivision of the area in the 20th Century. The standard assessment identified high levels of disturbance and modification, associated with residential development and utility installations. Within the activity area, GSV was recorded as generally high. It was determined that given a lack of surface cultural heritage or discernible topographic features, further archaeological assessment was not required.

Barker (2013) undertook a complex CHMP (#12617) for the proposed water reticulation extension at Reedy Swamp Road, Shepparton. The desktop assessment identified no previously registered Aboriginal places within the activity area. The desktop concluded that Aboriginal cultural heritage in the form of shell middens, scarred trees and artefacts scatters were most likely to be found on elevated areas, such as sandy dunes, adjacent to Reedy Swamp. A site prediction model for the activity area identified that Aboriginal cultural heritage was most likely to be identified between 1-1.2 m in a sand matrix. The standard assessment identified multiple landforms within the activity area, being undulating sand hills in the south and flat plains to the north. These landforms were observed as being relatively unmodified, outside of previous native vegetation and land clearance. Across the activity area, GSV was very low (0-5%), owing to dense grass coverage. The complex assessment comprised of two 1 x 1 m stratigraphic test pits, one 0.5 x 0.5 m test pits and 41 0.4 x 0.4 shovel test pits. The first test pit was excavated on the crest of a sand dune, and comprised a soil profile of upper red sands with compactness increasing with depth (0-1100 mm), overlying a red compact sandy clay at 1200 mm. The second test pit comprised a similar soil profile, with 14 *in situ* stone artefacts identified between 600-1100 mm. A third test pit was excavated in the north of the activity area, and comprised an upper sandy A horizon (0-220 mm), overlying a compacted silty clay base (220-530 mm), with a single stone artefact identified at 150 mm. During the complex assessment, two new Aboriginal places were identified being VAHR 7925-0622 (Reedy Creek Pipeline AS1-2) and 7925-0621 (Reedy Creek Pipeline AS1). The results of the complex assessment interpreted that the activity area had been used opportunistically and seasonally. Specific management conditions as part of this CHMP included the retention of 1.5 sqm of land associated with VAHR 7925-0621.

Barker (2014) prepared a complex CHMP (#12975) for the proposed repair and upgrade of the Marungi Street Drainage Outfall, Shepparton. The desktop assessment identified no previously registered Aboriginal places within the activity area. The desktop concluded that Aboriginal cultural heritage in the form of shell middens, scarred trees and artefacts scatters were most likely to be found on elevated areas, such as sandy dunes, adjacent to Reedy Swamp and were the result of brief Aboriginal camp sites. The standard assessment identified a single landform within the activity area, being a flat plain typical of the geomorphological Shepparton Formation. Ground disturbance associated with utility installation, roadway construction and land clearance was observed during the standard assessment. Given the presence of known archaeologically sensitive landforms and poor GSV, potential for Aboriginal cultural heritage to be present within the activity area was considered moderate. The complex assessment comprised a singular 1 x 1 m stratigraphic test pit and three 2 x 0.45 m backhoe pits. A relatively homogenous soil profile was identified, and comprised an upper sandy loam A horizon (0-100 mm), overlying a compacted clay and fill B horizon (100-130 mm). In the case of all back hoe pits, clay and rock fill was encountered generally to a depth of 1 m. No Aboriginal cultural heritage was identified, and the activity area was determined to have been highly disturbed during the stabilisation of the Goulburn River banks in the mid 20th Century. No specific management conditions were outlined in the CHMP.

Shiner and Griffin (2015) completed a complex CHMP (#13615) for the proposed development of a retirement village at Chas Johnson Reserve, Shepparton. The desktop assessment identified no previously registered Aboriginal places within the activity area, and determined that there was a moderate likelihood for shallow subsurface archaeological deposits to occur within the activity area. The standard assessment recorded low GSV (<5%), owing to dense ground coverage from grass and leaf litter. Some small areas of exposure were observed, most often nearby vegetation patches. Disturbance within the activity area was identified as utility installations, carparks and recreational facilities. No areas of archaeological potential were observed during the standard assessment, however areas potentially retaining natural sediments were observed. The complex assessment targeted these areas, and comprised of a singular 1 x 1 m stratigraphic test pit and ten shovel test pits. A generally homogenous soil profile was identified, consisting of an upper sandy silt humic layer to approximately 250 mm. Multiple STPs identified an underlying clayey silt strata identified between 200-340 mm. No Aboriginal cultural heritage was identified in the activity area, and no specific management conditions were outlined in the CHMP.

4.3.2 Summary of Desktop Aboriginal Cultural Heritage Assessment

The desktop assessment identified no previously registered Aboriginal places within the study area, however two places are located within 100 m of the study area:

- VAHR 7925-0621 (Reedy Swamp Road Pipeline AS1) - an artefact scatter comprised of 15 stone artefacts with raw materials including chert and quartz, generally located between 600-1100 mm depth in a sandy matrix (Barker 2013 CHMP #12617); and
- VAHR 7925-0489 (Wanganui Rd 1) – an artefact scatter consisting of a singular surface artefact of hornfels raw material, located on the north side of Wanganui Road on a vehicle access track (Tulloch and Vines 2001 AV#1950)

Within the 2 km search radius of the study area, 32 previously registered Aboriginal places were identified. Of these, half (n=16) were artefact scatters, with scarred trees also represented in high numbers (n=12). The vast majority of previously registered Aboriginal places have been identified in close proximity to the Goulburn River and surrounding wetland and swamps areas, and the majority of stone artefacts have been located in surface contexts. Previous archaeological investigations within close proximity to the study area have indicated that ground disturbing works, such as pastoral and agricultural activities, utility installations, vegetation clearance and road construction, have occurred across the wider Shepparton area. Previous investigations addressing past proposed alignments for the Goulburn Highway-Shepparton Bypass (Long 1995; Brown 1996; Debney 2000; Tulloch and Vines 2001) have all identified this disturbance. All of these investigations however were able to re-identify previously registered Aboriginal places, in addition to recording both new Aboriginal and historical places. As such, limitations such as reduced GSV owing to ground coverage (i.e. crops, introduced vegetation) and disturbance have not entirely disturbed or destroyed the archaeological character of wider Shepparton.

Previous archaeological assessments specific to the proposed Goulburn Highway-Shepparton Bypass (Long 1995; Brown 1996; Debney 2000; Tulloch and Vines 2001) have identified a number of areas of archaeological potential, relevant to the study area. Tulloch and Vines (2001) redefined these specific areas as including:

- Sandy soil area on Verney Road North and Wanganui Road;
- Road reserve along Verney Road North; and
- Previously registered Aboriginal archaeological sites

Other areas identified in these reports include geological and geomorphological areas of archaeological potential, such as:

- The riparian corridor bordering the Goulburn River
- Prior stream channels;
- Source bordering dunes and lunettes; and
- Alluvial terraces south of Goulburn River

Recent subsurface archaeological investigations like Barker's (2013) for the proposed water reticulation extension for Reedy Swamp, which intersects the study area, identified 14 *in situ* stone artefacts in a sandy matrix on the crest of a sand dune. These results corroborate the site prediction models formed by earlier reports.

A review of Kiddell's (2011) due diligence assessment for the current study area provides similar desktop conclusions, on the basis of previous archaeological investigations. The site inspection undertaken as part of the assessment concluded the following regarding Aboriginal cultural heritage:

- Works associated with redesigning the Grahamvale and Wanganui Road intersection would require further archaeological investigation, given that this portion of the study area was located within an area of sensitivity;
- Two areas of significant ground disturbance were identified, south of Wanganui Road owing to pipeline construction works, and north of Ford Road due to residential subdivision; and
- The preparation of a mandatory cultural heritage management plan (CHMP) for any road construction works involving the upgrading, realignment or duplication of the Wanganui-Ford Road corridor will be required , given that the study area is located in an area of Aboriginal cultural heritage sensitivity and the proposed works are regarded as a high impact activity

Kiddell (2011) concluded that where possible, works should be restricted to the road reserve in order to minimise harm to previously unidentified Aboriginal cultural heritage.

Given that a singular instance of subsurface testing has previously occurred within the study area, and little other archaeological work has been undertaken within 2 km, the archaeological character of the site is relatively undetermined. One subsurface stone artefact scatter, VAHR 7925-0621, is located less than 100 m north of the study area and is considered to have located *in situ* in undisturbed sediments associated with the former channel of the Goulburn River. A review of mapped areas of Aboriginal cultural heritage sensitivity (Map 2) indicates that the study area is located within two areas of sensitivity, at the westernmost point of Wanganui Road and the easternmost point of Ford Road. Kiddell (2011) determined that it was unclear whether the entire study area had been subject to ground disturbing works, and whether the study area could retain artefact bearing sediments. As such, the potential for *in situ* subsurface Aboriginal cultural material to be identified within the study area is moderate.

5 HISTORICAL CONTEXT

The section reviews the historical (non-Aboriginal) context of the study area and includes an examination of historical sources, previously recorded heritage places and historical archaeological site types and locations in the geographic region of the study area, and previous archaeological studies undertaken in the area. Together, these sources of information can be used to formulate a predictive statement concerning what types of sites are most likely to occur in the study area, and where these are most likely to occur.

5.1 Land Use History of the Study Area

Regional Land Use History

Major Thomas Mitchell was the first recorded European to traverse the area in the 1830s, recommending Shepparton as a place to camp along the Goulburn River en route from New South Wales through to South Australia. Two large squatting runs dominated the wider region, and were run by Gregor McGregor and Edward Khull. In the mid nineteenth century, Paddy Macguire established a crossing place on the Goulburn River to allow travellers to cross the River as they moved east from the Bendigo and Ballarat gold fields. The crossing (punt) was situated on the bank of the Goulburn River across from the present day Shepparton Police Station. Khull's run adjoined the area north of McGregor's, and was known as Tallygaroopna Run, encompassing the wider area of Shepparton (Sutherland 2010: 16).

The town of Shepparton garnered its name from Sherbourne Sheppard, who took up Tallygaroopna Station following its abandonment by Khull in 1843. The original course of the Goulburn River ran along the western side of Welsford Street, but was modified in the late twentieth century to allow an additional roadway connection through to High Street. The first building in Shepparton was Paddy Macguire's punt house which was associated with the river crossing. The punt house was sold to a John Hill in 1853 who converted it into a hotel, the Emu Bush Inn (Shepparton Historical Society 2016).

Figure 1: Painting of Macquire's Punt (1850s) from Shepparton Historical Collection.

The Goulburn River crossing place was named 'Macguire's Punt' and from 1853 to 1870 the name Macguire's Punt was the name of the township of Shepparton. The name 'Shepparton' gradually came into use from 1855 and was used interchangeably with Macquire's Punt. Early pioneers referred to the town as 'Sheppard town' or 'Sheppardton' after Sherbourne Sheppard, the early squatter who occupied the Tallygaroopna sheep run. The Shepparton Township Reserve was proclaimed by the Governor of Victoria in 1860. Shepparton separated from the Shire of Echuca in 1879 and became part of the newly formed Shire of Shepparton. Various urbanised developments reached Shepparton in the 1880s, with the railway from Seymour extended through to the town in addition to a mechanics institution in the same year (Barker 2014: 23). The railway was extended to Numurkah in 1881 and further to Cobram in 1887, bringing with industrialisation and a boom in intensive farming (Bossence 1979: 77, 2004; Kiddell 2011: 6). In 1896, politician and business William Orr built his 'Wanganui' homestead, north of Wanganui Road and the current study area. This structure is protected by the local heritage overlay of Greater Shepparton, and is currently used as a tertiary education institution.

Ongoing development resulted in the creation of the Borough of Shepparton in 1927. Shepparton was officially recognised as a regional city in 1949 (Shepparton Historical Society 2016). Farming throughout the wider areas of Shepparton continued throughout the 20th Century, and has formed an essential part of the town character of Shepparton. Over the past 160 years, Shepparton has grown from a simple river crossing, Macguire's Punt, into a thriving regional city.

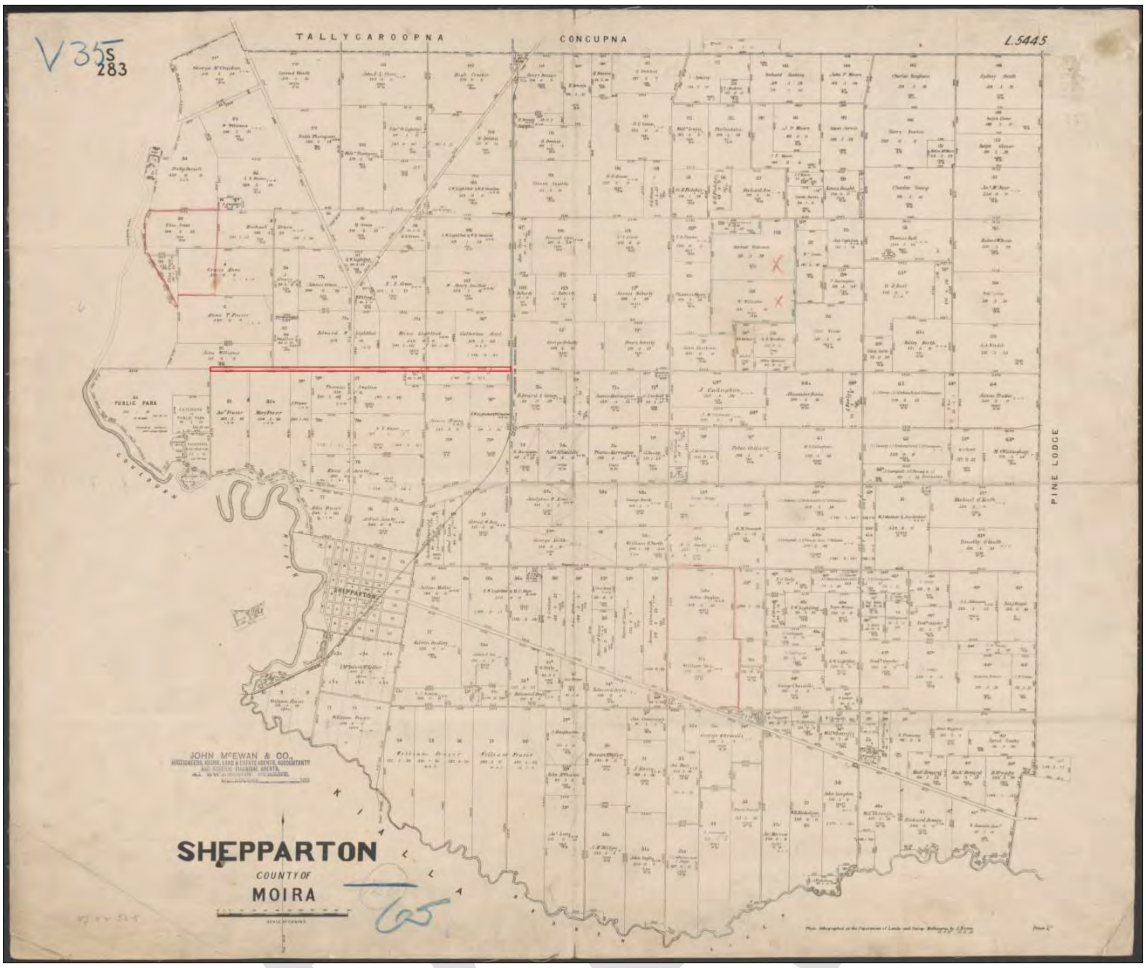

Figure 2: Shepparton, County of Moira Parish Plan dated 1887 showing study area and

Previous Archaeological Investigations of the Study Area

In addition to addressing Aboriginal cultural heritage, a number of previous archaeological investigations within a 2km search radius of the study area outlined the discovery of historical heritage, and areas of potential.

Long (1995) undertook an archaeological survey (AV #879) for the Shepparton Bypass Planning Study Phase 2, addressing two proposed corridor options for the Shepparton Bypass Planning Study. During the assessment, a total of 13 historical archaeological sites were identified and recorded, and included both structural and non-structural places. The following landform types in the study area were considered to be likely to contain historical heritage sites:

- The slopes defining the edges of the Goulburn River and Broken River flood plains; and
- Raised ridges on flatland adjacent to, or at a distance from, the flood plains

Debney et al. (2000) prepared a review (AV #3996) of the Western Route Planning Study for the Goulburn Valley Highway-Shepparton Bypass. In addition to the identified Aboriginal places, 13 historical sites were identified within the study area with no identified areas of historical archaeological potential.

Tulloch and Vines (2001) completed an archaeological survey (AV #1950) for the proposed freeway alignment options for the Shepparton Bypass, Shepparton and identified nine historical sites, with the majority of sites being farm complexes.

Gap Analysis of Previous Cultural Heritage Due Diligence

As per GTA Consultant's request, a gap analysis of the previous cultural heritage due diligence prepared by Dr Vincent Clark & Associates in 2011 was undertaken. Kiddell (2011) identified one historic heritage place, Victorian Heritage Inventory (VHI) site H7925-0040 (Wanganui Road 2), adjacent to the western extent of the study area and north of Wanganui Road. This place was defined as a historic artefact scatter, located in a field. Based on this finding, Kiddell (2011) recommended that works be restricted to the road reserve immediately north of Wanganui Road, so to not impact the historic place.

A review of the relevant historic heritage database (HERMES) identified that VHI site H7925-0040 (Wanganui Road Farm Complex), formally 'Wanganui Road 2', is located approximately 20 m of the study area, west of Rudd Road. The VHI details the historic place as:

> *'…large area of cultivated soil east of farm house, probably once a kitchen garden. There is a diffuse scatter of early 20th Century glass, ceramic, metal and other artefacts fragmented by ploughing and trampling by livestock'* (Tulloch & Vines 2001)

The site is detailed by the Heritage Inventory as having moderate significance, owing to the fact that dump sites are relatively common throughout the Shepparton area and that the site has been disturbed.

5.2 Register Searches

A search of the relevant historical heritage registers was conducted on 27 March 2017 for historical heritage places within a 2 km radius of the study area.

5.2.1 Victorian Heritage Register

The Victorian Heritage Register (VHR), established by the Victorian *Heritage Act 1995*, provides the highest level of statutory protection for historical sites in Victoria. Only the State's most significant historical sites are listed on the VHR. A search of the VHR for information relating to the study area was undertaken. The study area and the surrounding 2 km of land were investigated.

No heritage places were listed in the VHR within the search area or the study area.

5.2.2 Victorian Heritage Inventory

The Victorian Heritage Inventory (VHI), established by the Victorian *Heritage Act 1995*, provides the statutory protection for all historical archaeological sites, areas or relics, and private collections of relics, in Victoria. Sites listed on the VHI are not of State significance but are usually of regional or local significance. A search of the VHI for information relating to the study area was undertaken. The study area and the surrounding 2 km of land were investigated.

A singular historical place was listed on the VHI within the search area:

- VHI H7925-0040 (Wanganui Road Farm Complex), located approximately 20 m north of Wanganui Road, west of Rudd Road.

The details of this site can be found in Table 2. This heritage place is not located within the study area.

5.2.3 Local Council Heritage Overlay

The study area is located within the City of Greater Shepparton and is governed by the Greater Shepparton Planning Scheme (PS). Planning schemes set out policies and provisions for the use, development and protection of land. The Heritage Overlay of the Greater Shepparton Planning Scheme was examined.

A singular heritage place was identified in the PS within the search area:

- HO93 – Former Wanganui Homestead, 260 Wanganui Road, Shepparton, directly abutting Wanganui Road, east of Rudd Road

The details of this site can be found in Table 2. This heritage places is not located within the study area.

5.2.4 National Trust of Australia (Victoria) Register

The National Trust of Australia (Victoria) is an independent, not-for-profit organisation that classifies a number of heritage places. Listing by the National Trust does not impose any statutory protection, however often National Trust Register listings are supported by the local council Planning Scheme.

No heritage places were listed in the National Trust Register within the search area or the study area.

5.2.5 Victorian War Heritage Inventory

The Victorian War Heritage Inventory (VWHI) was established in 2011 as a means to catalogue Victoria's war history such as war memorials, avenues of honour, memorial buildings, former defence sites and places of commemoration. Places listed on the VWHI do not currently have discrete statutory protection, however many are concurrently listed on the VHR, VHI, or local planning schemes.

No heritage places were listed in the VWHI within the search area or the study area.

5.2.6 National, Commonwealth and International Heritage Lists

The Australian Government Department of the Environment and Energy (DoEE) maintains the National Heritage List (NHL), a register of exceptional natural, Aboriginal and historical heritage places which contribute to Australia's national identity. The DoEE also maintains the Commonwealth Heritage List (CHL), a Register of natural, Aboriginal or historical heritage places located on Commonwealth land which have Commonwealth heritage values.

A place can be listed on one or both lists, and placement on either list gives the place statutory protection under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act 1999).

The World Heritage List (WHL) lists cultural and natural heritage places which are considered by the World Heritage Council to have outstanding universal value. In addition, the DoEE also maintains the Register of the National Estate (RNE) which is a list of natural, Indigenous and historic heritage places throughout Australia. Following amendments to the *Australian Heritage Council Act 2003*, the RNE was frozen on 19 February

2007 and no new places were added or removed. In February 2012 the RNE ceased statutory operation and sites listed on the RNE no longer have statutory protection, however items listed on the RNE may continue to be considered during approvals processes.

Listings on the NHL, CHL, WHL and RNE are accessed via the Australian Heritage Database (AHD), managed by DoEE.

5.2.7 Summary of Desktop Historical Heritage Assessment

No heritage places were listed in the AHD within the study area, however two historic heritage places are located within 50 m:

- VHI H7925-0040 (Wanganui Road Farm Complex), located approximately 20 m north of Wanganui Road, west of Rudd Road; and
- HO93 – Former Wanganui Homestead, 260 Wanganui Road, Shepparton, directly abutting Wanganui Road, east of Rudd Road

Within the search area, 16 heritage places were listed in the AHD. Details of the sites can be found in Table 2.

Table 2: Historic Heritage Places within the Search Area.

Register & Place Number	Place Name	Place Type	Within Study Area?
H1082/ HO150	Bangerang Cultural Centre	Archaeological	No
H7925-0001	Ardpatrick Pre-Emptive Right	Archaeological	No
H7925-0004	Freemans Road Historical Scatter 1	Archaeological	No
H7925-0005	Freemans Road Historical Scatter 2	Archaeological	No
H7925-0009	Reedy Swamp Historical Scatter 1	Archaeological	No
H7925-0010	Reedy Swamp Historical Scatter 2	Archaeological	No
H7925-0017	Goulburn River Weir	Archaeological	No
H7925-0018	Goulburn River Haulage Track	Archaeological	No
H7925-0040	Wanganui Road Farm Complex	Archaeological	No, but approximately 20 m north
D7925-0045	The Boulevard Yards	Archaeological	No
HO200	25 Kingfisher Drive, Shepparton	Built Heritage	No
HO93	Former Wanganui Homestead- 260 Wanganui Road, Shepparton	Built Heritage	No, but directly abuts
HO202	Radio Australia -490 Verney Road, Shepparton	Built Heritage	No

Register & Place Number	Place Name	Place Type	Within Study Area?
HO82	Ivanhoe -9 Ivanhoe Court, Shepparton	Built Heritage	No
HO151	Phillipine House -Parkside Gardens, Parkside	Built Heritage	No

As per Section 5.1, the gap analysis of Kiddell's (2011) due diligence assessment of the study area identified one historic heritage place, H7925-0040 (Wanganui Road 2), adjacent to the western extent of the study area and north of Wanganui Road. This place was defined as a historic artefact scatter, located in a field. A review of the Victorian Heritage Database indicates that since the preparation of Kiddell's (2011) report, this place has been renamed to 'Wanganui Road Farm Complex', and has retained the same VHI number (H7925-0040).

Given that Wanganui Road Farm Complex (H7921-0040) is listed on the Victorian Heritage Inventory, should any proposed works impact on the site a Consent from Heritage Victoria will be required if impacts to the site cannot be avoided.

6 LEGISLATIVE AND POLICY IMPLICATIONS

6.1 Aboriginal Heritage Act 2006 (State)

6.1.1 Requirements

The *Aboriginal Heritage Act 2006* protects Aboriginal heritage in Victoria. If certain high impact activities are undertaken as stated in the *Aboriginal Heritage Regulations 2007* (the Regulations) then preparation of an Aboriginal Cultural Heritage Management Plan (CHMP) may be required to be approved by AV or the Registered Aboriginal Party (RAP) prior to lodging a planning permit.

Triggers for mandatory preparation of a CHMP include whether certain criteria are met under the Regulations, required by the Minister, or if the activity requires an Environmental Effects Statement (EES) under Sections 46 to 49 of the *Environmental Effects Act 1978*.

The Regulations require a mandatory CHMP if:

1. All or part of the proposed activity is a high impact activity; and
2. All or part of the activity area (study area) is an area of cultural heritage sensitivity (subject to whether the entire area of cultural heritage sensitivity has been subject to *significant ground disturbance*).

> 'Significant Ground Disturbance (SGD)' is defined in r.4 of the Regulations as meaning disturbance of – (a) the topsoil or surface rock layer of the ground; or (b) a waterway – by machinery in the course of grading, excavating, digging, dredging or deep ripping, but does not include ploughing other than deep ripping… The Victorian Civil and Administrative Tribunal (VCAT) has determined that the words "topsoil or surface rock layer" include the former topsoil or former surface rock layer if that topsoil or surface rock layer is a naturally occurring surface level that is readily ascertainable and does not include the current topsoil or current surface rock layer if established by the mere filling of the land (OAAV 2010: 2).

6.1.2 Implications for the Project

The following considerations are made regarding the requirement for a mandatory CHMP under the *Aboriginal Heritage Act 2006*.

Is the Study Area within an Area of Cultural Heritage Sensitivity?

The preliminary assessment indicates that the study area is located within an area of cultural heritage sensitivity under the *Aboriginal Heritage Regulations 2007* (Map 2). The specific area of cultural heritage sensitivity is:

- located within 200 m of a waterway, Reedy Swamp (r.23);
- is located within 200 m of a prior waterway, Goulburn River (r.24);

However, this is predicated on the entirety of those areas of sensitivity within the study area, being wholly undisturbed. Kiddell's (2011) site inspection of the study area indicated that two areas had potentially undergone significant ground disturbance. These areas were identified as:

- south of Wanganui Road owing to pipeline construction works; and
- north of Ford Road due to residential subdivision

Removal/disturbance of the topsoil by machinery is considered significant ground disturbance under r. 4 of the *Aboriginal Heritage Regulations 2007*. In particular, surface preparation, trenching and filling would have involved activities that are consistent with the definition of SGD as 'disturbance in the course of grading and excavation' as per AV (2016). Places which can be determined as having SGD may be exempt from the CHMP process.

However, review of the study area and recent archaeological investigations nearby indicate that approved CHMPs which abut the study area (Barker 2014) have identified Aboriginal cultural heritage north of the study area. This indicates that culturally bearing sediments have been retained in areas close to the study area, particularly southeast of Reedy Swamp.

Is the Proposed Activity a High impact Activity?

Under the *Aboriginal Heritage Regulations 2007* the proposed activity is considered a high impact activity. The specific high impact activity is:

- the construction of specific items of infrastructure, a roadway with a length exceeding 100 metres (r. 44 [1][e]

Is a Mandatory CHMP Required?

As the study area is within an area of cultural heritage sensitivity and the proposed activity is a high impact activity, a mandatory CHMP ***is*** required for the proposed development. However, as there is some evidence based on Kiddell's (2011) assessment to suggest the study area has been subject to significant ground disturbance, a mandatory CHMP may not be required for the proposed development. There is, however, some uncertainty as to whether the available information satisfactorily meets the definition of SGD (Appendix 3) as defined by the *Aboriginal Heritage Regulations 2007*. This can be assessed and certified by Aboriginal Victoria through a Preliminary Aboriginal Heritage Test (PAHT).

6.1.3 Harm to Aboriginal Cultural Heritage

Unless topsoils were removed completely from the study area during previous disturbance works, there is potential that Aboriginal cultural heritage in the form of stone artefacts is still present, albeit in a highly disturbed context. The *Aboriginal Heritage Act 2006* makes no distinction between disturbed or undisturbed archaeological sites when defining Aboriginal places. Thus, even highly disturbed sites are still Aboriginal places and are subject to protection under the Act. Similarly, it makes no distinction whether or not those sites have been previously identified and registered or not – all sites are protected.

This assessment considers that there is some potential for subsurface/disturbed archaeological deposits to be present in the westernmost area of Wanganui Road, given the results of recent archaeological investigations and known sensitivity of waterways.

It should also be noted that in the case of scarred trees, impacts do not just mean those above ground level, but also includes the root system below ground level. For the purposes of the extent of the ground system, the roots should be considered to extend at least to the diameter of the canopy or 20 m, whichever is smaller.

6.2 Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth)

6.2.1 Requirements

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) provides a national framework for the protection of heritage and the environment and the conservation of biodiversity. The EPBC Act is administered by the DoEE. The EPBC Act established the NHL, the CHL and the WHL for statutory protection of heritage places of national or international significance. Where Matters of National Environmental Significance (NES), including National Heritage Places, will or may be impacted by a development, then a referral to the Minister will be required to determine whether an approval under the EPBC Act is required.

The RNE is no longer a statutory register and listed sites are no longer protected (unless registered on another statutory register).

6.2.2 Implications for the Project

There are no known Matters of NES within the study area (Map 3). It is considered unlikely that any cultural heritage sites of National Significance will be located it the study area. Therefore no referral or further works would be required under the EPBC Act 1999.

6.3 Planning and Environment Act 1987 (State)

6.3.1 Requirements

All municipalities in Victoria are covered by land use planning controls which are prepared and administered by State and local government authorities. The legislation governing such controls is the *Planning and Environment Act 1987*. Places of significance to a locality can be listed on a local planning scheme and protected by a Heritage Overlay (or other overlay where appropriate). Places of Aboriginal cultural heritage significance are not often included on local government planning schemes. The study area is governed by the Greater Shepparton Planning Scheme. In addition to the Heritage Overlay, Clause 52.37 of the Particular Provisions provides protection to post boxes constructed before 1930 and dry stone walls constructed prior to 1940 (if listed in the schedule).

6.3.2 Implications for the Project

Within the study area there no heritage sites of local significance listed on the Heritage Overlay under the City of Greater Shepparton Planning Scheme (Map 3). However, one heritage site directly abuts the study area:

- HO93 - Former Wanganui Homestead

There are no dry stone walls listed in Schedule 1 of Clause 52.37 within the study area.

Should the proposed activity extend beyond the existing road reserves of Wanganui Road and cannot avoid impacts to this site, a planning permit from the City of Greater Shepparton will be required to remove, impact or destroy the Heritage Overlay site (Former Wanganui Homestead).

6.4 Heritage Act 1995 (State)

6.4.1 Requirements

This Act protects all heritage places on the VHR and all non-Aboriginal archaeological sites older than 50 years. If a site is of State Significance it is listed on the VHR and a Permit from Heritage Victoria (HV) is required to disturb it. If an archaeological site is not of State significance it is usually listed on the VHI and Consent from Heritage Victoria would be required to disturb it.

6.4.2 Implications for the Project

There are no registered Historical Heritage Places within the study area. One site, H7925-0040 (Wanganui Road Farm Complex), is located approximately 20 m north of Wanganui Road, west of Rudd Road. The site is listed on the VHI; therefore a Consent from Heritage Victoria will be required if impacts to the site cannot be avoided.

There is one registered Historical Heritage Place (HO93) which abuts the study area and is listed on the local Heritage Overlay which directly abuts the study area. Therefore, if impacts to the site cannot be avoided a Permit from City of Greater Shepparton will be required.

Note: Places on the Heritage Overlay that are also on the VHR will not require a Council permit, as permitting conditions under the *Heritage Act 1995* take precedence and only the HV permit is required.

7 CONCLUSION AND RECOMMENDATIONS

7.1 Conclusions

The following conclusions are made regarding the likely presence of Aboriginal and/or historical heritage within the study area:

Aboriginal Cultural Heritage

Following the results of the desktop assessment, the following conclusions are made regarding Aboriginal cultural heritage within the study area:

- There are no previously registered Aboriginal places within the study area, however two registered Aboriginal places are located within 100 m of the study area. These are:
  - VAHR 7925-0621 (Reedy Swamp Road Pipeline AS1) - an artefact scatter comprised of 15 stone artefacts with raw materials including chert and quartz, generally located between 600-1100 mm depth in a sandy matrix (Barker 2013 CHMP #12617); and
  - VAHR 7925-0489 (Wanganui Rd 1) – an artefact scatter consisting of a singular surface artefact of hornfels raw material, located on the north side of Wanganui Road on a vehicle access track (Tulloch and Vines 2001 AV#1950)
- The study area is located within multiple *mapped* areas of cultural heritage sensitivity, being:
  - Being within 200 m of a named waterway, Reedy Swamp (r.23); and
  - Being within 200 m of a prior waterway, Goulburn River (r.24)
- Previous archaeological investigations within close proximity to the study area have indicated that ground disturbing works, such as pastoral and agricultural activities, utility installations, vegetation clearance and road construction, have occurred across the wider Shepparton area. Previous investigations addressing past proposed alignments for the Goulburn Highway-Shepparton Bypass (Long 1995; Brown 1996; Debney 2000; Tulloch and Vines 2001) have all identified this disturbance. Additionally, a review of recent aerial photography indicates that the study area wholly comprises of existing roadways, road reserves and associated installations and infrastructure.
- All previous investigations for the study area were able to re-identify previously registered Aboriginal places, in addition to recording both new Aboriginal and historical places. Recent subsurface archaeological investigations including Barker's (2013), for the proposed water reticulation extension for Reedy Swamp, which intersects the study area, identified 14 *in situ* stone artefacts in a sandy matrix on the crest of a sand dune.
- Kiddell (2011) undertook a cultural heritage due diligence assessment for the current study area, and formulated the following conclusions regarding Aboriginal cultural heritage:
  - Works associated with redesigning the Grahamvale and Wanganui Road intersection would require further archaeological investigation, given that this portion of the study area was located within an area of sensitivity;

   - Two areas of significant ground disturbance were identified, south of Wanganui Road owing to pipeline construction works, and north of Ford Road due to residential subdivision; and
   - The preparation of a mandatory cultural heritage management plan (CHMP) for any road construction works involving the upgrading, realignment or duplication of the Wanganui-Ford Road corridor will be required, given that the study area is located in an area of Aboriginal cultural heritage sensitivity and the proposed works are regarded as a high impact activity.
- Kiddell (2011) determined that it was unclear whether the entire study area had been subject to ground disturbing works, and whether the study area could retain artefact bearing sediments. As such, the potential for *in situ* subsurface Aboriginal cultural material to be identified within the study area is moderate.
- Given that a singular instance of subsurface testing has previously occurred within the study area, and little other archaeological work has been undertaken within 2 km, the archaeological character of the site is relatively undetermined. Recent archaeological investigations have identified both Aboriginal cultural heritage and undisturbed landforms north of the study area at the westernmost point of Wanganui Road. This indicates that undisturbed landforms and *in situ* Aboriginal cultural material may be present in areas of mapped cultural heritage sensitivity.

Historical Heritage

There are no historical heritage places within the study area; however, two historical heritage places are located within 100 m of the study area:

- VHI H7925-0040 (Wanganui Road Farm Complex), is located approximately 20 m north of Wanganui Road, west of Rudd Road; and
- HO93 (Former Wanganui Homestead, 260 Wanganui Road, Shepparton), directly abuts Wanganui Road, east of Rudd Road

Should the proposed works impact on either of these historic heritage places, consultation with the relevant authority will be required. In the case of H7921-0040 (Wanganui Road Farm Complex), a Consent from Heritage Victoria will be required if impacts to the site cannot be avoided. For HO93 (Former Wanganui Homestead), if impacts to the site cannot be avoided a Permit from City of Greater Shepparton will be required.

7.2 Recommendations

Aboriginal Cultural Heritage

Recommendation 1: Requirement for a mandatory CHMP

A mandatory CHMP may be required for the study area, given that the current proposed works are a high impact activity. Given that the study area is located in multiple areas of Aboriginal cultural heritage sensitivity as defined by the *Aboriginal Heritage Act 2006*, a mandatory CHMP **will be** required. However, a mandatory CHMP will not be required by the *Aboriginal Heritage Regulations* if the following can be determined:

- Part of a waterway or part of the land within 200 m of a waterway has been subject to significant ground disturbance, that part is not an area of cultural heritage sensitivity (r.23 [2]); and/or
- Part of a prior waterway or part of the land within 200 m of a prior waterway has been subject to significant ground disturbance, that part is not an area of cultural heritage sensitivity (r.24 [2])

Due to the potential for significant ground disturbance (SGD) to be present within these areas of sensitivity, a mandatory CHMP may not be required. A Preliminary Aboriginal Heritage Test (PAHT) can be used to verify SGD, which, if certified by AV, would remove the requirement for a mandatory CHMP, as outlined as Recommendation 2 below.

Recommendation 2: Preliminary Aboriginal Heritage Test

The Preliminary Aboriginal Heritage Test (PAHT) provides sponsors with certainty about whether a cultural heritage management plan (CHMP) is required for a proposed activity. The PAHT is a voluntary process, which allows for the Secretary to the Department of Premier and Cabinet (Secretary) to certify whether a CHMP is required for a proposed activity.

A person may be unclear whether an approved CHMP is required for a proposed activity in accordance with the requirements of the *Aboriginal Heritage Act* 2006 (Act) and the *Aboriginal Heritage Regulations* 2007 (Regulations). For instance, a sponsor may be unclear as to whether their proposed activity area has been subject to significant ground disturbance (see Practice Note: Significant Ground Disturbance which is available on the Aboriginal Victoria website and in Appendix 3).

In such cases, a person is able to prepare a PAHT to establish whether a CHMP is required for the activity. The PAHT can then be submitted to the Secretary, who must decide whether to certify the PAHT as correct within a 21 day evaluation period. The preparation of a PAHT for the study area may be able to utilise the results of this desktop assessment.

Recommendation 3: Proceed with a voluntary CHMP

Given that two previously registered Aboriginal places are located within 100 m of the study area in addition to multiple areas of Aboriginal cultural heritage sensitivity, should future proposed works not be regarded as a high impact activity it is strongly recommended that the client undertake a voluntary CHMP. The preparation of a voluntary CHMP has the following advantages:

- *No requirement for Cultural Heritage Permits at a later stage*: there are no cultural heritage permit requirements in relation to a CHMP as long as you are acting in accordance with the CHMP. There is no requirement for an excavation permit or a permit to harm, or any of the other permit requirements. In effect, the approved CHMP is a permit. If Aboriginal cultural heritage is unexpectedly discovered during the activity, there is therefore no permit requirement if a CHMP has in place. Any unexpected Aboriginal cultural heritage is dealt with through contingency plans in the CHMP, already signed off and agreed to by RAP in the CHMP process;
- *Increased certainty for your project*: as there are no Cultural Heritage Permit requirements at a later stage, there is more certainty for the project. This certainty is provided during the planning phase, allowing the activity to remain unimpeded by cultural heritage legislation. A CHMP removes the

activity from the harm provisions of the *Aboriginal Heritage Act 2006*, as long as the proponent acts in accordance with the CHMP; and

- *Good Risk Management*: rises and elevated areas and the margins of water courses are well documented as areas that retain Aboriginal cultural heritage sites in the general region. A voluntary CHMP could effectively investigate the area for any evidence of Aboriginal sites and minimise the risk that any significant Aboriginal sites would be impacted by the activity, which would cause delays and added expense to the construction process.
- *Provides advice for avoiding, minimising or mitigating harm to Aboriginal Places*. Recommendations are made for the avoidance, minimisation and mitigation of harm to specific Aboriginal Places in the CHMP. Once all places have been identified, consultation is undertaken with the RAP to determine the best strategies to protect or salvage places on a case by case basis. These strategies can include salvage, fencing, landscaping approaches and buffers.

In the event that the client elects to pursue a voluntary CHMP, this must be undertaken by a qualified Heritage Advisor in association with relevant RAP. Any voluntary CHMP undertaken for the study area may be able to utilise the results of this desktop assessment.

Historical Heritage

To avoid potential impacts to historical heritage, the following recommendations are made:

- Conducting a HHA to determine the nature and extent of H7921-0040 (Wanganui Road Farm Complex), including an archaeological survey and further detailed historical research in addition to detailed design plans;
- Deploy landscaping approaches and planning measures to avoid impacts to sites. i.e. paths should avoid archaeological deposits and green spaces be planned to frame existing historic heritage.
- If impacts to the site cannot be avoided, Consent to Excavate from Heritage Victoria will be required prior to the commencement of works. The preparation of a Consent to Excavate will require consultation with Heritage Victoria in order to formulate the methodology of the initial investigation;
- Consultation with Heritage Victoria should occur following the initial test excavation in order to determine any requirement for further archaeological works at the study area, i.e. open area excavation; and
- If impacts to HO93 (Former Wanganui Homestead) cannot be avoided, a Permit from City of Greater Shepparton will be required

These works should be undertaken by a suitably qualified Heritage Advisor in association with Heritage Victoria and/or the City of Greater Shepparton.

MAPS

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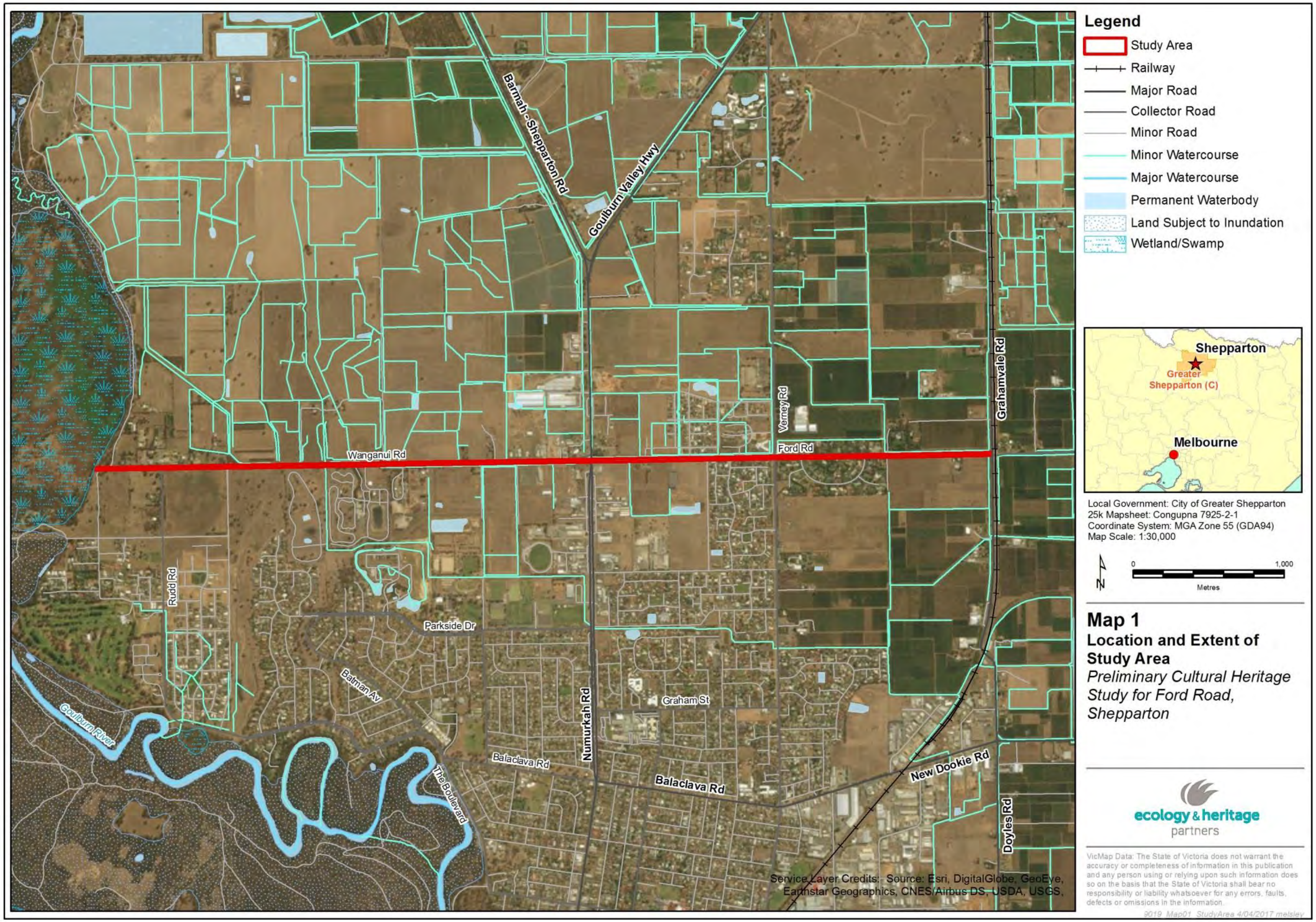
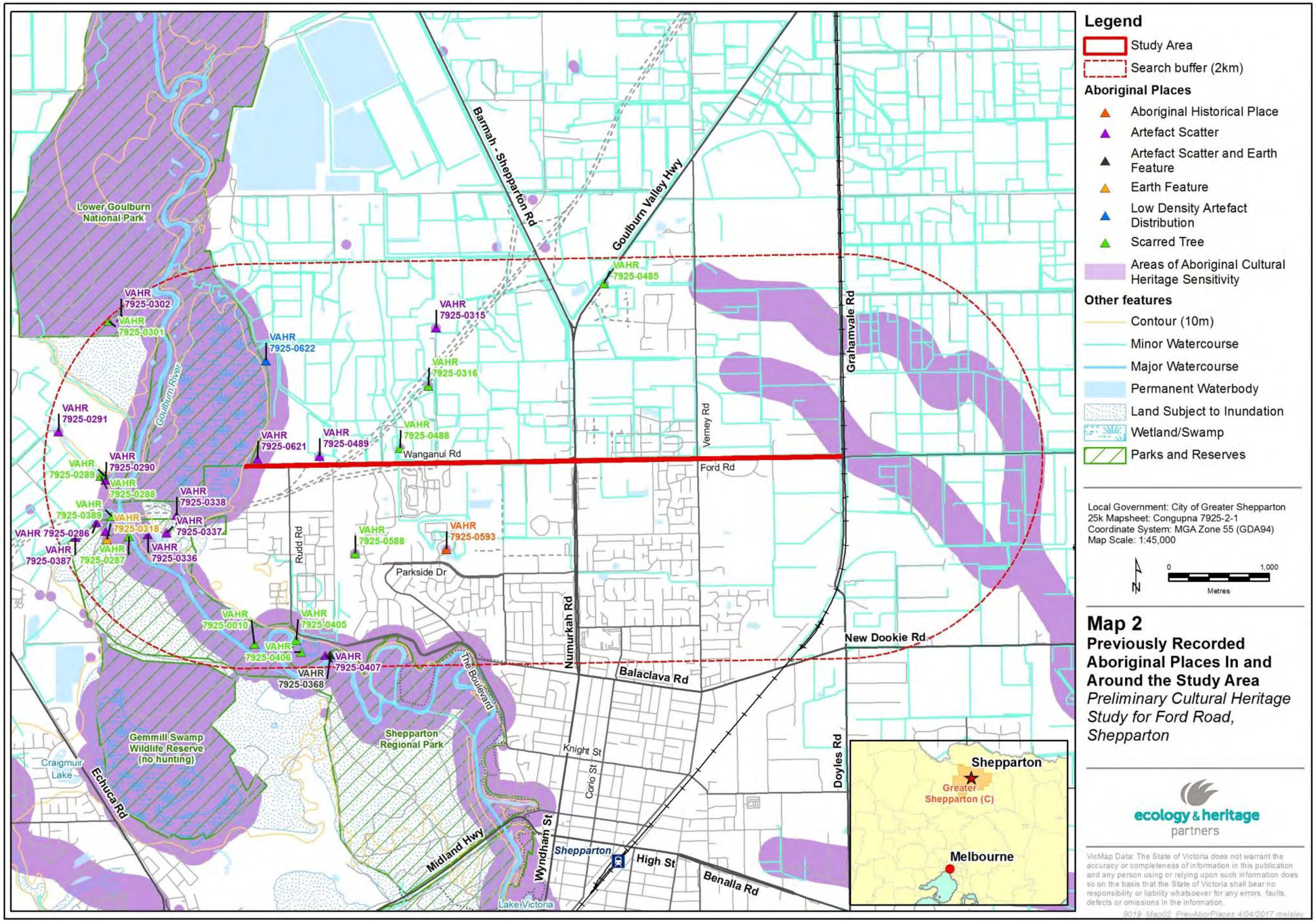


Map 1
Location and Extent of Study Area
Preliminary Cultural Heritage Study for Ford Road, Shepparton



Map 2
Previously Recorded Aboriginal Places In and Around the Study Area
Preliminary Cultural Heritage Study for Ford Road, Shepparton

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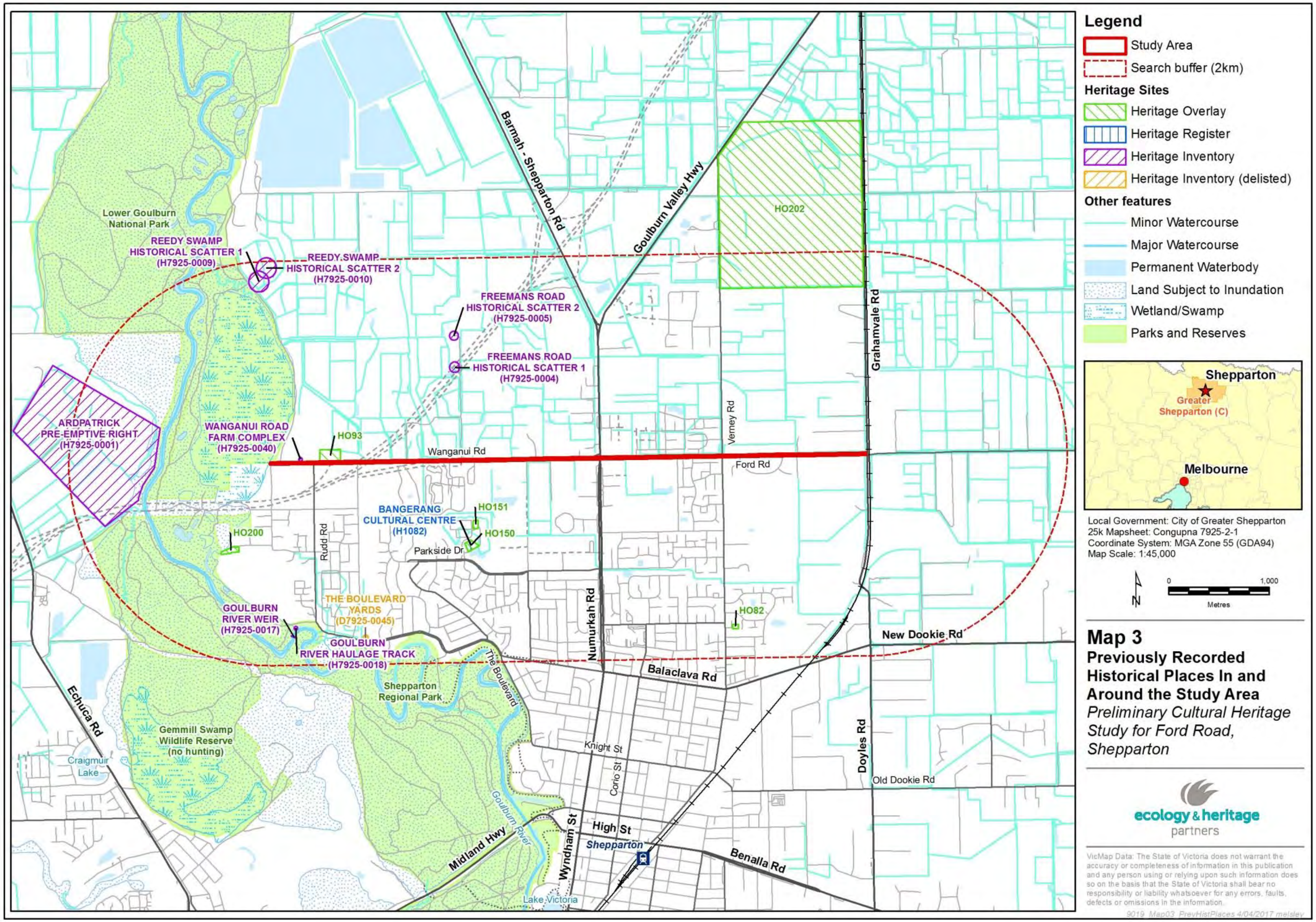

Map 3
Previously Recorded Historical Places In and Around the Study Area
Preliminary Cultural Heritage Study for Ford Road, Shepparton

APPENDICES

Appendix 1: Author Details

Caiti Holzheimer

Caiti is a heritage advisor and archaeologist at Ecology and Heritage Partners Pty Ltd with over two years' experience in Australian archaeology. Caiti completed her archaeology degree with Honours at La Trobe University in 2016. Her thesis focused on historical archaeology, in particular the comparative analysis of two nineteenth-century cesspits in inner-city Melbourne. Additionally, Caiti has assisted on a number of large, inner-city historical excavations in Melbourne as well as Aboriginal excavation across Victoria since 2014. She has contributed to a variety of Aboriginal heritage assessments and excavations, including projects such as windfarms, railways and large area residential and industrial developments. Caiti has authored and co-authored a number of cultural heritage due diligence assessments, desktop assessments, survey and excavation reports including Aboriginal Cultural Heritage Management Plans. She has also established good working relationships with Registered Aboriginal Parties and Traditional Owner groups, as well as regulatory bodies such as Aboriginal Victoria and Heritage Victoria. Her formal qualifications include:

- Bachelor of Archaeology (Honours), La Trobe University (2016).

Appendix 2: Summary of Previously Identified Aboriginal Places within the Search Area.

Table 3: Summary of Previously Identified Aboriginal Places within a 2 km Search Radius

VAHR Place	Component Number	Site Name	Site Type	Within Study Area?
7925-0010	1	SHEPPARTON GOLF CLUB 1	Scarred Tree	No
7925-0286	1	ARDPATRICK 1	Artefact Scatter	No
7925-0287	1	ARDPATRICK 2	Scarred Tree	No
7925-0288	1	ARDPATRICK 3	Scarred Tree	No
7925-0289	1	ARDPATRICK 4	Scarred Tree	No
7925-0290	1	ARDPATRICK 5	Artefact Scatter	No
7925-0291	1	ARDPATRICK 6	Artefact Scatter	No
7925-0301	1	COOMA BEND 5	Scarred Tree	No
7925-0302	1	COOMA BEND 6	Artefact Scatter	No
7925-0315	1	FREEMANS ROAD 1	Artefact Scatter	No
7925-0316	1	FREEMANS ROAD 2	Scarred Tree	No
7925-0318	1	GEMMILLS TRACK 2	Earth Feature	No
7925-0336	1	REEDY SWAMP SOUTH 1	Artefact Scatter	No
7925-0337	1	REEDY SWAMP SOUTH 2	Artefact Scatter	No
7925-0338	1	REEDY SWAMP SOUTH 3	Artefact Scatter	No
7925-0339	1	REEDY SWAMP SOUTH 4	Artefact Scatter	No
7925-0368	1	GOULBURN RIVER-KITTLES ROAD 1	Artefact Scatter	No
	2		Earth Feature	
7925-0387	1	ARDPATRICK 10	Artefact Scatter	No
7925-0388	1	ARDPATRICK 11	Artefact Scatter	No
7925-0389	1	ARDPATRICK 12	Scarred Tree	No
7925-0390	1	ARDPATRICK 13	Artefact Scatter	No
7925-0405	1	THE BOULEVARD 1	Scarred Tree	No
7925-0406	1	THE BOULEVARD 2	Scarred Tree	No

VAHR Place	Component Number	Site Name	Site Type	Within Study Area?
7925-0407	1	THE BOULEVARD 3	Artefact Scatter	No
7925-0485	1	RINGMASTER 1	Scarred Tree	No
7925-0488	1	WANGANUI RD 3	Scarred Tree	No
7925-0489	1	WANGANUI RD 1	Artefact Scatter	No
7925-0588	1	THE BOULEVARD 4	Scarred Tree	No
7925-0593	1	BANGERANG CULTURAL CENTRE	Aboriginal Historical Place	No
7925-0622	1	Reedy Swamp Road Pipeline AS2	Low Density Artefact Distribution	No
7925-0621	1	Reedy Swamp Road Pipeline AS1	Artefact Scatter	No, but within 50 m

Appendix 3: AV Practice Note: Significant Ground Disturbance

Aboriginal Heritage Act 2006 Practice Note: Significant Ground Disturbance

This Practice Note provides guidance about the meaning of **significant ground disturbance** as it relates to requirements to prepare Cultural Heritage Management Plans under the *Aboriginal Heritage Act* 2006*.

The Practice Note covers:

- when a Cultural Heritage Management Plan is required
- why significant ground disturbance should be assessed
- what significant ground disturbance means
- who needs to provide proof
- how to determine significant ground disturbance
- who can determine this
- what is the role of the responsible authority
- how Aboriginal cultural heritage is protected in areas of significant ground disturbance.

Background

The *Aboriginal Heritage Act* 2006 (Act) and Aboriginal Heritage Regulations 2007 (Regulations) provide protection in Victoria for all Aboriginal places, objects and human remains regardless of their inclusion on the Victorian Aboriginal Heritage Register or whether they are located on public or private land.

When is a Cultural Heritage Management Plan required?

A Cultural Heritage Management Plan is required for an activity (i.e. the use or development of land) if the activity:

- is a high impact activity
- falls in whole or in part within an area of cultural heritage sensitivity.

The terms 'high impact activity' and 'cultural heritage sensitivity' are defined in the Regulations.

A Plan must also be prepared when an activity requires an Environmental Effects Statement, or when the Minister for Aboriginal Affairs requires.

High impact activities are categories of activity that are generally regarded as more likely to harm Aboriginal cultural heritage. Most high impact activities provided for in the Regulations are subject to a requirement that the activity results in significant ground disturbance. The term 'significant ground disturbance' is defined in the Regulations.

Areas of cultural heritage sensitivity are landforms and land categories that are generally regarded as more likely to contain Aboriginal cultural heritage. A registered Aboriginal cultural heritage place is also an area of cultural heritage sensitivity.

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Practice note – significant ground disturbance 1

If part of an area of cultural heritage sensitivity (other than a cave) has been subject to significant ground disturbance that part is not an area of cultural heritage sensitivity.

If a Cultural Heritage Management Plan is required for an activity it must be approved before the sponsor can obtain any necessary statutory authorisation for the activity and/or before the activity can start. For more information about Cultural Heritage Management Plans see Aboriginal Affairs Victoria's (AAV) website (www.aboriginalaffairs.vic.gov.au).

Why should significant ground disturbance be assessed?

It is important to assess significant ground disturbance when considering whether a cultural heritage management plan is required because:

- A Cultural Heritage Management Plan does not need to be prepared for a high impact activity if all the area of cultural heritage sensitivity within the activity area has been subject to significant ground disturbance.
- Some types of activity will not be a high impact activity, meaning a Cultural Heritage Management Plan would not need to be prepared, if the activity does not cause significant ground disturbance.

The Regulations specify the landforms and land categories that are areas of cultural heritage sensitivity. Areas of cultural heritage sensitivity are displayed in a series of maps available on AAV's website. The areas delineated on these maps however do not take account of the past history of land use and development that may have caused significant ground disturbance in localised areas.

How is significant ground disturbance defined?

'Significant ground disturbance' is defined in r.4 of the Regulations as meaning disturbance of –

(a) the topsoil or surface rock layer of the ground; or

(b) a waterway –
by machinery in the course of grading, excavating, digging, dredging or deep ripping, but does not include ploughing other than deep ripping.

The words 'disturbance', 'topsoil', 'surface rock layer', 'machinery', 'grading', 'excavating', 'digging', 'dredging', 'ploughing' (other than deep ripping) are not defined in the regulations and therefore have their ordinary meanings.

The Victorian Civil and Administrative Tribunal (VCAT) has determined that the words "topsoil or surface rock layer" include the former topsoil or former surface rock layer if that topsoil or surface rock layer is a naturally occurring surface level that is readily ascertainable and does not include the current topsoil or current surface rock layer if established by the mere filling of the land.

Ploughing (other than deep ripping) to any depth is not significant ground disturbance. Deep ripping is defined in the regulations to mean 'ploughing of soil using a ripper or subsoil cultivation tool to a depth of 60 centimetres or more'. None of the words used in this definition are defined, and therefore have their ordinary meanings. VCAT has determined that a ripper or subsoil cultivation tool must be distinguished from conventional ploughs or topsoil cultivation tools such as disc ploughs or rotary hoes which are not sufficient to show significant ground disturbance.

Deep ripping will result in significant ground disturbance regardless of the degree of disturbance caused to the topsoil or surface rock layer of the ground.

Who needs to provide proof that land has been subject to significant ground disturbance?

The burden of proving that an area has been subject to significant ground disturbance rests with the applicant for a statutory authorisation for the activity (or the sponsor of the activity). The responsible authority may assist by providing the applicant access to any relevant records it has about past land use and development.

How can a sponsor determine whether significant ground disturbance has occurred?

The responsible authority should require evidence of support for claims that there has been significant ground disturbance of an area. The levels of inquiry outlined below provide some guidance about what information should be required to satisfy a responsible authority (depending on the circumstances of each case) that significant ground disturbance has occurred. The levels of inquiry are listed in order of the level of detail that may be required. An assessment of whether significant ground disturbance has occurred should be dealt with at the lowest possible level in order to avoid unnecessary delay or cost to applicants.

Little weight should be given to mere assertions by applicants or land owners that an activity area has been subject to significant ground disturbance.

Level 1 – Common knowledge

The fact that land has been subject to significant ground disturbance may be common knowledge. Very little or no additional information should be required from the responsible authority.

For example, common knowledge about the redevelopment of a petrol station with extensive underground storage tanks.

Level 2 – Publicly available records

If the existence of significant ground disturbance is not common knowledge, a responsible authority may be able to provide assistance from its own records about prior development and use of land, or advise the applicant about other publicly available records, including aerial photographs.

These documents may allow a reasonable inference to be made that the land has been subject to significant ground disturbance. In such event, no further inquiries or information would be needed by the responsible authority. The particular records and facts relied upon should be noted by the responsible authority as a matter of record.

For example, a former quarry site subsequently filled, but where the public records show the area of past excavation.

Level 3 – Further information

If 'common knowledge' or 'publicly available records' do not provide sufficient information about the occurrence of significant ground disturbance, the applicant may need to present further evidence either voluntarily or following a formal request from the responsible authority. Further evidence could consist of land use history documents, old maps or photographs of the land or statements by former landowners or occupiers. Statements should be provided by statutory declaration or similar means.

For example, the construction of a former dam on a farm.

Level 4 – Expert advice or opinion

If these levels of inquiry do not provide sufficient evidence of significant ground disturbance (or as an alternative to level 3), the applicant may submit or be asked to submit a professional report with expert advice or opinion from a person with appropriate skills and experience. Depending on the circumstances, this may involve a site inspection and/or a review of primary documents. If there is sufficient uncertainty some preliminary sub-surface excavation or geotechnical investigation may be warranted.

An expert report should comply with VCAT's practice note on expert evidence.

The responsible authority must be reasonably satisfied that the standard of proof presented by the applicant shows that all of the land in question has been subject to significant ground disturbance.

A level 1 or 2 inquiry will commonly provide sufficient information as to whether or not the activity area has been subject to significant ground disturbance, and a level 3 or 4 inquiry should not be required as a matter of course.

There will be cases when the responsible authority is simply not persuaded or where there remains genuine doubt about significance ground disturbance regardless of the level of inquiry. In these circumstances the default position is that a Cultural Heritage Management Plan is required. This is in line with the purpose of the Act and Regulations to provide for the protection of Aboriginal cultural heritage in Victoria.

Who can provide expert advice about significant ground disturbance?

A person needs to have expertise to decide, based upon an inspection of the land or interpreting primary documents, whether the land has been subject to significant ground disturbance.

A cultural heritage advisor may not necessarily have this expertise. Under section 189 of the Act, an advisor must have a qualification directly relevant to the management of Aboriginal cultural heritage such as 'anthropology, archaeology or history' or have extensive experience or knowledge in relation to the management of heritage. An advisor appropriately qualified in archaeology may be able to assist where excavation is required to determine significant ground disturbance.

Other experts such as a land surveyor, geomorphologist or civil engineer could also have the necessary expertise (depending on the circumstances). For example, a civil engineer should have the qualifications and experience to determine the extent of previous engineering works along a watercourse or road, and therefore the extent of significant ground disturbance.

What is the role of the responsible authority?

The responsible authority determines whether a Cultural Heritage Management Plan is required for an activity. It may require the applicant to provide information to satisfy it that an area has been subject to significant ground disturbance.

Evaluating information relating to the occurrence of significant ground disturbance may be critical in deciding whether a Cultural Heritage Management Plan is required and therefore whether a statutory authorisation can be granted. This question should be resolved at an early stage in planning a proposed development. Applicants for statutory authorisations and the responsible authority should therefore seek to agree at an early stage about whether a Cultural Heritage Management Plan is required. In the event of a dispute this can be brought without delay to VCAT for resolution. The responsible authority should take care to document the steps taken in each case.

What if Aboriginal cultural heritage is discovered in an area determined to have been subject to significant ground disturbance?

It is possible that there are Aboriginal cultural heritage places, objects or human remains within areas determined to no longer be areas of cultural heritage sensitivity due to significant ground disturbance. It is also possible that Aboriginal cultural heritage could be harmed by activities which do not amount to high impact activities.

These Aboriginal places are still protected under the Act. In particular, it is an offence under sections 27 and 28 of the Act to harm Aboriginal cultural heritage unless acting in accordance with a Cultural Heritage Permit or approved Cultural Heritage Management Plan (regardless of whether a Plan was required).

** This Practice Note is based on VCAT's determination about significant ground disturbance. For further details see VCAT, Reference No. P1020/2008 – Mainstay Australia vs Mornington Peninsula SC and Reference No. P1204/2010 – Colquhouns & Ors vs Yarra SC.*

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E.3 Appendix E3: Acoustic Noise Impact Assessment

WatsonMossGrowcott Acoustics

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SHEPPARTON BYPASS LINK STAGE ONE

SHEPPARTON NORTH

Consideration of Traffic Noise Level Changes at Existing Residential Dwellings Due to Changes in Road Configuration

Prepared for:

Greater Shepparton City Council
90 Welsford Street
Shepparton
Victoria 3630

Ref. 12089-1ng DRAFT.docx
30 January 2018

TABLE OF CONTENTS

1. INTRODUCTION

It is proposed to construct a new road known as the Shepparton Bypass Link.

The proposed road will diverge from the Goulbourn Valley Highway at a location south of Kialla West and traverse lands to the west of Shepparton and Mooroopna, before re-joining the Goulbourn Valley Highway to the north of Congupna.

The proposed road is to be built in stages. Stage One will connect the Midland Highway west of Mooroopna to Wanganui Road north of Shepparton.

At the completion of the stage one road construction, it is expected that significant increases in traffic will occur along Wanganui Road, with more modest increases along Ford Road.

In response to concerns regarding the expected increase in traffic, Watson Moss Growcott has been to engaged to conduct an assessment of likely changes in traffic noise level associated with the proposed Shepparton Bypass Link, Stage One. The assessment has included the following:

1. Two attended site visits during which the attending engineer carried out handheld traffic noise level measurements;
2. Analysis of four unattended noise logging devices deployed at representative locations along Wanganui and Ford Roads;
3. Review of traffic counts carried out (by others) concurrently with the noise logging and predicted traffic flows as result of the construction of Shepparton Bypass Link Stage One; and
4. Traffic noise modelling in accordance with 'Calculation of Road Traffic Noise' – Department of Transport Welsh Office (CoRTN) and the VicRoads Requirements of Developers.

This report sets out the results and findings of the assessment.

2. SITE AND ENVIRONS

The assessment has been carried out along Wanganui Road and Ford Road, Shepparton, from near Rudd Road where Stage 1 of the Shepparton Bypass Link is proposed to meet Wanganui Rd in the west to Grahamvale Road in the east.

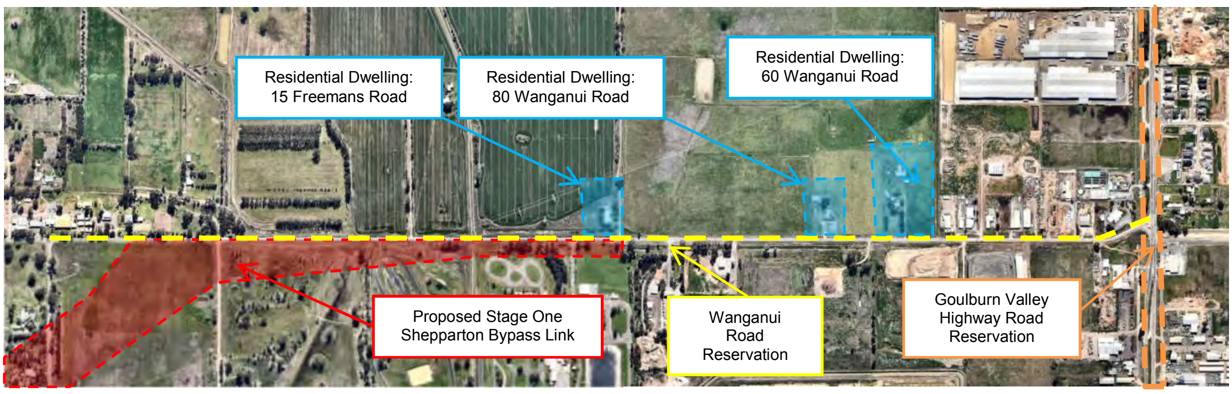
A map showing the proposed bypass is included at Appendix 1.

Wanganui Road is located between Golf Drive in the west and the Goulburn Valley Highway in the east. It is currently surrounded primarily by farming land with some commercial uses particularly at the east end near the Goulburn Valley Highway. Three residential dwellings are located on the north side of the road.

Ford road connects the Goulburn Valley Highway in the west to Grahamvale Road in the east. The road is surrounded by a mixture of residential dwellings and farming areas. It is noted that additional residential dwellings are proposed and/or currently under construction in the area in the vicinity of Ford Road. Commercial use was identified near the Goulburn Valley Highway and Verney Road.

The subject site and surrounding area is located on flat land.

An aerial photo identifying the relevant components within the vicinity of Wanganui Road Reservation appears below:



An aerial photo identifying the relevant components within the vicinity of Ford Road Reservation appears below:

3. NOISE ASSESSMENT METHODOLOGY

3.1 Noise Assessment Terminology

The following terms are used in this report:

dB(A) Decibels recorded on a sound level meter, which has had its frequency response modified electronically to an international standard, to quantify the average human loudness response to sounds of different character.

L_{90} the level exceeded for 90% of the measurement period, which is representative of the typical lower levels in a varying noise environment. It is the noise measure defined by the EPA as the measure of the background noise level to use in determining noise limits.

L_{eq} the equivalent continuous level that would have the same total acoustic energy over the measurement period as the actual varying noise level under consideration. It is the noise measure defined by the EPA as the measure of the noise to use in assessing compliance with noise limits.

L_{10} Commonly described as the average of the higher levels of a range of noise levels. It is the value of a range of values exceeded for 10% of the observation period, *i.e.* the level exceeded for 6 minutes for every 60 minutes of observation.

$L_{10,18hr}$ The $L_{10,18hour}$ noise level is the arithmetic average of the hourly L10 noise levels measured between 6:00am and midnight.

3.2 Noise Measurement Equipment

As part of the assessment, Watson Moss Growcott has carried out attended site measurements, as well as unattended noise logging within the boundaries of the subject site.

Noise measurements at the subject site were conducted using the following equipment:

Table 1: Noise Measuring Equipment

Equipment Designation	Use of Equipment
Rion NA27 Precision Sound Level Meter	Handheld Noise Measurements
Ngara Real Time Sound Acquisition System	Unattended Noise Logging Measurements

The field calibration of the measurement equipment was checked before and after the site measurements, and was within the correct calibration range.

3.3 Traffic Noise Modelling in Relation to Future Traffic Noise Levels

Calculation of future traffic noise levels has been conducted using the procedures set out in *Calculation of Road Traffic Noise* (CoRTN), Department of Transport (Welsh Office) 1988, as implemented in the software package Prediction of Environmental Noise (PEN) 3D.

4. TRAFFIC NOISE CONSIDERATIONS INCLUDING VICROADS TRAFFIC POLICY

The traffic noise assessment has given consideration to the VicRoads Traffic Noise Policy 2005.

The policy includes the following guidelines with regards to limiting noise next to new or improved roads:

> *Where arterial roads and freeways are built on new alignments, or where existing arterial roads or freeways are widened by two or more lanes and buildings previously protected from traffic noise are exposed by removal of buildings required for widening, the traffic noise level will be limited to the objectives set out below or the level that would have prevailed if the road improvements had not occurred, whichever is the greater.*
>
> - ***Category A**: - For residential dwellings, aged persons homes, hospitals, motels, caravan parks and other buildings of a residential nature, the noise level objective will be **63 dB(A) L_{10} (18hr)** measured between 6 am and midnight,*
> - ***Category B**: - For schools, kindergartens libraries and other noise-sensitive community buildings the noise level objective will be **63 dB(A)L_{10} (12hr)** measured between 6 am and 6 pm,*
> - *Where the noise level adjacent to **Category A or B** buildings prior to road improvements is less than **50 dB(A)L_{10} (18hr)**, consideration will be given to limiting the noise level increase to **12 dB(A).***

The proposed changes to Wanganui Rd and Ford Rd as part of Stage 1 of the Shepparton Bypass do not trigger the objectives above, as the road changes do not involve building a road on a new alignment and the changes to the existing roads do not involve removal of buildings required for widening that would expose buildings previously protected from traffic noise to the traffic stream.

The VicRoads Traffic Noise Policy noise objectives can be used to provide a context for increased traffic noise levels associated with the project.

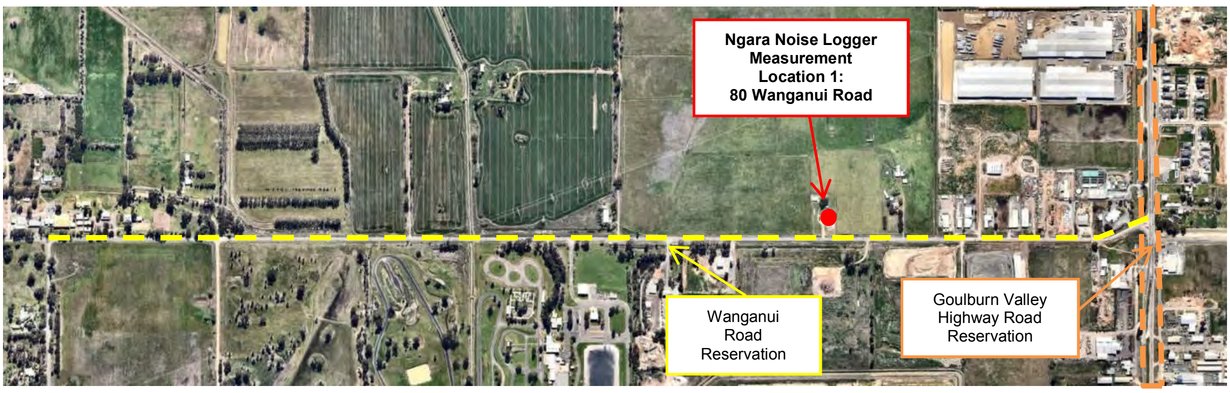
Consideration can also be given to traffic noise level increases based on the following generally accepted subjective responses to increases in noise level:
- An increase of 1-2 decibels is commonly not perceptible.
- An increase of 3 decibels is commonly perceived as a ‘just noticeable difference’.
- An increase of 5 decibels is commonly perceived as a ‘clearly noticeable difference’.
- An increase of 10 decibels is commonly perceived as a doubling of loudness.

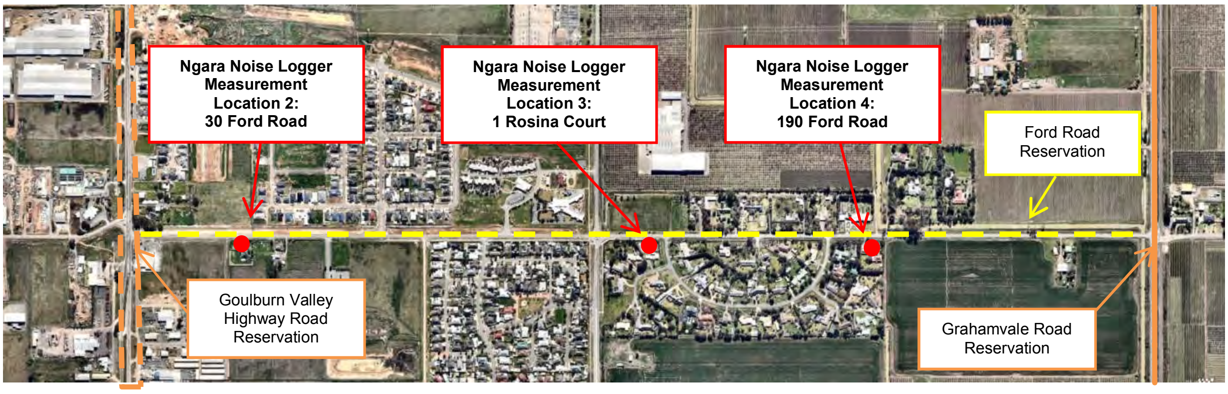
5. TRAFFIC NOISE MEASUREMENTS AND NOISE LOGGING

As part of the assessment, Watson Moss Growcott has carried out attended hand held noise measurements, and unattended noise logging at the subject site. The attended and unattended noise measurements were carried out during the following times:

1. Site attended noise survey including hand held noise level measurements between 2:00pm and 4:00pm on Thursday 10th August 2017;
2. A total of four unattended noise loggers were deployed at the residential premises along the relevant roads during the period Thursday 10th August until Tuesday 15th August 2017.

A mark-up of the assessment locations is attached below:





A summary of the measurement locations and noise measurement equipment is set out below.

Table 2: Noise Monitoring Details

Noise Measurement Location	Latitude and Longitude of Microphone Position	Noise Logging Device
Measurement Location 1 80 Wanganui Road (front of dwelling)	Latitude: 36° 20' 49.6" S Longitude: 145° 23' 34.6" E	ARL Ngara Environmental Noise Logger
Measurement Location 2 38 Ford Road (middle of front yard, representative of the setback of the house at 50 Ford Rd from the road)	Latitude: 36° 20' 52.1" S Longitude: 145° 24' 20.1" E	ARL Ngara Environmental Noise Logger
Measurement Location 3 1 Rosina Court (middle of rear yard)	Latitude: 36° 20' 52.4" S Longitude: 145° 25' 2.6" E	ARL Ngara Environmental Noise Logger
Measurement Location 4 190 Ford Road (front of dwelling)	Latitude: 36° 20' 52.1" S Longitude: 145° 25' 25.6" E	ARL Ngara Environmental Noise Logger

The locations were selected as locations on the subject site which receive representative exposure to noise associated with vehicle movements along the Wanganui Road and Ford Road, road reservations.

5.1 Weather Conditions During Unattended Noise Monitoring

Unattended noise logging was carried out at the site in the period Thursday 10th August until Tuesday 15th August 2017.

VicRoads traffic noise measurement guidelines for acoustic consultants require that a minimum of three days are recorded as part of any noise measurement assessment.

In addition, the document indicates that wind speeds during noise level measurements 'shall not exceed 3 m/s for any significant period/s during the conduct of the measurements'.

In practice, satisfying each of these requests is challenging.

In previous projects including the involvement of VicRoads, breeze conditions with marginally higher speeds have been accepted provided that the breeze is blowing from the relevant road reservation in the direction of the subject site.

Further to the above, VicRoads have been accepting of fewer than three days of noise logging provided that the measurement days are relatively consistent.

For the purposes of this assessment, Watson Moss Growcott has used the noise measurements obtained for Monday 14th August. This period was selected as exact traffic counts were available to correlate with the noise measurements.

During this day, the wind speeds were typically in the range 0.0-6.1 m/s. The upper end of this range is slightly above typical targets, however due to the close proximity of the road to the unattended noise logging devices and the fact the wind speeds were highest during the times of traffic peaks and calm during time of low traffic, these weather conditions are considered suitable for traffic noise analysis.

Based on consideration of the above, a summary of the weather conditions at Shepparton during the assessed day considered suitable for traffic noise analysis is set out below:

Table 3: Weather conditions on Monday 14 August 2017

Date	Time	Wind Speeds (m/s)	Direction of Wind
Monday 14th August 2017	9:00am	4.7	NE
	3:00pm	3.6	N

5.2 Measurement Data Recorded as Part of Unattended Noise Logging

The measured noise levels at logging location one were dominated by noise associated with vehicle movements along Wanganui Road. The measured noise levels at logging locations two to four inclusive were dominated by vehicle movements along Ford Road.

At locations one and four, the noise logger was located within close proximity of the external wall of the residential dwelling which causes what is referred to as façade build up, compared with locations two and three where the logger was located in a free field environment.

VicRoads methodology requires that a façade reflection adjustment of 2.5 dB(A) is applied to measurements which are measured in a free field environment, to account for the increase of measured noise level in close proximity to acoustically reflective surfaces.

The table below set outs the measured $L_{10,18\ hour}$ results for the four location over the four full days of noise monitoring:

Table 4: Measured Traffic Noise Levels dB(A) $L_{10,18hour}$ over noise logging period August 2017

Date	Measurement Location			
	80 Wanganui Road*	38 Ford Road	1 Rosina Court	190 Ford Road*
Friday 11	52.6	60.9	52.0	55.4
Saturday 12	52.0	59.3	50.0	52.7
Sunday 13	49.4	57.7	49.3	54.3
Monday 14	52.6	59.1	51.4	56.5

* Measurement result includes façade reflection adjustment of 2.5 dB(A)

These results fit the commonly observed pattern that weekend traffic noise levels are lower than those on weekdays.

The following summarised data has been attached in Appendix One:

1. Measured Hourly dB(A) L_{eq} and dB(A) L_{10} values;
2. Measured dB(A) $L_{10\ 18\ Hour}$ (Arithmetic Average 6am to Midnight);
3. Measured dB(A) $L_{eq\ 15\ Hour}$ (Logarithmic Average 7am to 10pm);
4. Measured dB(A) $L_{eq\ 16\ Hour}$ (Logarithmic Average 6am to 10pm)
5. Measured dB(A) $L_{eq\ 9\ Hour}$ (Logarithmic Average 10pm to 7am)
6. Measured dB(A) $L_{eq\ 8\ Hour}$ (Logarithmic Average 10pm to 6am)

6. ROAD TRAFFIC NOISE PREDICTIONS

As per VicRoads requirements, traffic predictions have been carried out using procedures described in Calculation of Road Traffic Noise- Department of Transport Welsh office (CoRTN)

6.1 TRAFFIC NOISE MODELLING

Watson Moss Growcott has considered the following inputs:

1. Measured Traffic flow volumes (vehicles per 18-hours);
2. Measured Proportion of heavy vehicles;
3. Measured Traffic speeds;
4. Measured Noise levels;
5. Predicted future traffic flow volumes (vehicles per 18-hours);
6. Predicted future proportion of heavy vehicles;
7. No allowance has been made for changes in road surface type;
8. No allowance has been made for changes in road traffic speed.

Information regarding the traffic flow volumes, proportion of heavy vehicles, traffic speeds, both measured and predicted has been provided by the client.

A summary of the measured traffic results for Monday 14th August 2017 is presented in the table below.

Table 5: Measured Traffic Noise Levels dB(A) $L_{10,18hour}$ and Traffic Volume on Monday 14th August 2017

Measurement Location	80 Wanganui Road	38 Ford Road	1 Rosina Court	190 Ford Road
Measured Traffic Volume 18h	1644	3446	2653	2621
Measured Traffic Speed Mean km/h	71.8	60.7	61.9	62.0
Measured Proportion Heavy Vehicles %	6.1	8.1	9.3	8.2
Measured Noise Level $L_{10,\ 18h}$	53	62*	54*	57

*includes façade reflection adjustment as per VicRoads measurement methodology.

6.2 FUTURE TRAFFIC NOISE LEVEL PREDICTIONS

No information has been provided with regards to current or future road surface conditions at the subject site, therefore the initial traffic noise modelling has been based on the existing conditions.

The existing road surface appears to be a significantly worn stone seal with the stones protruding little above the surface for much of the route under consideration. With this degree of wear the road surface is expected to be similar to dense graded asphalt in terms of traffic noise generation, which is consistent with the comparison of calculated and measured levels.

Increased traffic noise levels at residential premises along Wanganui and Ford Roads will be influenced most significantly by the traffic flow increases and the proportion of heavy vehicle travelling along the Wanganui Road and Ford Road reservations.

The proposed road alignment drawings, attached as an Appendix, indicate that the east-bound lanes will move to the north. This will tend to moderate traffic noise increases at residential locations on the southern side of the road and accentuate traffic noise increases at residential locations on the northern side of the road.

A summary of the predicted traffic flow conditions used for 2031 and the resulting predicted traffic noise levels for the locations at which noise monitoring was conducted are presented in the table below.

Table 6: Predicted Traffic Noise Levels dB(A) $L_{10,18hour}$ in 2031

Measurement Location	80 Wanganui Road	38 Ford Road	1 Rosina Court	190 Ford Road
Predicted Traffic Volume 18h	10,800	5,400	3,700	3,700
Predicted Traffic Speed Mean km/h	80	60	60	60
Predicted Proportion Heavy Vehicles %	12.0	13.0	18.9	18.9
Predicted Noise Level $L_{10,\ 18h}$*	65	62	56	60

*includes façade reflection adjustment as per VicRoads methodology.

Based on consideration of the predicted traffic flow parameters for 2031 and measured 2017 traffic flow parameters and noise levels, the predicted noise levels along the relevant road sections in the absence of noise shielding barriers will be up to 65 dB(A) $L_{10,18hr}$.

A summary of the predicted traffic flow conditions used for 2041 and the resulting predicted traffic noise levels are presented in the table below.

Table 7: Predicted Traffic Noise Levels dB(A) $L_{10,18hour}$ in 2041

Measurement Location	80 Wanganui Road	38 Ford Road	1 Rosina Court	190 Ford Road
Predicted Traffic Volume 18h	12,500	7,100	4,700	4,700
Predicted Traffic Speed Mean km/h	80	60	60	60
Predicted Proportion Heavy Vehicles %	12.0	11.3	14.9	14.9
Predicted Noise Level $L_{10,\ 18h}$*	65	63	57	61

*includes façade reflection adjustment as per VicRoads methodology.

Traffic noise modelling has also been conducted in order to reach conclusions regarding traffic noise increases at houses along the Wanganui Rd/Ford Rd route other than those at which noise monitoring was conducted.

The Ford Rd section benefits from the 60 km/h speed limit and relatively low traffic volumes compared with Wanganui Rd, and based on a road surface no noisier than what appears to be a worn stone seal at present the modelling results for 2031 and 2041 remain below the 63 dB(A) L_{10} (18 hour) VicRoads Traffic Noise Policy target without any noise barriers.

Based on a comparison of the existing measured levels and modelled future levels, traffic noise level increases in the range 3-5 dB(A) would be expected.

Changing to a fresh stone seal would likely increase noise levels by at least 2 dB(A). This would be enough to push some locations above 63 dB(A) L_{10} (18 hour), but the majority would remain below 63. A dense graded asphalt road surface would be expected to achieve similar noise generation characteristics as the existing worn stone seal and similar to the noise modelling basis.

15 Freemans Rd and 80 Wanganui Rd have predicted future noise levels of 65-66 dB(A) L_{10} (18 hour). 60 Wanganui Rd is sufficiently further removed from Wanganui Rd that it would not be above 63 dB(A) L_{10} (18 hour).

The predicted increase in traffic noise level at 80 Wanganui Rd is 12 dB(A) compared with the existing measured level. This is a significant increase, due to both the significant increase in traffic volume and movement of the nearest traffic lanes closer to the house. This magnitude of noise level increase is approximately equivalent to a perceived doubling of loudness.

Future traffic noise levels could be kept at or close to 63 dB(A) at 15 Freemans Rd and 80 Wanganui Rd by the use of an open graded asphalt road surface without adding noise barriers.

Noise barriers would be problematic at 80 Wanganui Rd as access to the property is directly from Wanganui Rd. Any noise barriers would require gaps, which would reduce effectiveness but would still provide a noise reduction.

Extending the 60 km/h zone to the west of 80 Wanganui would reduce the traffic noise level at 80 Wanganui Rd, but only by a small margin.

Adoption of an open graded asphalt road surface would reduce the modelled noise levels by about 2 dB(A) at all locations within the extent of application of the open graded asphalt surface.

7. NOISE CONTROL OPTIONS FOR CONSIDERATION

The results for the Ford Rd section of the project, both in terms of the absolute level compared with the VicRoads Traffic Noise Policy objectives, and in terms of the relative change compared with existing conditions, indicate no need for consideration of noise control measures.

Houses along Wanganui Rd have been predicted to have traffic noise levels following the implementation of Stage 1 higher than the VicRoads Policy target and approximately twice as loud in subjective terms as the existing level. The specific conditions of the VicRoads Policy requiring implementation of noise control are not met by the project, so provision of noise control remains an option for consideration, not an obligation.

An option that would mitigate noise level increases wherever it is applied along the project, without any visual implications, would be a low noise open graded asphalt road surface. VicRoads information indicates this to be 2 dB(A) lower in noise level than dense graded asphalt.

There is a likelihood that the significance of low-noise road surfaces will become more significant over time as engine and exhaust noise levels of vehicles reduce.

Future traffic noise levels could be kept at or close to 63 dB(A) at 15 Freemans Rd and 80 Wanganui Rd by the use of an open graded asphalt road surface without adding noise barriers.

Noise barriers have the potential to provide the greatest noise reductions, but have visual and other implications.

Noise barriers would be problematic at 80 Wanganui Rd as access to the property is directly from Wanganui Rd. Any noise barriers would require gaps, which would reduce effectiveness but would still provide a noise reduction.

Extending the 60 km/h zone to the west of 80 Wanganui would reduce the traffic noise level at 80 Wanganui Rd, but only by a small margin.

8. OVERVIEW

Existing traffic noise levels have been measured at four locations along Wanganui and Ford Roads, which are expected to carry additional traffic as part of Stage 1 of the proposed Shepparton Bypass Link.

Noise modelling has been used to predict likely future noise levels following implementation of Stage 1 of the proposed bypass link.

The most significant factor contributing to increases in traffic noise level associated with Stage 1 is the expected increase in traffic volume, with a secondary factor being relocation of the east-bound traffic lanes further to the north than at present.

Ford Rd is expected to have a relatively small increase in traffic associated with Stage 1, and the increase in traffic noise levels is expected to be small. In decibel terms this is expected to be 3-5 dB(A), which translates to a ‘just detectable’ to ‘clearly detectable’ change in human perception terms.

The VicRoads Traffic Noise Policy Target Levels are not strictly speaking applicable to this project, but nevertheless the future predicted traffic noise levels along Ford Rd have been calculated to remain below the targets.

There are three houses along the Wanganui Rd section of the project that will be exposed to significantly greater increases in traffic volume and, being located on the northern side of the road, will be closer to the nearest traffic lanes under the proposed plans.

Consequently, calculated traffic noise level increases are higher along this section of road than Ford Rd. At the two houses nearest to the road in this section, traffic noise levels have been calculated to increase by more than 10 decibels, which translates to an approximate doubling of perceived loudness. In absolute terms, the calculated future levels are 2-3 dB(A) above the (strictly not applicable) VicRoads Traffic Noise Policy target level.

Adoption of a low-noise open graded asphalt road surface would reduce resultant noise levels by approximately 2 dB(A) compared with the base case, equivalent to dense graded asphalt or worn stone seal.

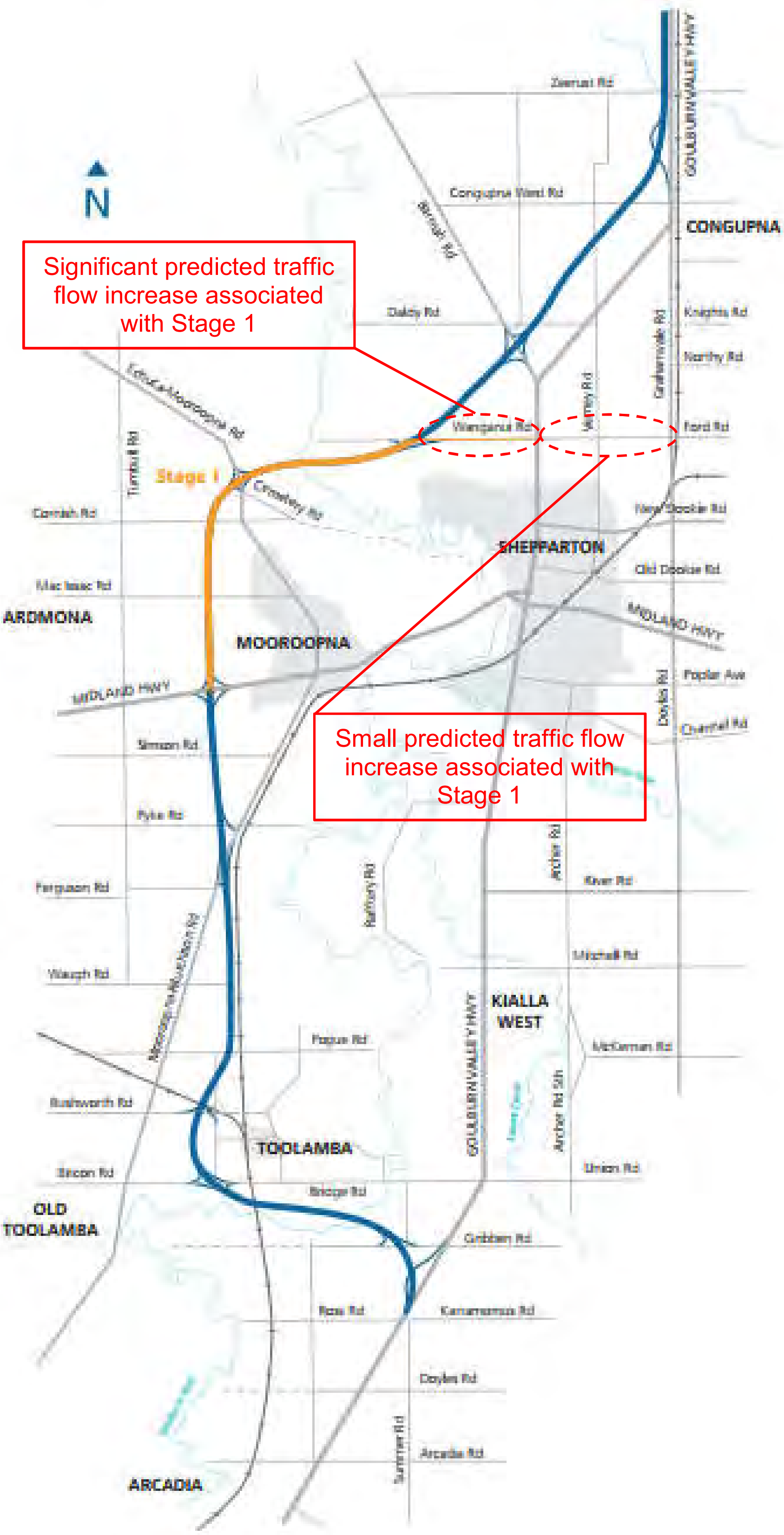
Construction of the Stage 1 bypass using a new stone seal would result in noise levels 2-5 dB(A) higher than discussed above.

Consideration could be given to the use of noise barriers to reduce the magnitude of the calculated noise level increases at houses along Wanganui Rd, but effectiveness would be limited by the need for direct access to Wanganui Rd from two out or the three houses.

<u>NEVILLE GODDARD</u>
WATSON MOSS GROWCOTT
Acoustics Pty Ltd

APPENDICES

1. Map of Proposed Shepparton Bypass Link

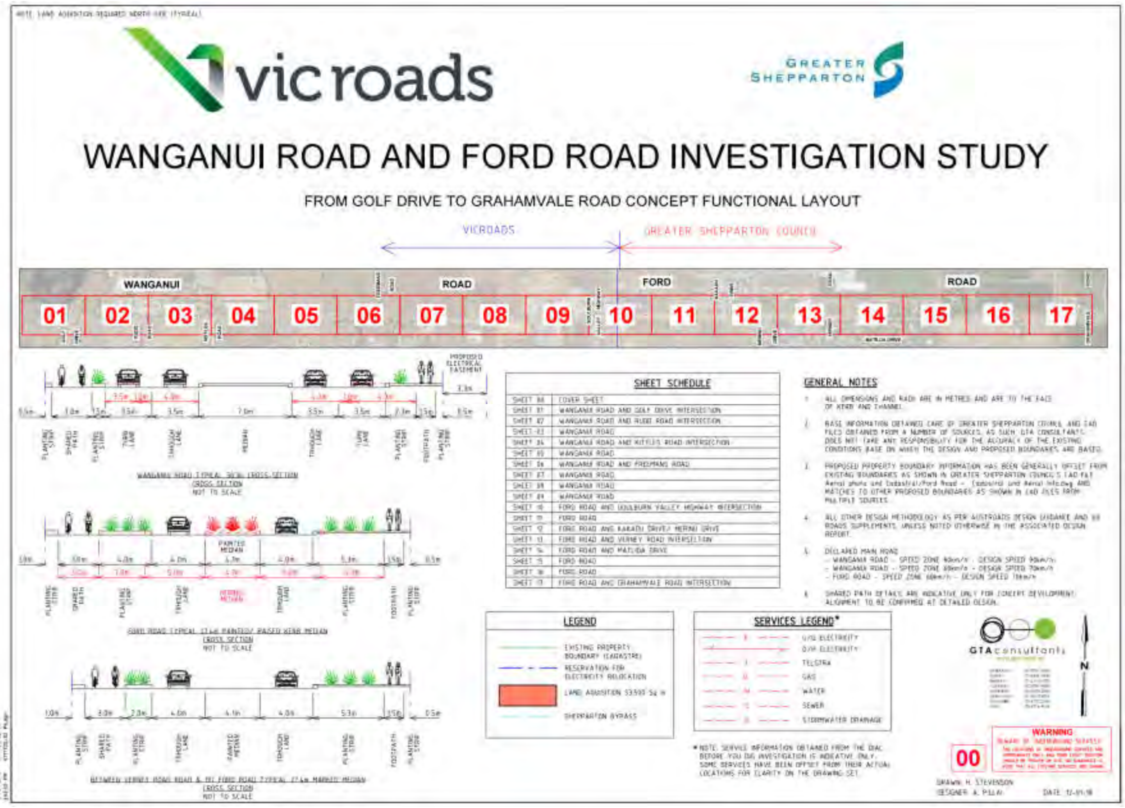


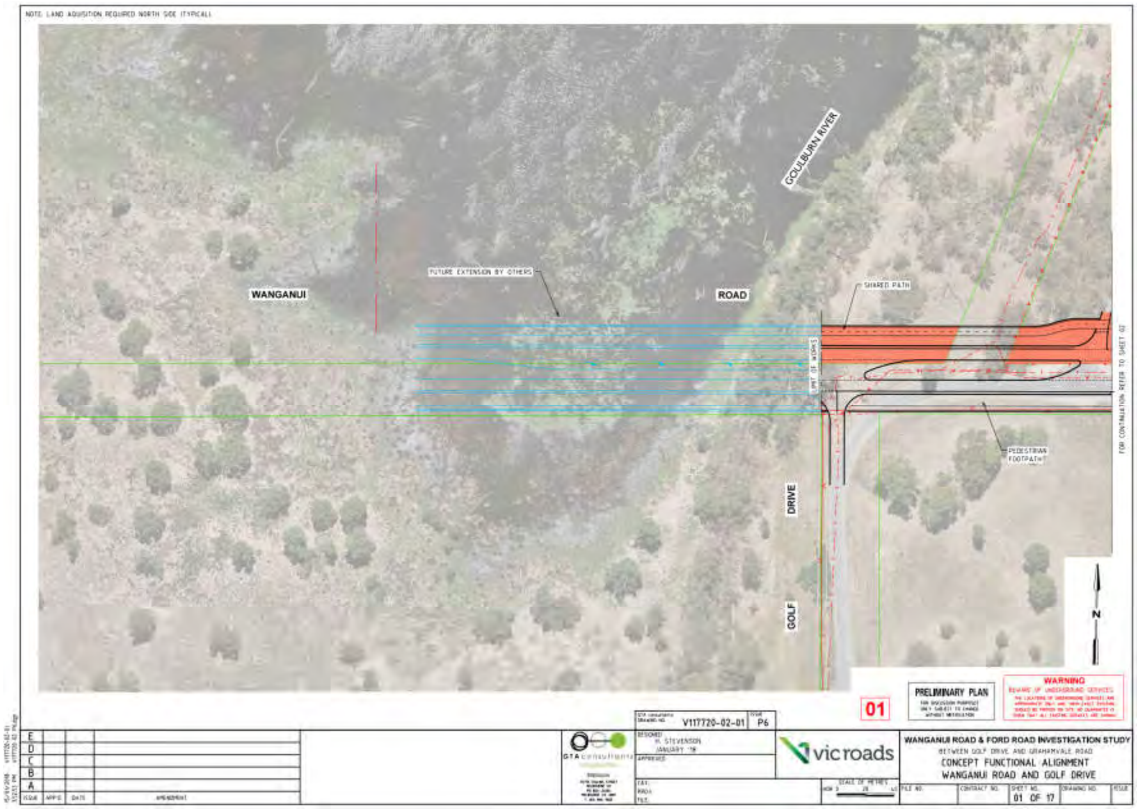
2. SUMMARY OF NOISE LEVEL DATA RECORDED BY UNATTENDED NOISE LOGGERS

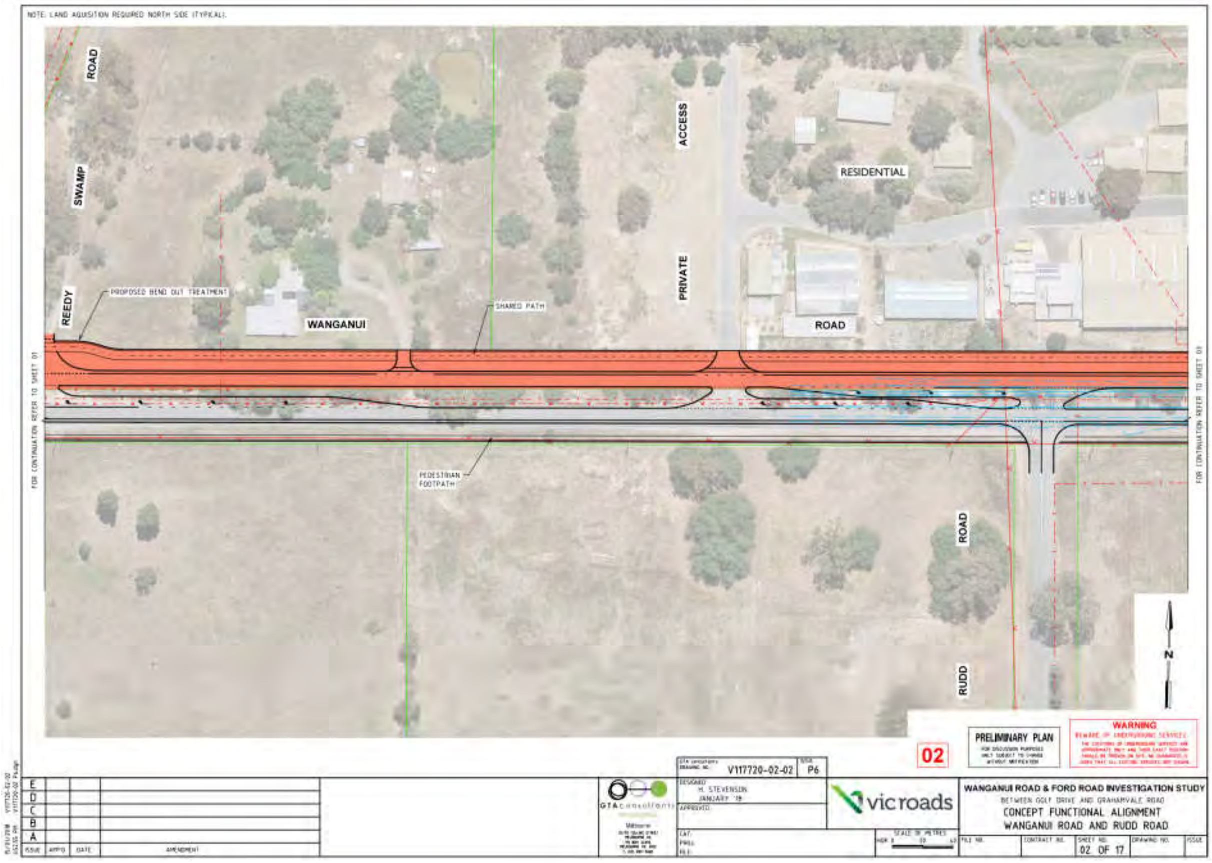
Monday 14th August 2017 Time Period	Measurement Location 1: 80 Wanganui Road		Measurement Location 2: 38 Ford Road		Measurement Location 3: 1 Rosina Court		Measurement Location 4: 190 Ford Road	
	Measured Noise Level							
	dB(A) L_{10}	dB(A) L_{eq}	dB(A) L_{10}	dB(A) L_{eq}	dB(A) L_{10}	dB(A) L_{eq}	dB(A) L_{10}	dB(A) L_{eq}
00:00 – 01:00	36.3	40.3	40.6	43.7	37.8	38.2	40.6	44.1
01:00 – 02:00	35.4	38.3	39.0	39.7	37.3	36.8	40.2	42.0
02:00 – 03:00	35.2	37.3	39.5	47.6	40.6	44.0	45.3	50.3
03:00 – 04:00	37.3	37.3	44.8	54.7	40.6	49.3	42.5	52.1
04:00 – 05:00	40.2	44.7	44.8	47.4	41.6	46.7	44.5	49.5
05:00 – 06:00	44.8	48.4	52.4	53.6	46.6	45.9	51.0	52.4
06:00 – 07:00	50.6	51.5	58.1	56.9	52.6	50.7	57.9	56.5
07:00 – 08:00	57.6	55.8	62.9	59.7	54.1	52.1	61.3	58.5
08:00 – 09:00	56.0	50.3	63.6	60.2	55.8	53.5	62.2	59.8
09:00 – 10:00	55.4	53.3	62.1	59.2	54.5	52.7	60.0	57.2
10:00 – 11:00	52.9	50.2	61.1*	59.2*	51.9	50.7	57.8	55.1
11:00 – 12:00	51.9	52.1	60.6*	58.5*	52.1	51.2	56.9	55.0
12:00 – 13:00	53.8	54.0	59.7*	56.8*	52.0	50.6	57.7	56.2
13:00 – 14:00	51.9	51.7	61.0*	56.0*	52.2	52.0	57.8	54.9
14:00 – 15:00	51.3	50.1	60.7	57.2	53.1	51.5	57.8	55.8
15:00 – 16:00	54.3	51.3	62.6	59.3	54.6	51.8	59.8	56.9
16:00 – 17:00	55.1	52.4	62.2	59.1	54.2	52.9	61.2	59.7
17:00 – 18:00	57.4	55.9	63.2	60.0	54.1	52.0	60.1	56.8
18:00 – 19:00	58.3	57.1	62.1	58.9	53.1	50.9	57.6	55.4
19:00 – 20:00	55.2	57.1	58.9	57.2	50.1	49.1	54.7	54.4
20:00 – 21:00	51.5	53.1	55.1	53.8	47.3	46.5	50.9	51.1
21:00 – 22:00	49.1	53.4	55.8	55.6	47.1	47.9	49.6	53.1
22:00 – 23:00	45.5	51.0	49.5	51.8	44.6	45.6	48.9	51.6
23:00 – 24:00	39.0	39.3	45.4	49.1	41.6	44.8	45.5	48.0
Overall Measured L10 $_{18\ Hour}$ Value (Arithmetic 6am to midnight)	52.6		59.1		51.4		56.5	
Overall Measured Leq $_{15\ Hour}$ Value (Logarithmic 7am to 10pm)		53.8		58.4		51.4		56.5
Overall Measured Leq $_{16\ Hour}$ Value (Logarithmic 6am to 10pm)		53.7		58.3		51.3		56.5
Overall Measured Leq $_{9\ Hour}$ Value (Logarithmic 10pm to 7am)		46.4		50.9		46.3		50.9
Overall Measured Leq $_{8\ Hour}$ Value (Logarithmic 10pm to 6am)		45.5		49.9		45.1		49.6

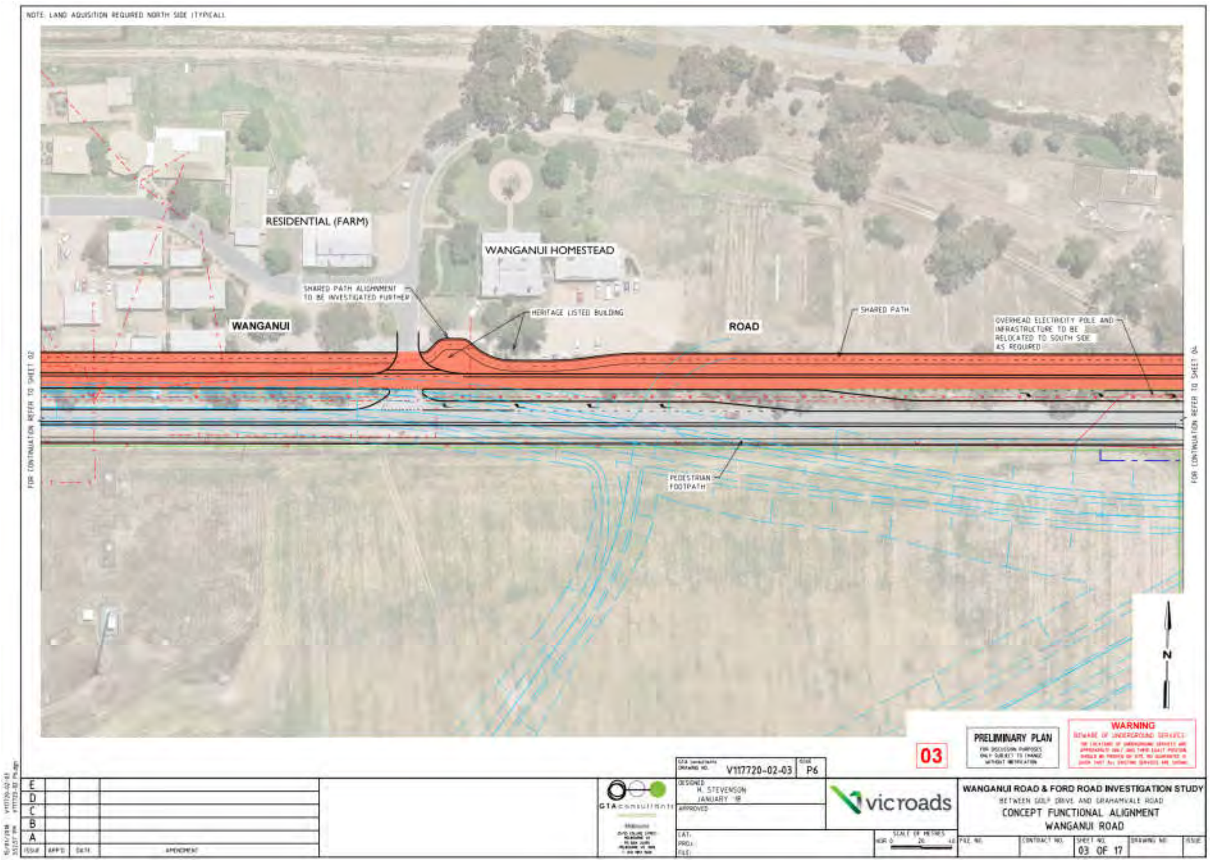
* Measured value corrected to exclude noise associated with drive way works at the measurement location.

3. DRAWINGS ON WHICH TRAFFIC NOISE MODELLING HAS BEEN BASED






NOTE: LAND AQUISITION REQUIRED NORTH SIDE (TYPICAL)
REEDY
SWAMP
ROAD
PROPOSED BEND OUT TREATMENT
WANGANUI
SHARED PATH
PRIVATE
ACCESS
RESIDENTIAL
ROAD
PEDESTRIAN FOOTPATH
RUDD
ROAD
N
02
PRELIMINARY PLAN
WARNING
V117720-02-02
P6
H. STEVENSON
JANUARY '18
vicroads
WANGANUI ROAD & FORD ROAD INVESTIGATION STUDY
BETWEEN GOLF DRIVE AND GRAHAMVALE ROAD
CONCEPT FUNCTIONAL ALIGNMENT
WANGANUI ROAD AND RUDD ROAD
02 OF 17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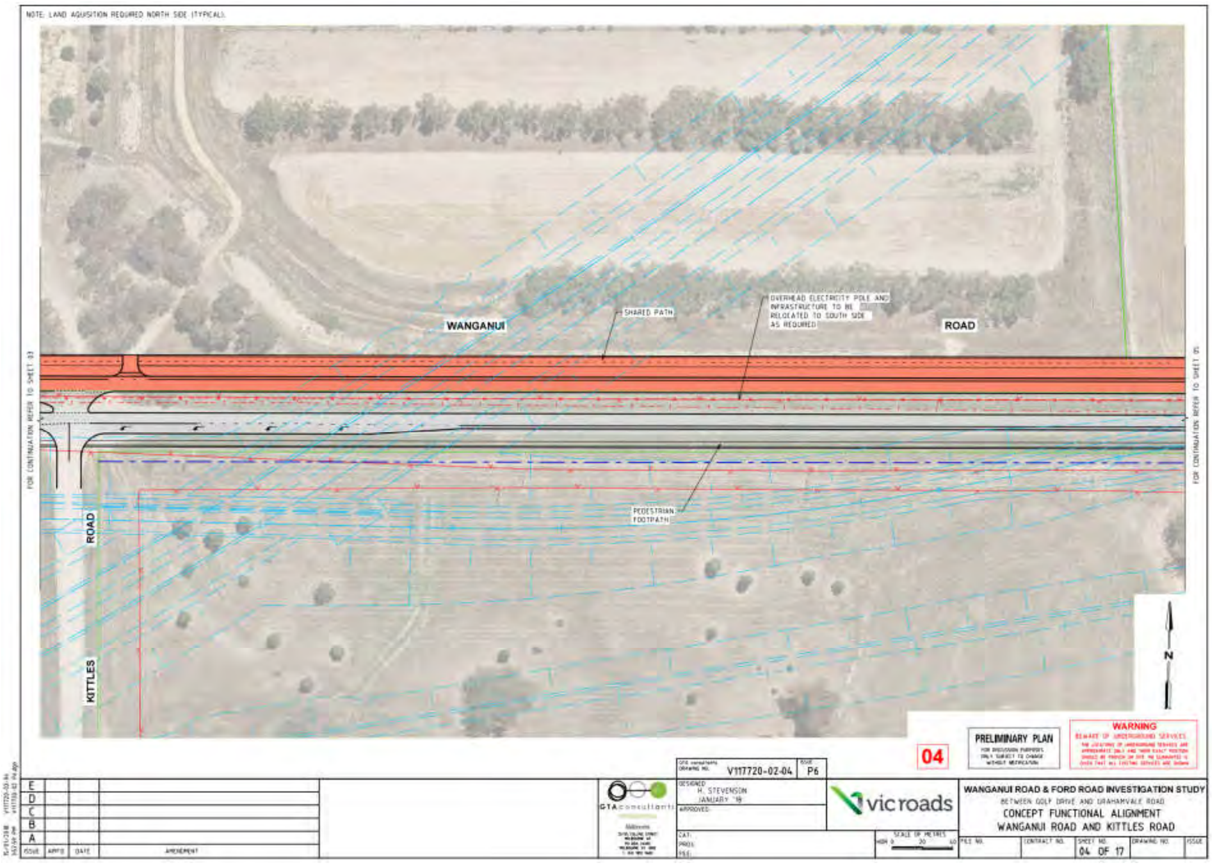
RESIDENTIAL (FARM)
WANGANUI HOMESTEAD
SHARED PATH ALIGNMENT TO BE INVESTIGATED FURTHER
HERITAGE LISTED BUILDING
SHARED PATH
OVERHEAD ELECTRICITY POLE AND INFRASTRUCTURE TO BE RELOCATED TO SOUTH SIDE AS REQUIRED
WANGANUI
ROAD
PEDESTRIAN FOOTPATH
N
03
PRELIMINARY PLAN
WARNING
V117720-02-03
P6
H. STEVENSON
JANUARY '18
vicroads
WANGANUI ROAD & FORD ROAD INVESTIGATION STUDY
BETWEEN GOLF DRIVE AND GRAHAMVALE ROAD
CONCEPT FUNCTIONAL ALIGNMENT
WANGANUI ROAD
03 OF 17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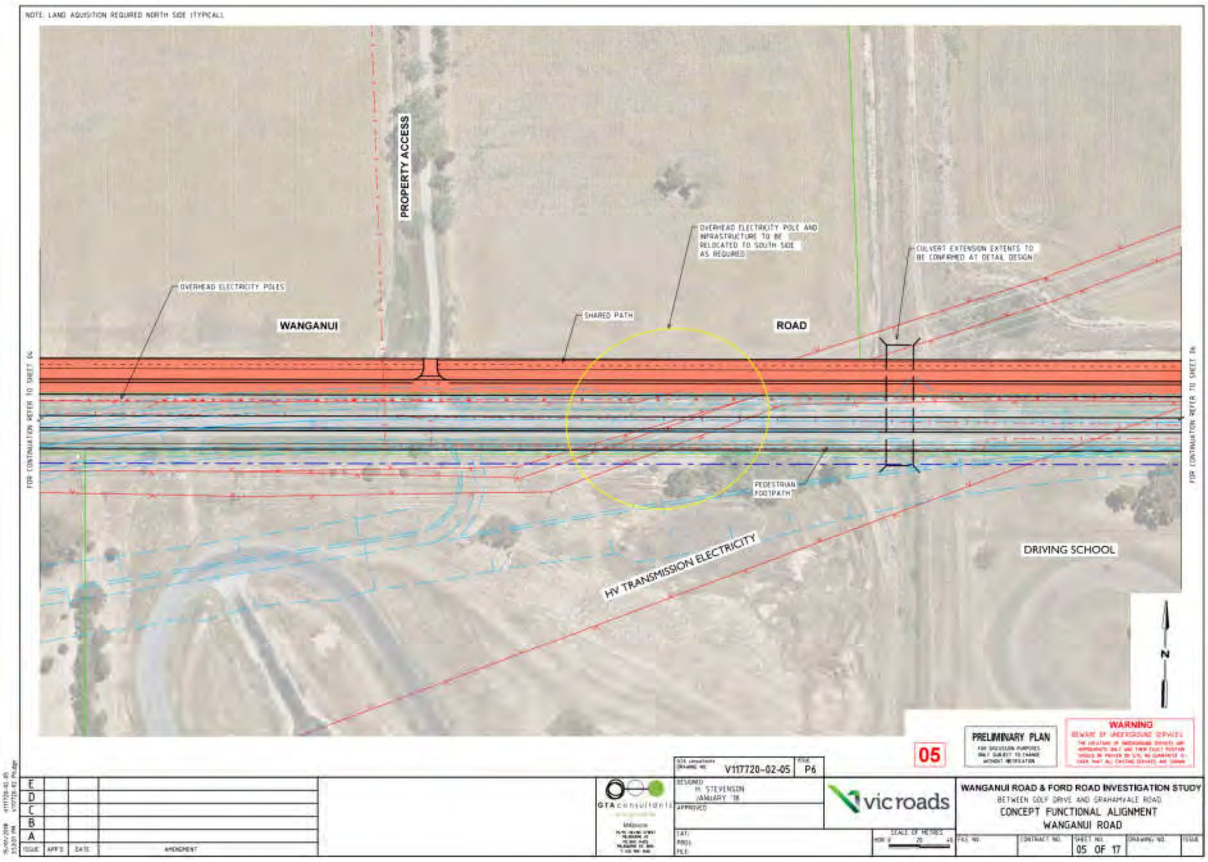
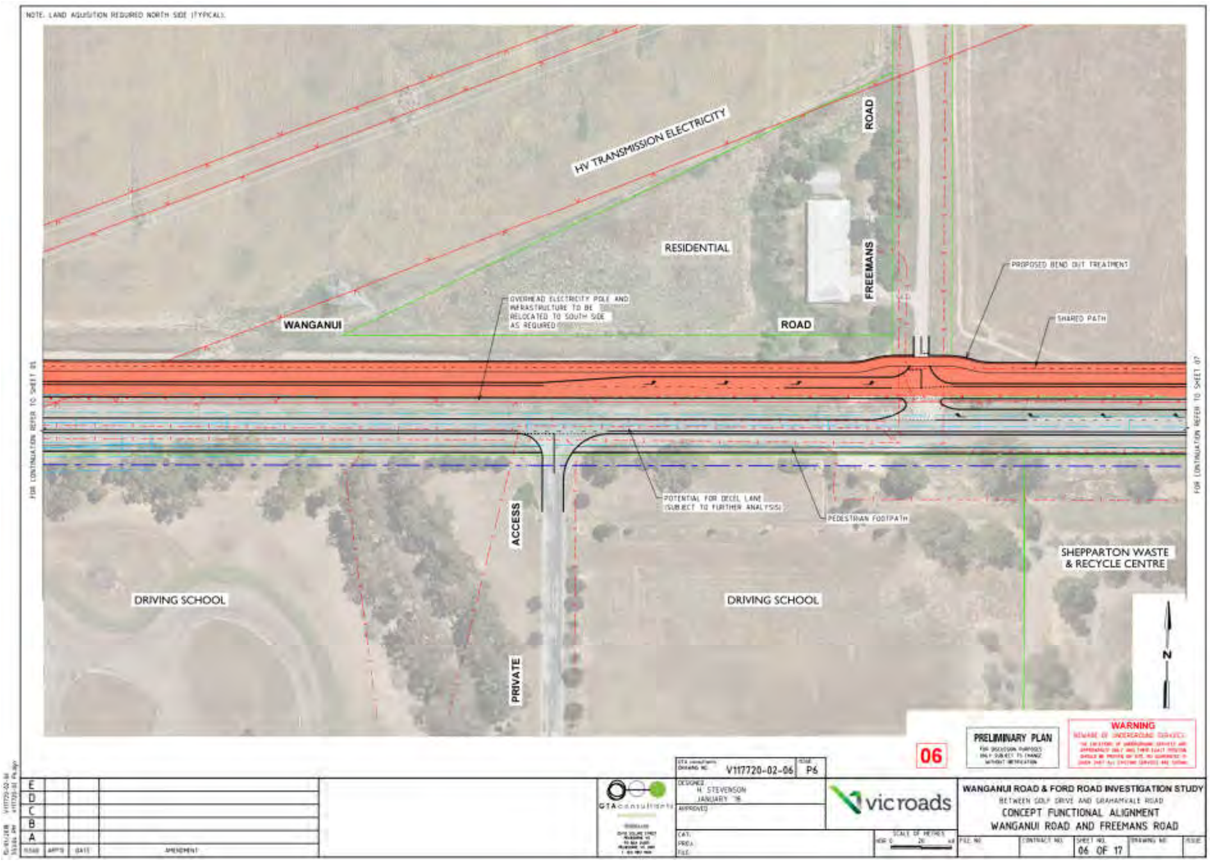
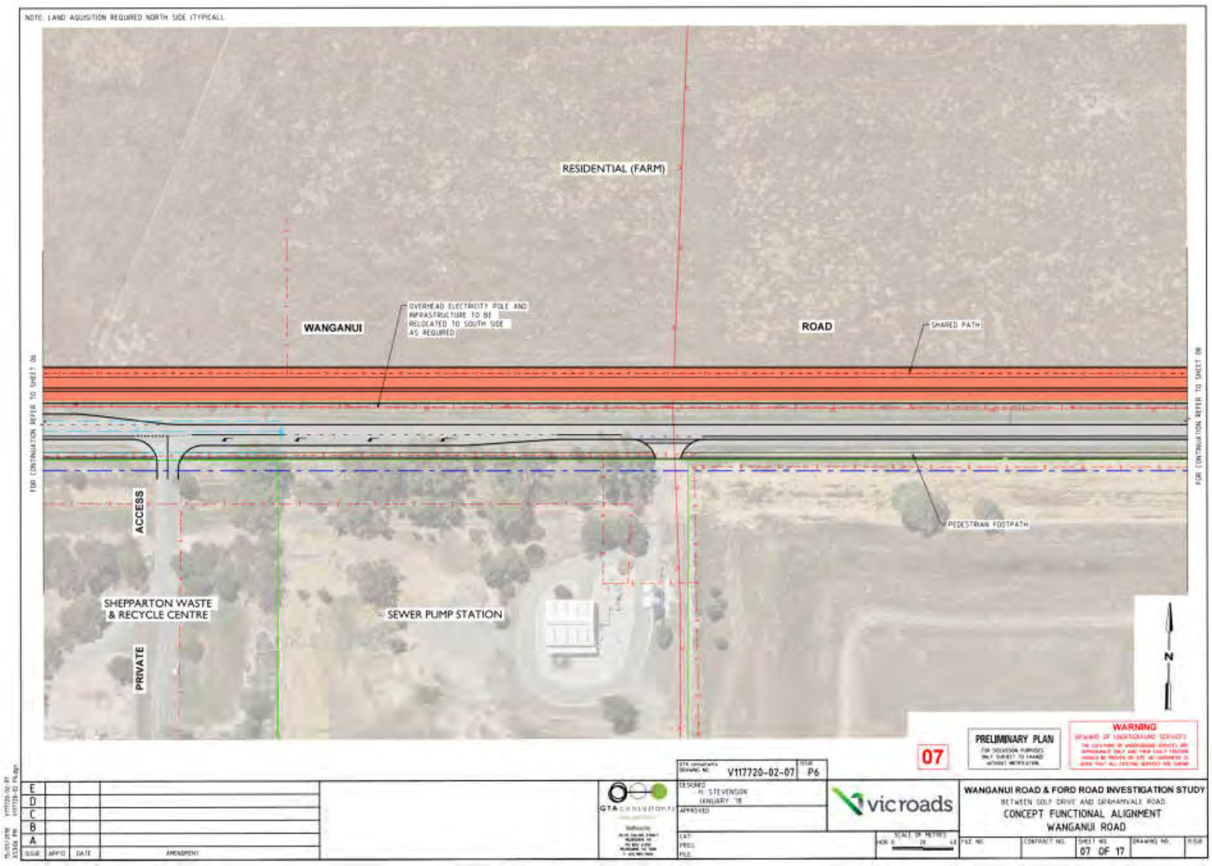
WANGANUI
ROAD
SHARED PATH
OVERHEAD ELECTRICITY POLE AND INFRASTRUCTURE TO BE RELOCATED TO SOUTH SIDE AS REQUIRED
PEDESTRIAN FOOTPATH
KITTLES
ROAD
N
04
PRELIMINARY PLAN
WARNING
BEWARE OF UNDERGROUND SERVICES
V117720-02-04
P6
H. STEVENSON
JANUARY '18
vicroads
WANGANUI ROAD & FORD ROAD INVESTIGATION STUDY
BETWEEN GOLF DRIVE AND GRAHAMVALE ROAD
CONCEPT FUNCTIONAL ALIGNMENT
WANGANUI ROAD AND KITTLES ROAD
04 OF 17


NOTE: LAND AQUISITION REQUIRED NORTH SIDE (TYPICAL)
PROPERTY ACCESS
OVERHEAD ELECTRICITY POLES
OVERHEAD ELECTRICITY POLE AND INFRASTRUCTURE TO BE RELOCATED TO SOUTH SIDE AS REQUIRED
CULVERT EXTENSION EXTENTS TO BE CONFIRMED AT DETAIL DESIGN
WANGANUI
SHARED PATH
ROAD
PEDESTRIAN FOOTPATH
HV TRANSMISSION ELECTRICITY
DRIVING SCHOOL
N
05
PRELIMINARY PLAN
WARNING
BEWARE OF UNDERGROUND SERVICES
V117720-02-05
P6
H. STEVENSON
JANUARY '18
vicroads
WANGANUI ROAD & FORD ROAD INVESTIGATION STUDY
BETWEEN GOLF DRIVE AND GRAHAMVALE ROAD
CONCEPT FUNCTIONAL ALIGNMENT
WANGANUI ROAD
05 OF 17


NOTE: LAND AQUISITION REQUIRED NORTH SIDE (TYPICAL)
HV TRANSMISSION ELECTRICITY
RESIDENTIAL
FREEMANS
ROAD
WANGANUI
ROAD
OVERHEAD ELECTRICITY POLE AND INFRASTRUCTURE TO BE RELOCATED TO SOUTH SIDE AS REQUIRED
PROPOSED BEND OUT TREATMENT
SHARED PATH
POTENTIAL FOR DECEL LANE (SUBJECT TO FURTHER ANALYSIS)
PEDESTRIAN FOOTPATH
ACCESS
PRIVATE
DRIVING SCHOOL
DRIVING SCHOOL
SHEPPARTON WASTE & RECYCLE CENTRE
N
PRELIMINARY PLAN
WARNING
06
V117720-02-06
P6
H. STEVENSON
JANUARY '18
vicroads
WANGANUI ROAD & FORD ROAD INVESTIGATION STUDY
BETWEEN GOLF DRIVE AND GRAHAMVALE ROAD
CONCEPT FUNCTIONAL ALIGNMENT
WANGANUI ROAD AND FREEMANS ROAD
06 OF 17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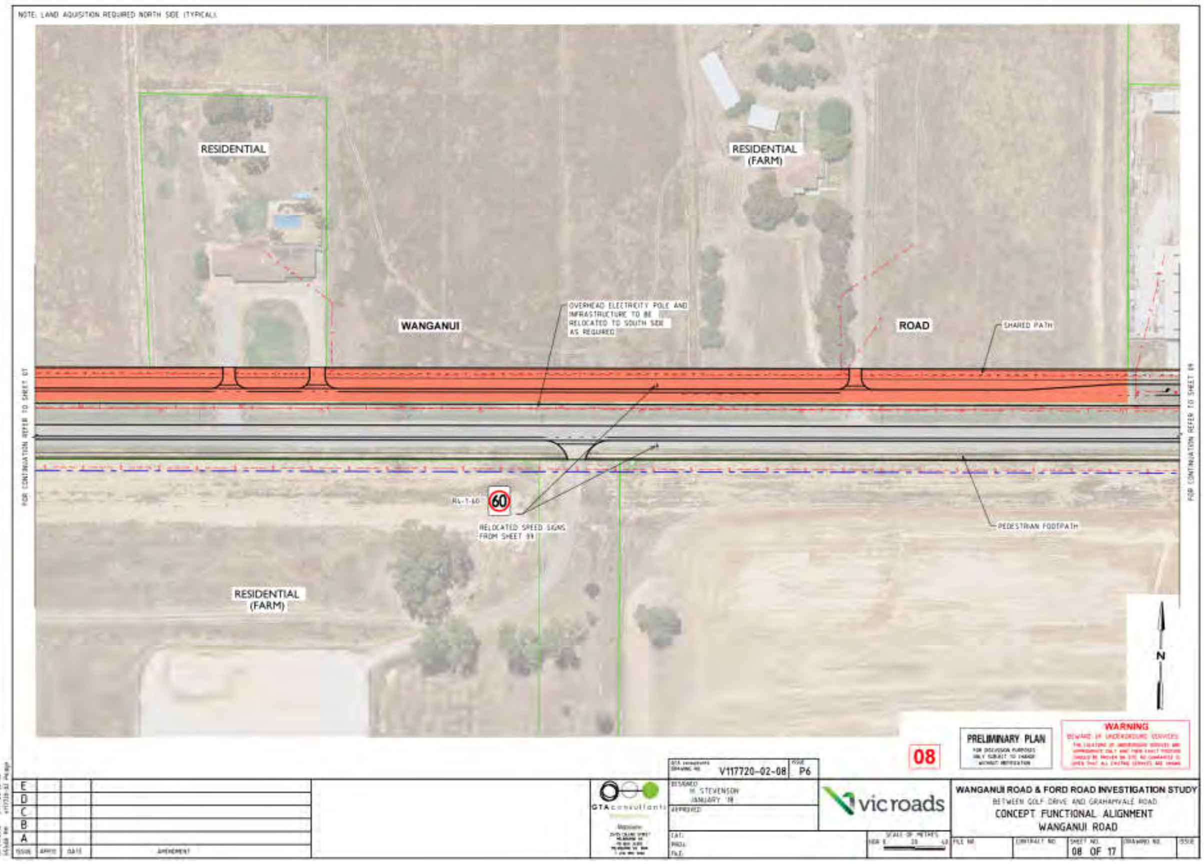
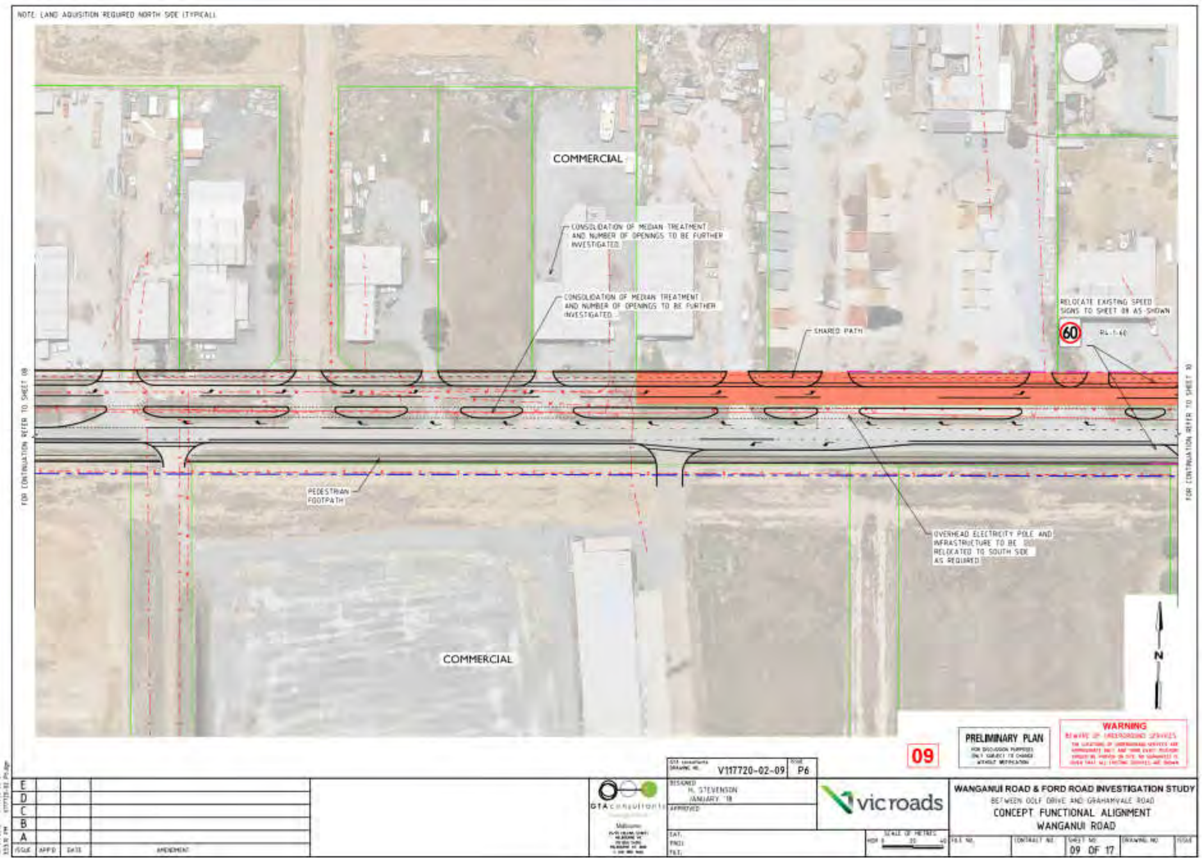
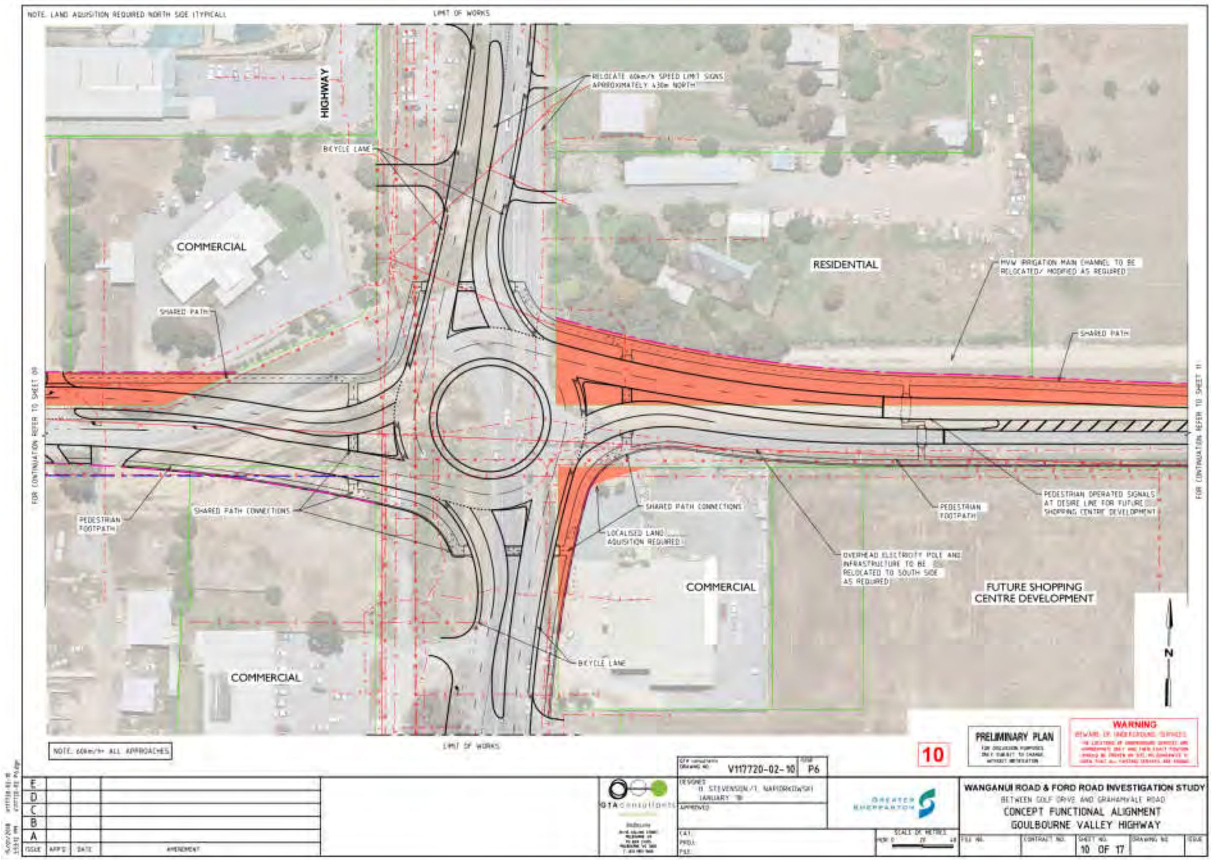
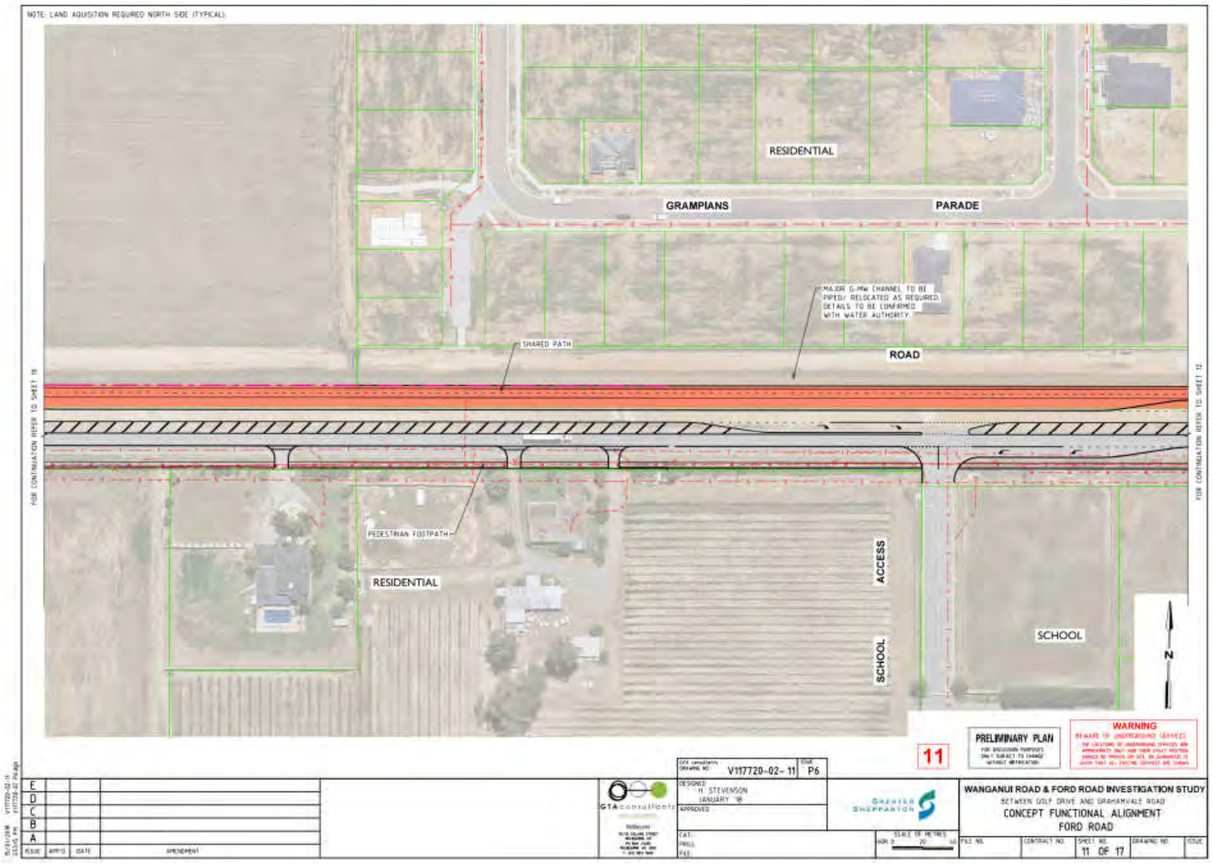
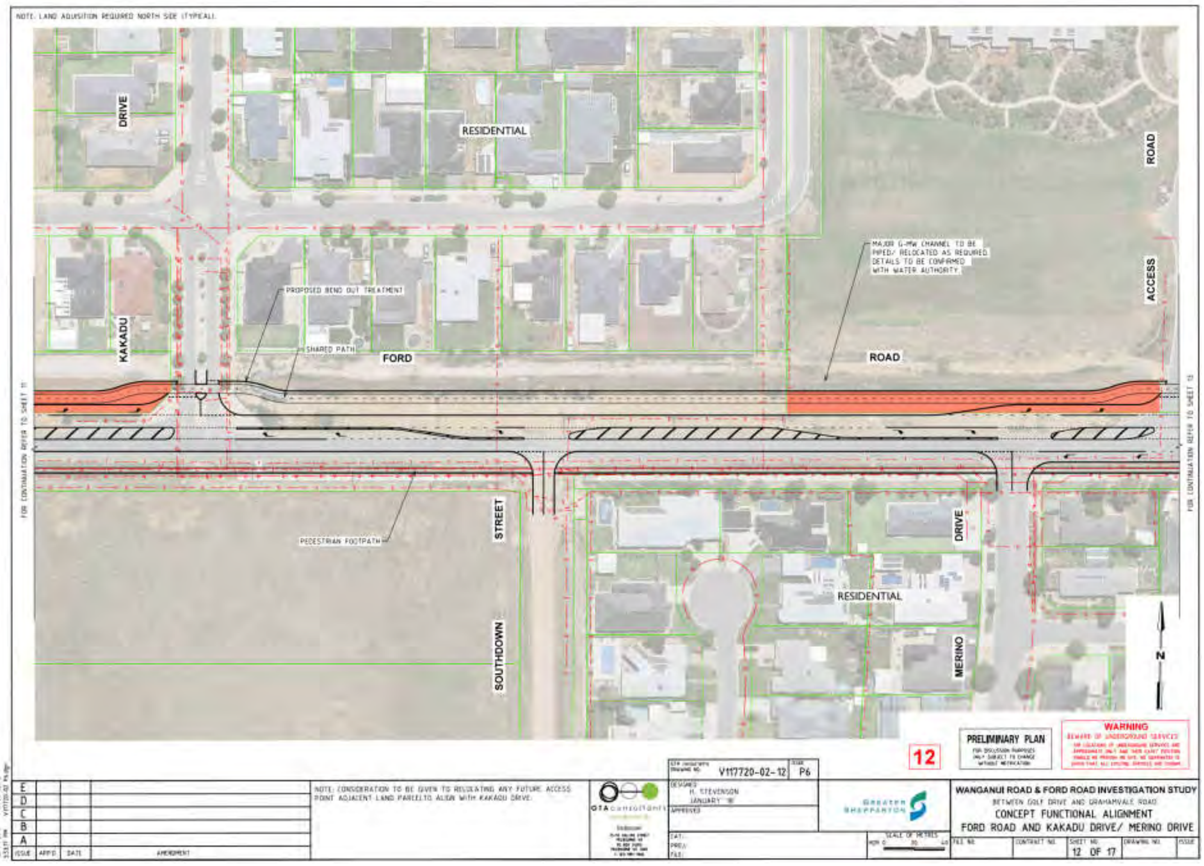
RESIDENTIAL (FARM)
WANGANUI
ROAD
OVERHEAD ELECTRICITY POLE AND INFRASTRUCTURE TO BE RELOCATED TO SOUTH SIDE AS REQUIRED
SHARED PATH
PEDESTRIAN FOOTPATH
ACCESS
PRIVATE
SHEPPARTON WASTE & RECYCLE CENTRE
SEWER PUMP STATION
N
PRELIMINARY PLAN
WARNING
07
V117720-02-07
P6
H. STEVENSON
JANUARY '18
vicroads
WANGANUI ROAD & FORD ROAD INVESTIGATION STUDY
BETWEEN GOLF DRIVE AND GRAHAMVALE ROAD
CONCEPT FUNCTIONAL ALIGNMENT
WANGANUI ROAD
07 OF 17

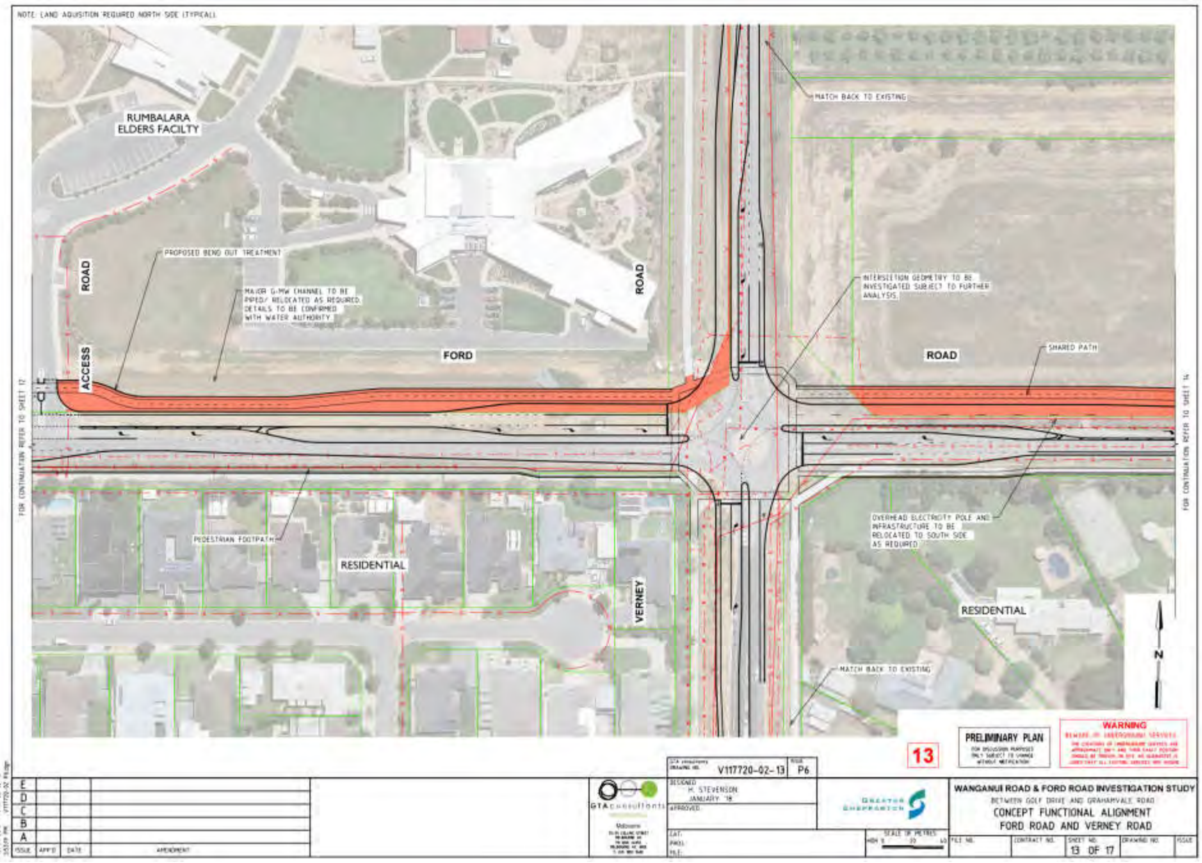

NOTE: LAND AQUISITION REQUIRED NORTH SIDE (TYPICAL)
RESIDENTIAL
RESIDENTIAL (FARM)
WANGANUI
ROAD
OVERHEAD ELECTRICITY POLE AND INFRASTRUCTURE TO BE RELOCATED TO SOUTH SIDE AS REQUIRED
SHARED PATH
60
RELOCATED SPEED SIGNS FROM SHEET 09
PEDESTRIAN FOOTPATH
RESIDENTIAL (FARM)
N
PRELIMINARY PLAN
WARNING
08
V117720-02-08
P6
vicroads
WANGANUI ROAD & FORD ROAD INVESTIGATION STUDY
BETWEEN GOLF DRIVE AND GRAHAMVALE ROAD
CONCEPT FUNCTIONAL ALIGNMENT
WANGANUI ROAD
08 OF 17

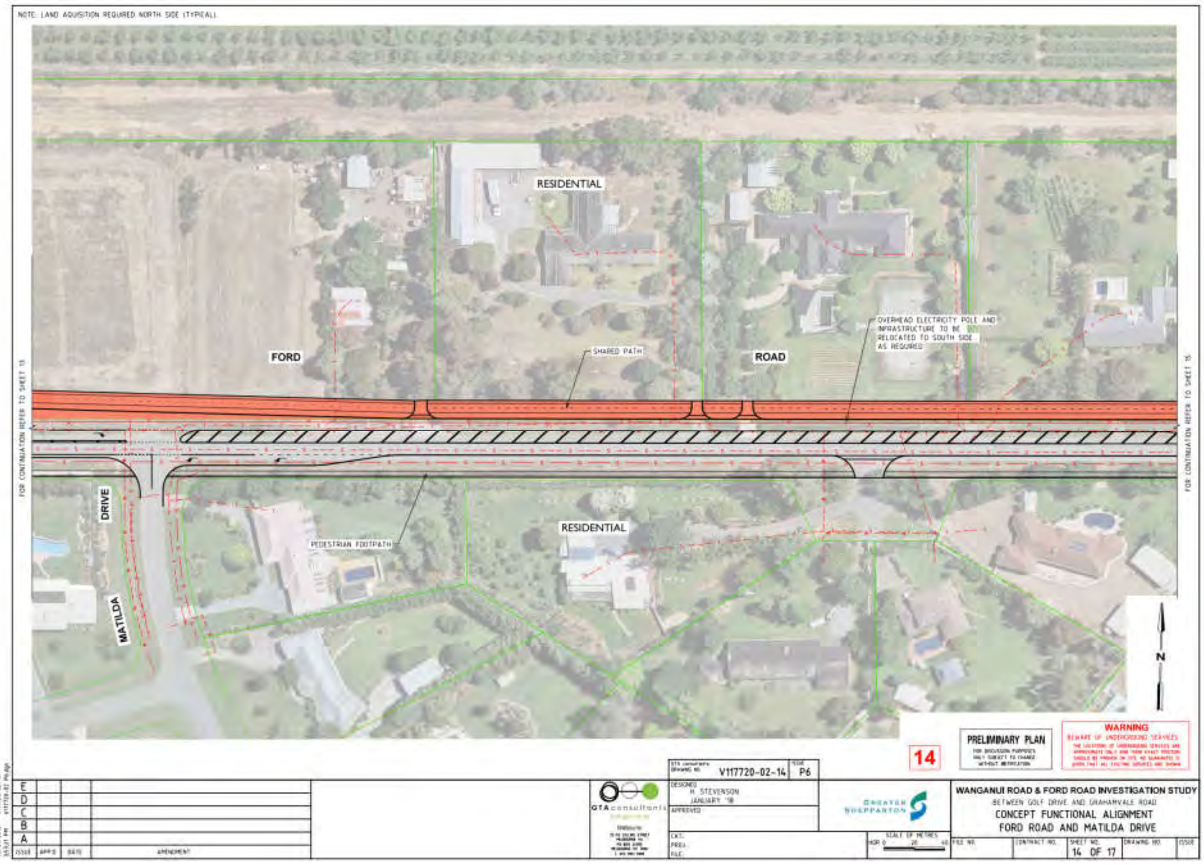

NOTE: LAND AQUISITION REQUIRED NORTH SIDE (TYPICAL)
COMMERCIAL
CONSOLIDATION OF MEDIAN TREATMENT AND NUMBER OF OPENINGS TO BE FURTHER INVESTIGATED
CONSOLIDATION OF MEDIAN TREATMENT AND NUMBER OF OPENINGS TO BE FURTHER INVESTIGATED
SHARED PATH
RELOCATE EXISTING SPEED SIGNS TO SHEET 08 AS SHOWN
60
PEDESTRIAN FOOTPATH
OVERHEAD ELECTRICITY POLE AND INFRASTRUCTURE TO BE RELOCATED TO SOUTH SIDE AS REQUIRED
COMMERCIAL
N
PRELIMINARY PLAN
WARNING
09
V117720-02-09
P6
vicroads
WANGANUI ROAD & FORD ROAD INVESTIGATION STUDY
BETWEEN GOLF DRIVE AND GRAHAMVALE ROAD
CONCEPT FUNCTIONAL ALIGNMENT
WANGANUI ROAD
09 OF 17

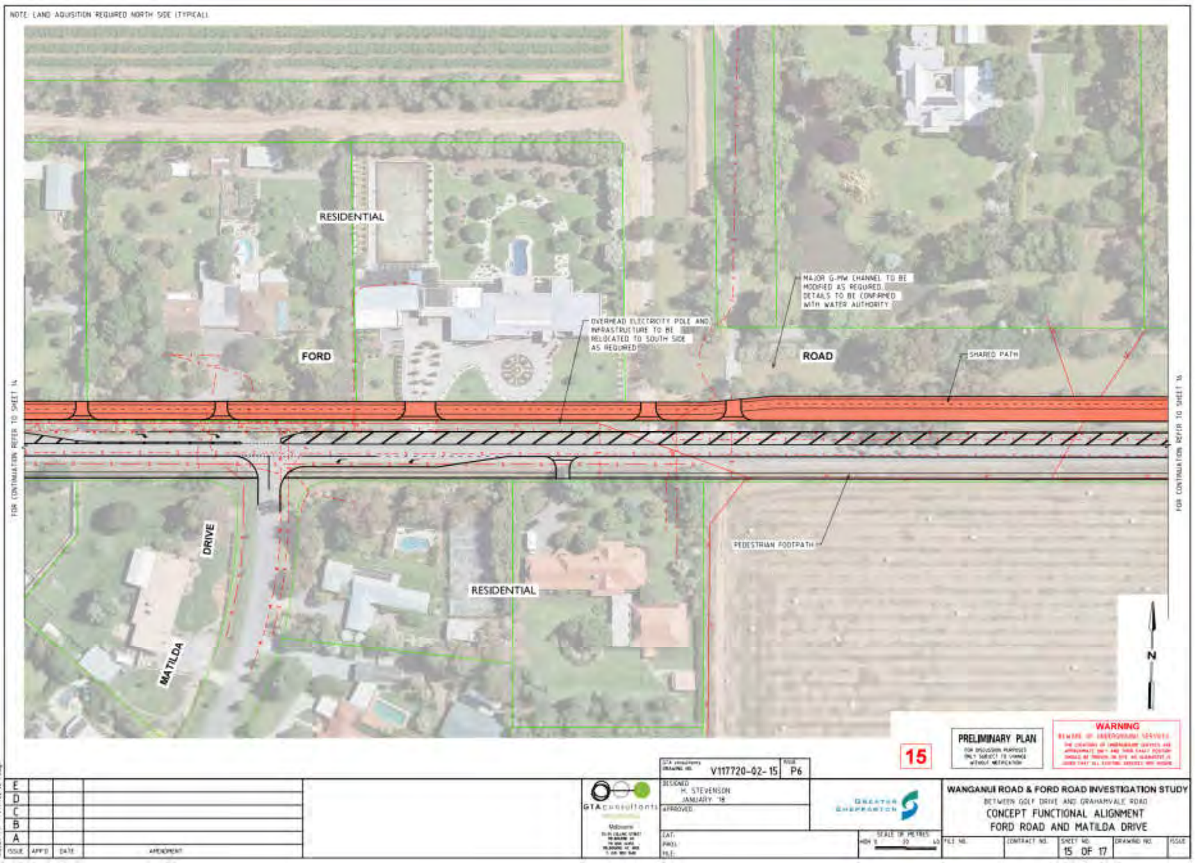

NOTE: LAND AQUISITION REQUIRED NORTH SIDE (TYPICAL)
LIMIT OF WORKS
HIGHWAY
BICYCLE LANE
RELOCATE 60km/h SPEED LIMIT SIGNS APPROXIMATELY 430m NORTH
COMMERCIAL
RESIDENTIAL
SHARED PATH
SHARED PATH CONNECTIONS
PEDESTRIAN FOOTPATH
LOCALISED LAND AQUISITION REQUIRED
COMMERCIAL
FUTURE SHOPPING CENTRE DEVELOPMENT
PEDESTRIAN OPERATED SIGNALS AT DESIRE LINE FOR FUTURE SHOPPING CENTRE DEVELOPMENT
NOTE: 60km/h ALL APPROACHES
PRELIMINARY PLAN
WARNING
10
V117720-02-10 P6
WANGANUI ROAD & FORD ROAD INVESTIGATION STUDY
CONCEPT FUNCTIONAL ALIGNMENT
GOULBOURNE VALLEY HIGHWAY
10 OF 17

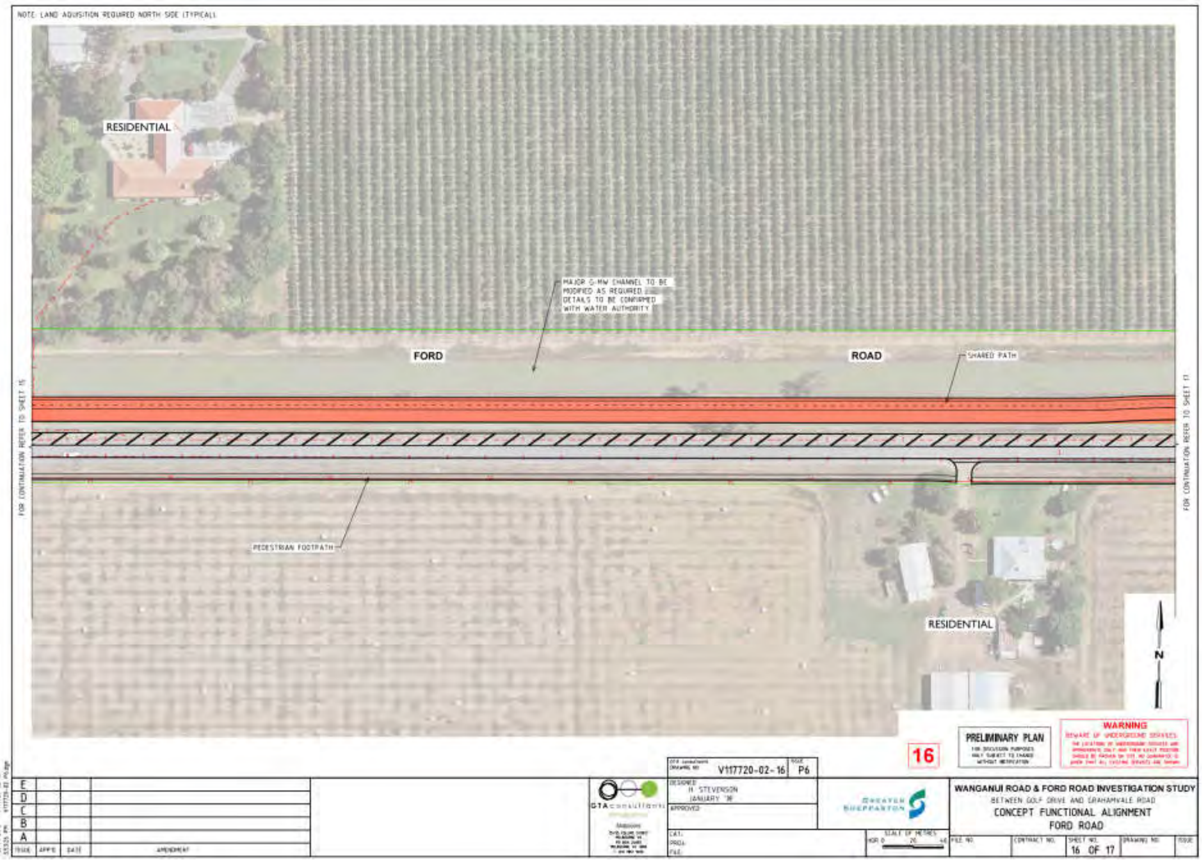

NOTE: LAND AQUISITION REQUIRED NORTH SIDE (TYPICAL)
RESIDENTIAL
GRAMPIANS
PARADE
SHARED PATH
ROAD
PEDESTRIAN FOOTPATH
RESIDENTIAL
ACCESS
SCHOOL
SCHOOL
PRELIMINARY PLAN
WARNING
11
V117720-02-11 P6
WANGANUI ROAD & FORD ROAD INVESTIGATION STUDY
CONCEPT FUNCTIONAL ALIGNMENT
FORD ROAD
11 OF 17

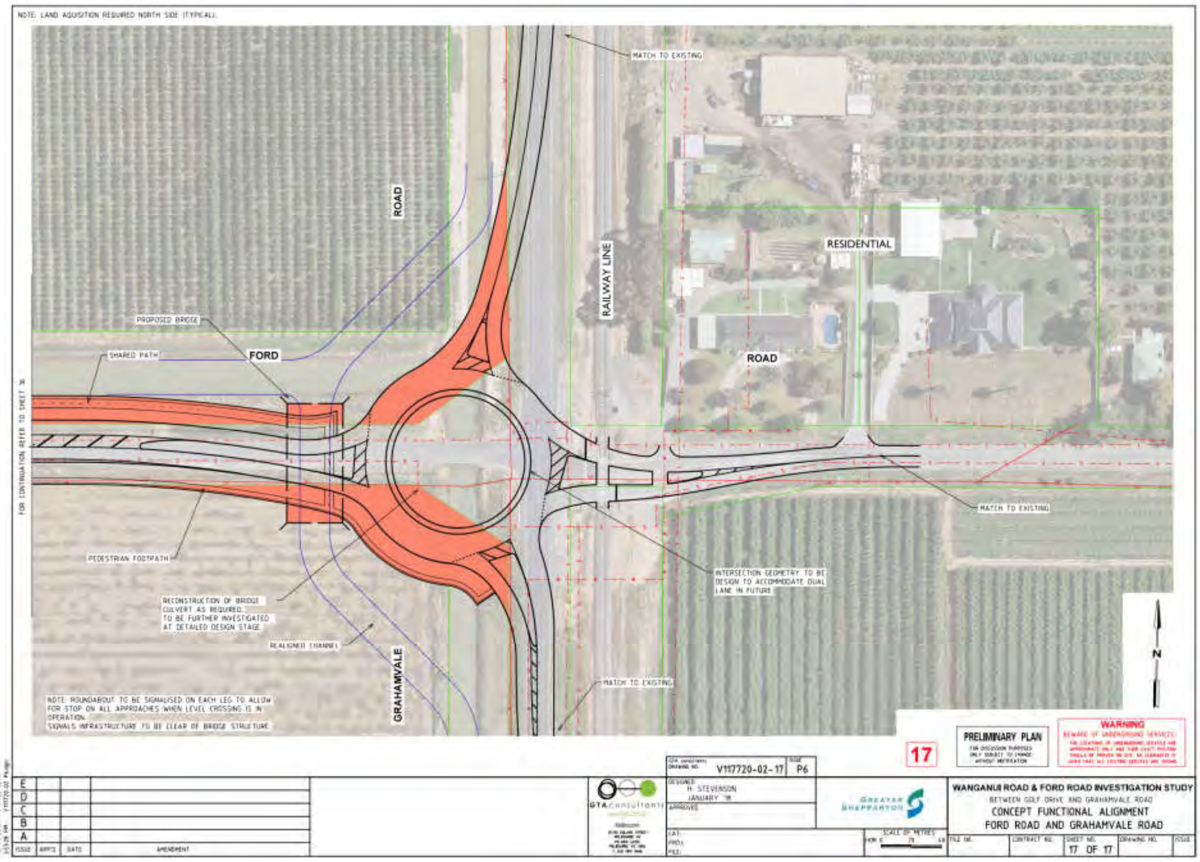

NOTE: LAND AQUISITION REQUIRED NORTH SIDE (TYPICAL)
DRIVE
RESIDENTIAL
ROAD
ACCESS
MAJOR G-MW CHANNEL TO BE PIPED/ RELOCATED AS REQUIRED. DETAILS TO BE CONFIRMED WITH WATER AUTHORITY
PROPOSED BEND OUT TREATMENT
SHARED PATH
KAKADU
FORD
ROAD
PEDESTRIAN FOOTPATH
STREET
SOUTHDOWN
DRIVE
MERINO
RESIDENTIAL
FOR CONTINUATION REFER TO SHEET 11
FOR CONTINUATION REFER TO SHEET 13
PRELIMINARY PLAN
WARNING
12
V117720-02-12
P6
NOTE: CONSIDERATION TO BE GIVEN TO RELOCATING ANY FUTURE ACCESS POINT ADJACENT LAND PARCEL TO ALIGN WITH KAKADU DRIVE.
H. STEVENSON
JANUARY '18
GTA consultants
GREATER SHEPPARTON
WANGANUI ROAD & FORD ROAD INVESTIGATION STUDY
BETWEEN GOLF DRIVE AND GRAHAMVALE ROAD
CONCEPT FUNCTIONAL ALIGNMENT
FORD ROAD AND KAKADU DRIVE/ MERINO DRIVE
12 OF 17


NOTE: LAND AQUISITION REQUIRED NORTH SIDE (TYPICAL)
RUMBALARA ELDERS FACILITY
MATCH BACK TO EXISTING
PROPOSED BEND OUT TREATMENT
ROAD
ACCESS
MAJOR G-MW CHANNEL TO BE PIPED/ RELOCATED AS REQUIRED. DETAILS TO BE CONFIRMED WITH WATER AUTHORITY
ROAD
INTERSECTION GEOMETRY TO BE INVESTIGATED SUBJECT TO FURTHER ANALYSIS.
FORD
ROAD
SHARED PATH
PEDESTRIAN FOOTPATH
RESIDENTIAL
VERNEY
OVERHEAD ELECTRICITY POLE AND INFRASTRUCTURE TO BE RELOCATED TO SOUTH SIDE AS REQUIRED
RESIDENTIAL
MATCH BACK TO EXISTING
FOR CONTINUATION REFER TO SHEET 12
FOR CONTINUATION REFER TO SHEET 14
PRELIMINARY PLAN
WARNING
13
V117720-02-13
P6
H. STEVENSON
JANUARY '18
GTA consultants
GREATER SHEPPARTON
WANGANUI ROAD & FORD ROAD INVESTIGATION STUDY
BETWEEN GOLF DRIVE AND GRAHAMVALE ROAD
CONCEPT FUNCTIONAL ALIGNMENT
FORD ROAD AND VERNEY ROAD
13 OF 17


NOTE: LAND AQUISITION REQUIRED NORTH SIDE (TYPICAL)
RESIDENTIAL
FORD
ROAD
SHARED PATH
OVERHEAD ELECTRICITY POLE AND INFRASTRUCTURE TO BE RELOCATED TO SOUTH SIDE AS REQUIRED
DRIVE
MATILDA
PEDESTRIAN FOOTPATH
RESIDENTIAL
N
PRELIMINARY PLAN
WARNING
14
V117720-02-14
P6
H. STEVENSON
JANUARY '18
WANGANUI ROAD & FORD ROAD INVESTIGATION STUDY
BETWEEN GOLF DRIVE AND GRAHAMVALE ROAD
CONCEPT FUNCTIONAL ALIGNMENT
FORD ROAD AND MATILDA DRIVE
14 OF 17

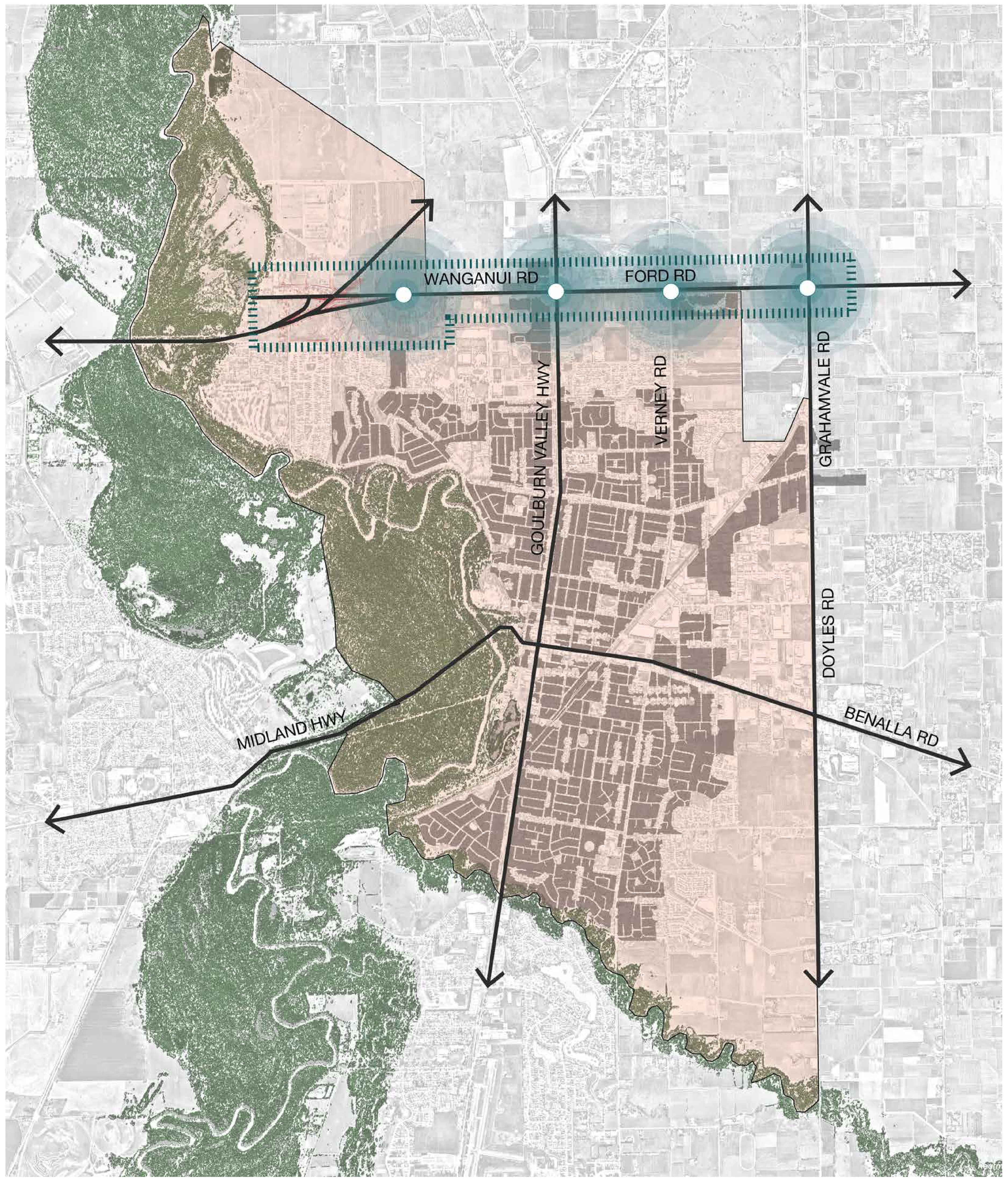

NOTE: LAND AQUISITION REQUIRED NORTH SIDE (TYPICAL)
RESIDENTIAL
MAJOR G-MW CHANNEL TO BE MODIFIED AS REQUIRED. DETAILS TO BE CONFIRMED WITH WATER AUTHORITY
OVERHEAD ELECTRICITY POLE AND INFRASTRUCTURE TO BE RELOCATED TO SOUTH SIDE AS REQUIRED
FORD
ROAD
SHARED PATH
PEDESTRIAN FOOTPATH
DRIVE
MATILDA
RESIDENTIAL
N
PRELIMINARY PLAN
WARNING
15
V117720-02-15
P6
H. STEVENSON
JANUARY '18
WANGANUI ROAD & FORD ROAD INVESTIGATION STUDY
BETWEEN GOLF DRIVE AND GRAHAMVALE ROAD
CONCEPT FUNCTIONAL ALIGNMENT
FORD ROAD AND MATILDA DRIVE
15 OF 17


NOTE: LAND AQUISITION REQUIRED NORTH SIDE (TYPICAL).
RESIDENTIAL
MAJOR G-MW CHANNEL TO BE MODIFIED AS REQUIRED DETAILS TO BE CONFIRMED WITH WATER AUTHORITY
FORD
ROAD
SHARED PATH
PEDESTRIAN FOOTPATH
RESIDENTIAL
N
16
PRELIMINARY PLAN
WARNING
V117720-02-16
P6
H. STEVENSON
JANUARY '18
WANGANUI ROAD & FORD ROAD INVESTIGATION STUDY
BETWEEN GOLF DRIVE AND GRAHAMVALE ROAD
CONCEPT FUNCTIONAL ALIGNMENT
FORD ROAD
16 OF 17


NOTE: LAND AQUISITION REQUIRED NORTH SIDE (TYPICAL).
MATCH TO EXISTING
ROAD
RAILWAY LINE
RESIDENTIAL
PROPOSED BRIDGE
SHARED PATH
FORD
ROAD
MATCH TO EXISTING
PEDESTRIAN FOOTPATH
RECONSTRUCTION OF BRIDGE CULVERT AS REQUIRED. TO BE FURTHER INVESTIGATED AT DETAILED DESIGN STAGE.
REALIGNED CHANNEL
INTERSECTION GEOMETRY TO BE DESIGN TO ACCOMMODATE DUAL LANE IN FUTURE
GRAHAMVALE
MATCH TO EXISTING
NOTE: ROUNDABOUT TO BE SIGNALISED ON EACH LEG TO ALLOW FOR STOP ON ALL APPROACHES WHEN LEVEL CROSSING IS IN OPERATION. SIGNALS INFRASTRUCTURE TO BE CLEAR OF BRIDGE STRUCTURE.
N
17
PRELIMINARY PLAN
WARNING
V117720-02-17
P6
H. STEVENSON
JANUARY '18
WANGANUI ROAD & FORD ROAD INVESTIGATION STUDY
BETWEEN GOLF DRIVE AND GRAHAMVALE ROAD
CONCEPT FUNCTIONAL ALIGNMENT
FORD ROAD AND GRAHAMVALE ROAD
17 OF 17

E.4 Appendix E4: Landscape Masterplan

Overall Plan - Scale 1:1500 @ A0

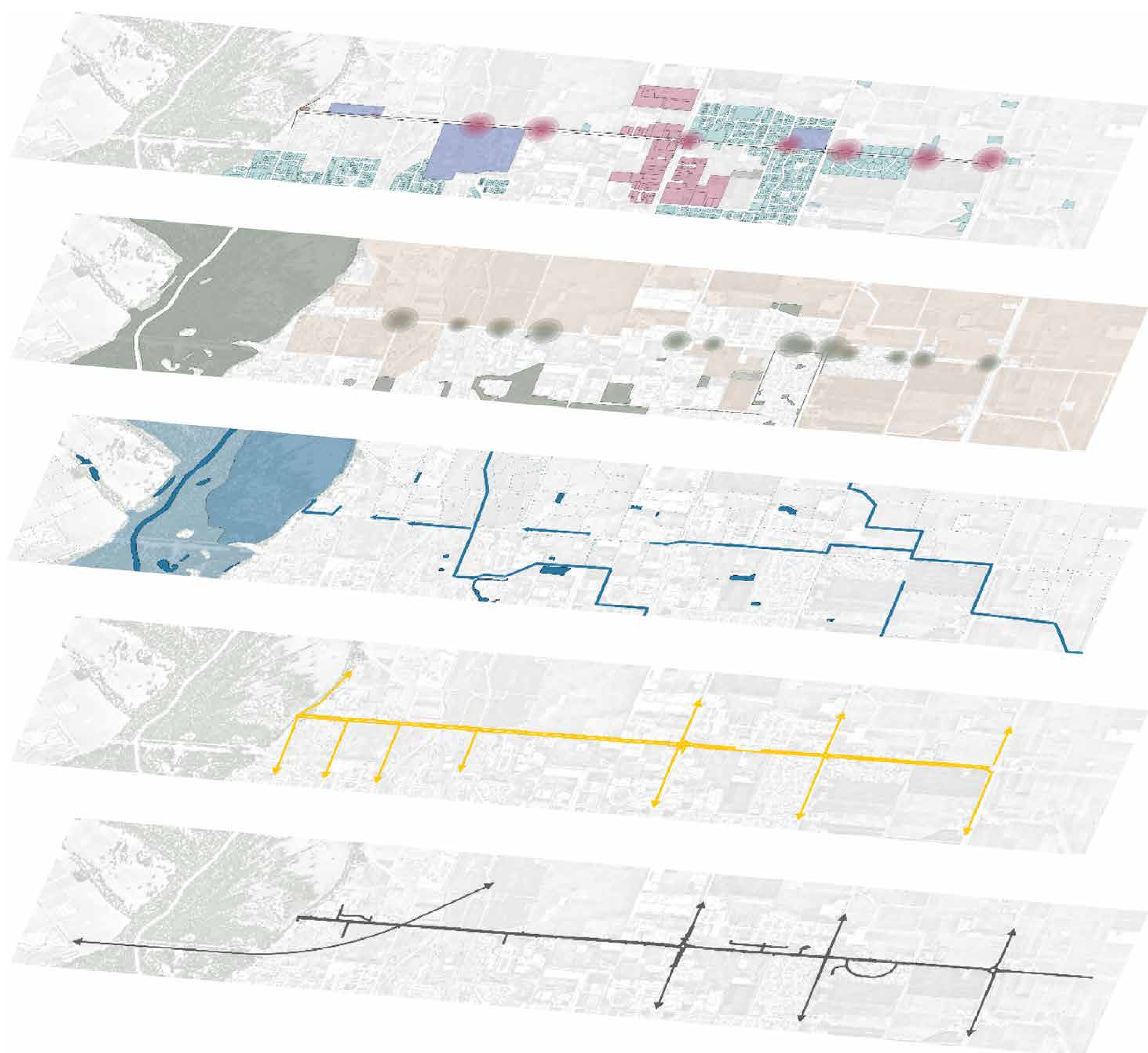


Landscape Concept of Five Connecting Ribbons

The upgrade works to Wanganui and Ford Roads offers a great opportunity to not only improve access and movement for vehicles using the upgraded infrastructure. Road corridors are arteries that convey more than just traffic. They connect communities. Both, in longitudinal direction and across. These include, next to cyclists and pedestrians using active transport methods, also flora and fauna that spread and connect bio-habitat areas through road corridors.

In order to curate the various methods and types of transport, the idea of 5 ribbons has been deployed, each focussing on a special programme. In their linear development, these ribbons respond to site specific characteristics, strengthening relevant aspects and creating new opportunities.

Wanganui and Ford Roads will grow into the well established network of grand avenues of tall, stately native trees, that make Shepparton a special place, creating entry experiences into the city's inner expands whilst offering small and slow places and opportunities to engage with the rich natural setting of the city.



Plan 01 - Scale 1:400

Pink Ribbon

Culture and Community. This strategy provides an opportunity for small moments enabling community life: gathering spaces, picnic tables, seating benches, etc. It can include design guidelines and offer inspiration for public art installations, driveway/ entry gate designs, letter boxes etc.

Green Ribbon

Tree canopy and ground cover. In line with the city Council's urban forest strategy an increase of tree canopy using a wide range of species, predominantly Australian native, in a way to create bio habitat and define quality of spaces. Part of the Green ribbon will be a detailed planting plan that considers VicRoads' requirements, spatial design and flowering regimes of proposed tree and under storey vegetation.

Blue Ribbon

Water management. Shepparton and its surrounds are defined and shaped by water. From wetlands and riparian landscapes of the Goulburn River to the manmade irrigation channels that traverse and connect the agricultural land. The project offers a great opportunity to connect, extend and feed these systems by using a swale system in lieu of a standard pipes to convey stormwater run off. This supports as passive irrigation the vegetation of the road verges.

Yellow Ribbon

The Shared User Path. Active transport can include walking, cycling, skating, skateboarding and other ways to get from A to B. Active transport is an easy way to participate in physical activity for recreational or health benefits. To support the use of Shared User Path a series of 'hubs' are proposed at special landscape settings such as channel crossings to provide resting points, bike pumps and repair stations, water fountains, etc.

Black Ribbon

The Road network. The design of the roads will provide a clear delineation between driveways, intersections, securing safety for all users.

MCGREGOR COXALL

Client
Greater Shepparton City Council

Project Name
Ford and Wanganui Roads

Project No.
0641MEL

Address
Shepparton, Victoria

Key Plan

Issue Log

Rev	Revision Description	By / Checked	Date
A	Draft masterplan	HL/CB	18/11/17
B	Draft masterplan update	HL/CB	5/2/18
C	Final masterplan	HL/CB	8/2/18

Scale
As shown
1:1,500 — 0 20 40 60 80 100 M
1:400 — 0 5 10 15 20 25 M

North

Phase
Final Master Plan

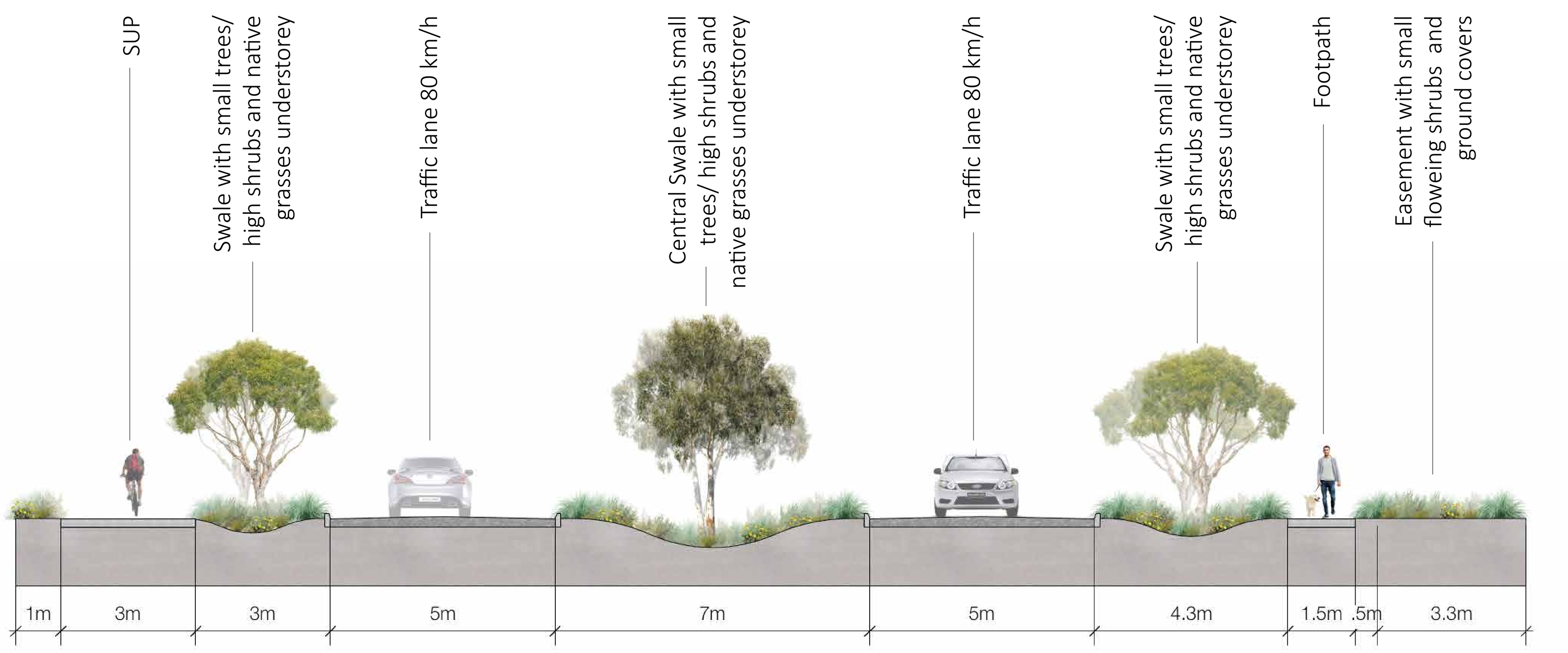
Sheet Title
Masterplan

Sheet No.
LD-SK-P01

Rev
C

Overall Plan - Scale 1:1500 @ A0

Plan 02 - Scale 1:400



Section A

Sectional perspective A

Plan 03 - Scale 1:400

Tree & Plant opportunities

Trees and large shrubs

Angophora costata "Smooth Bark Apple Gum"

Corymbia citriodora "Lemon Scented Gum"

Corymbia maculata "Spotted Gum"

Lophostemon confertus "Queensland Brush Box"

Eucalyptus damaldulensis "River Red Gum"

Eucalyptus microcarpa "Grey Box"

Hakea tephrosperma

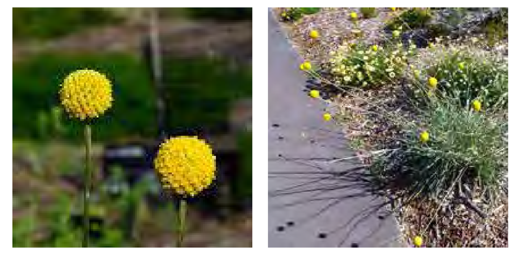
Acacia hakeoides, Acacia verniciflua

Callistemon sieberi

Shrub

Brachyscome multifida

Pycnosorus globosus



Atriplex nummularia

Grasses & Tussocks

Carex appressa

Juncus amabilis, Juncus flavidus, Juncus usitatus

Themeda triandra

Ficinia nodosa

Lomandra longifolia

Poa poiformis & labillardieri

MCGREGOR COXALL

Client
Greater Shepparton City Council

Project Name
Ford and Wanganui Roads

Project No.
0641MEL

Address
Shepparton, Victoria

Key Plan

Issue Log

Rev	Revision Description	By / Checked	Date
A	Draft masterplan	HL/CB	18/11/17
B	Draft masterplan update	HL/CB	5/2/18
C	Final masterplan	HL/CB	8/2/18

Scale
As shown
1:1,500 — 0 20 40 60 80 100 M
1:400 — 0 5 10 15 20 25 M

North

Phase
Final Master Plan

Sheet Title
Masterplan

Sheet No.
LD-SK-P02

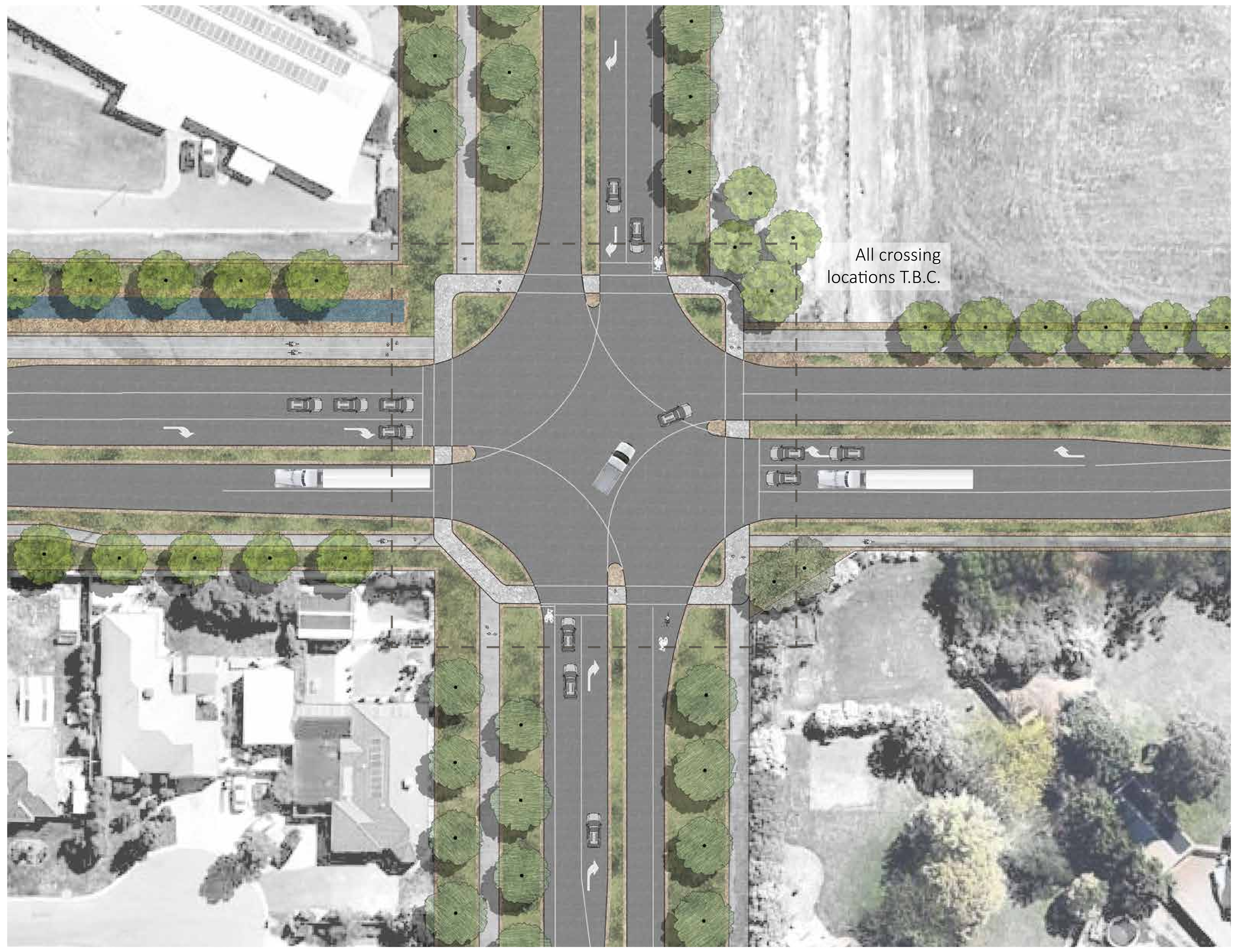
Rev
C

Overall Plan - Scale 1:1500 @ A0

Plan 04 - Scale 1:400

Section B

Sectional perspective B



Plan 05 - Scale 1:400

Section C

Sectional perspective C

Pink Ribbon features (i.e. picnic tables, seating benches, resting areas, etc)



Green and Blue ribbon features (i.e. WSUD road verges)

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Client
Greater Shepparton City Council

Project Name
Ford and Wanganui Roads

Project No.
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Address
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Key Plan

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Scale
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North

Phase
Final Master Plan

Sheet Title
Masterplan

Sheet No.
LD-SK-P03

Rev
C

Overall Plan - Scale 1:1500 @ A0


Plan 06 - Scale 1:400

Section D


Sectional perspective D

Plan 07 - Scale 1:400

Section E


Sectional perspective E

Yellow Ribbon features (i.e. shared user path, resting points, bike repair staions, etc)

Black ribbon features (i.e. artful signages, gates and entry driveways)

Plan 07 - Scale 1:400

Client	Greater Shepparton City Council			
Project Name	Ford and Wanganui Roads			
Project No.	0641MEL			
Address	Shepparton, Victoria			
Key Plan				

Issue Log

Rev	Revision Description	By / Checked	Date
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C	Final masterplan	HL/CB	8/2/18

Scale
As shown
1:1,500 — 0 20 40 60 80 100 M
1:400 — 0 5 10 15 20 25 M

North

Phase
Final Master Plan

Sheet Title
Masterplan

Sheet No.
LD-SK-P04

Rev
C

MCGREGOR COXALL

E.5 Appendix E5: Flood Modelling

Wanganui Rd Flood Modelling Investigation

Wanganui Road Flood Investigation

Greater Shepparton City Council

July 2017

Document Status

Version	Doc type	Reviewed by	Approved by	Date issued
01	Draft	Ben Tate	Ben Tate	27/07/2017

Project Details

Project Name	Wanganui Road Flood Investigation
Client	Greater Shepparton City Council
Client Project Manager	Eric Frescher
Water Technology Project Manager	Lachlan Inglis
Water Technology Project Director	Ben Tate
Authors	Lachlan Inglis
Document Number	5205_01_R01_V02a.docx

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27 July 2017

Eric Frescher
Design Engineer
Greater Shepparton City Council
Locked Bag 1000
SHEPPARTON, VICTORIA 3632

Dear Eric

Wanganui Flood Modelling Investigation

Please find the report below detailing the flood modelling investigation of the proposed upgrade to Wanganui Road as part of the Shepparton bypass project.

Yours sincerely

Lachlan Inglis
Project Engineer
lachlan.inglis@watertech.com.au
WATER TECHNOLOGY PTY LTD

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EXECUTIVE SUMMARY

Greater Shepparton City Council are investigating the proposed design of the Shepparton Bypass Link along Wanganui Road. Much of this alignment is prone to flooding and currently sits within the 1% AEP flood extent as shown in Figure 1-1. An upgrade of the road to Austroads\VicRoads standards requires the roadway (proposed 3 lane upgrade compared to existing 2 lanes) to be raised above the 1% AEP flood level.

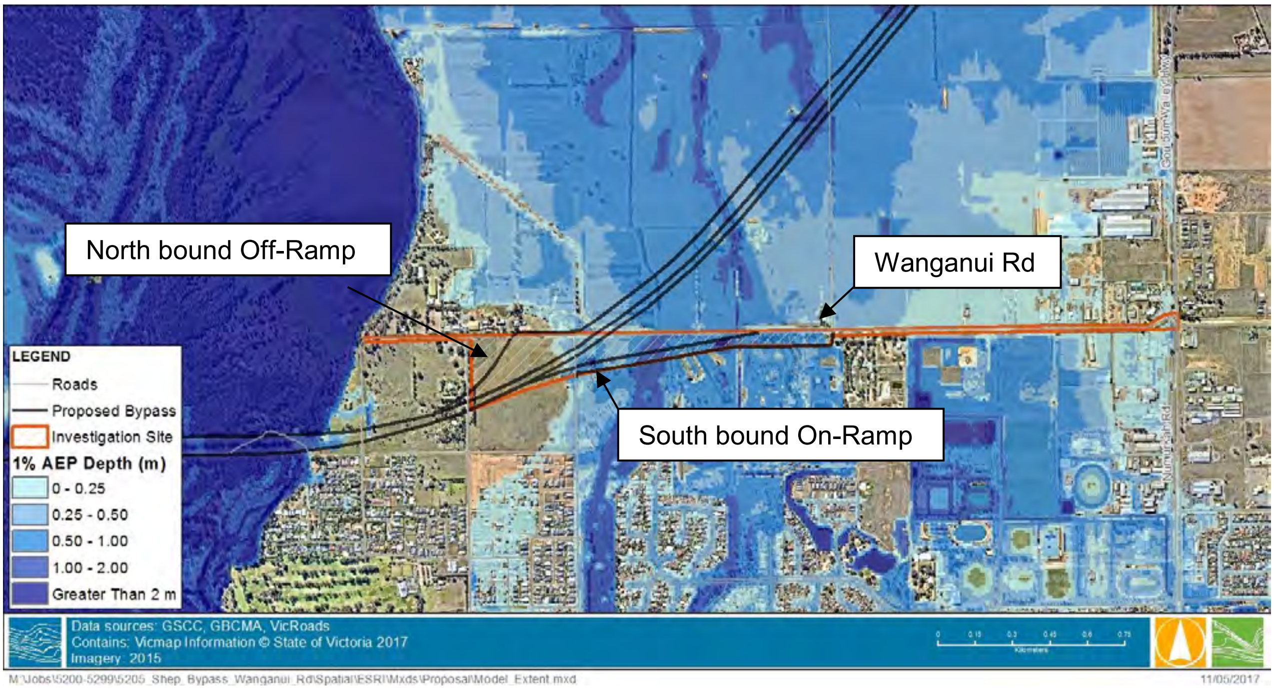

Figure 1-1 Site Map and Investigation Extent

The flood mapping undertaken has found that a peak flow rate of approximately 170 m^3/s overtops Wanganui Road in a 1% AEP event, with the majority of that flow being conveyed through a floodway between Kittles Road and Freemans Road. The floodway collects flow that breaks out of the Goulburn River to the south of Wanganui Road and is activated once the Goulburn River reaches a level of 11.0 m at the Shepparton streamflow gauge. This is considered a Major Flood event, similar to the floods experienced in 1974, 1993 and 2010. Under existing conditions, the flood level in a 1% AEP event is 111.3 m AHD, with depths close to one metre across the roadway. A number of roads in the area including Numurkah Road are inundated in a 1% AEP flood event.

Several mitigation options involving large banks of box culverts with up to 113 culverts were modelled, however the results showed the culverts were not able to convey the large flow efficiently, and resulted in significant increases in flood levels up to 2 km upstream of the roadway. It does not appear that box culverts alone will be suitable to convey the 1% AEP flow through the upgraded raised Wanganui Road without having adverse impacts on flood levels upstream of the roadway.

An alternative approach which used an extended floodway at Wanganui Road was modelled and showed that maintaining or improving the conveyance through the road was achievable without increasing flood levels upstream. This would however require either Wanganui Road to the west of the southbound onramp to be bridged or to be inundated and closed in a 1% AEP flood event. Further investigation into a suitable bridge or floodway design should be undertaken. Consultation with VicRoads to incorporate all proposed road alignments including entry and exit ramps is recommended given the extensive nature of flooding along the proposed bypass route.

CONTENTS

LIST OF FIGURES

LIST OF TABLES

1 INTRODUCTION

The proposed road upgrade along Wanganui Rd is still in the feasibility study stage, but will likely be a three-lane road (one lane either direction with centre median turning lanes), compared with the current two lane configuration. The road upgrade assumes raising of the road to be above flood level requirements for VicRoads. The length of road for the study area is approximately 3,230 m from the north bound off ramp at the most westerly location through to the Numurkah Road intersection in the east.

The design will also be required to provide adequate freeboard above the 1% AEP flood level and have appropriate drainage capacity to ensure no detrimental impacts on surrounding properties during a 1% AEP flood event. The AustRoads/VicRoads Guidelines are provided in Section 3.3.

Flood mapping was undertaken to assess Wanganui Road under existing conditions and the impact of the proposed upgrade on flooding conditions.

2 BACKGROUND

Shepparton and Mooroopna have a long history of flooding, with a number of significant historic flood events and subsequent flood mapping studies resulting in the flood behaviour being well documented and understood.

2.1 Current Planning Scheme

The Shepparton Mooroopna Floodplain Management Study[1] was undertaken in 2002 by Sinclair Knight Merz in conjunction with Lawson and Treloar Pty Ltd. This study used a MIKE 21 flood model to calibrate the flood events of 1974 and 1993 to within +/- 500 mm. The model topography utilised photogrammetry flown in September 1999 and a model grid resolution of 12.5 m for the 'inner area' and a 25 m grid resolution in the 'outer area'. The Wanganui Road area sits in the 'inner area'.

The modelling undertaken in the 2002 flood study formed the basis for the current planning scheme. The existing 1% AEP flood level along Wanganui Road is 111.2 m AHD. The existing flood level contours show a head drop of up to 0.40 m across the roadway. This highlights the road is acting as a hydraulic control across the floodplain in a 1% AEP flood event.

The current planning scheme (Figure 2-1) shows two sections of Urban Floodway Zone (UFZ) directly to the South of Wanganui Road, the western section measuring around 1.5 km along Wanganui Road while the eastern section is approximately 450 metres in length. North of Wanganui Road there is around 550 metres of Floodway Overlay (FO). The entirety of the Wanganui Road proposed for upgrade is within a Land Subject to Inundation Overlay (LSIO) on both the northern and southern sides of Wanganui Road.

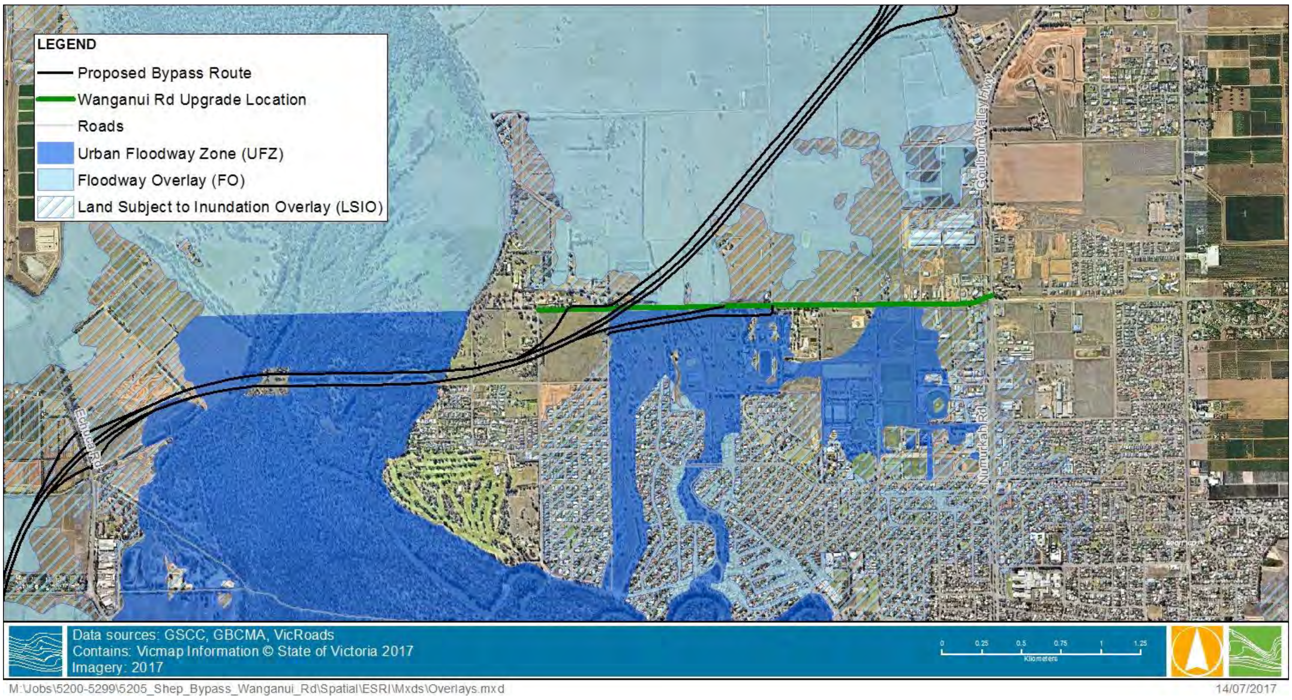

Figure 2-1 Current Flood Planning Controls at Wanganui Road

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[1] Sinclair Kinght Merz (2002), Shepparton–Mooroopna Floodplain Management Strategy, prepared for the Greater Shepparton City Council and the Goulburn Broken Catchment Management Authority

2.2 Shepparton-Mooroopna Flood Mapping and Intelligence Investigation

Water Technology are currently undertaking flood modelling of the Shepparton-Mooroopna area; this is currently the best available flood information for Shepparton and Mooroopna including the Wanganui Road site. The modelling for the Shepparton-Mooroopna Flood Mapping and Intelligence Study[2] used high resolution Light Detection and Ranging (LiDAR) survey, resampled to a 10 m grid resolution. The flood model extent for the Shepparton-Mooroopna Flood Mapping and Intelligence Study along with the model extent for the Wanganui Road model are shown in Figure 2-2. The model was calibrated using surveyed flood height marks from the 1993, 2010 and 1974 floods and further validated using aerial imagery from these events. Calibration of water levels for these events was aimed at within +/- 200 mm. Local drainage issues were not addressed as part of this study. At the time of the investigation, the calibration of the model to the historical events had been undertaken along with design modelling.

The modelling undertaken for the Wanganui Road Flood investigation replicated the modelling being undertaken for the ongoing flood mapping and intelligence study. This involved utilising the same model parameters as used in the Shepparton-Mooroopna Flood Mapping and Intelligence Study and ensuring existing conditions flood levels matched the ongoing flood study results.

[2] Water Technology (2017), Shepparton-Mooroopna Flood Mapping and Intelligence Study, prepared for the Greater Shepparton City Council

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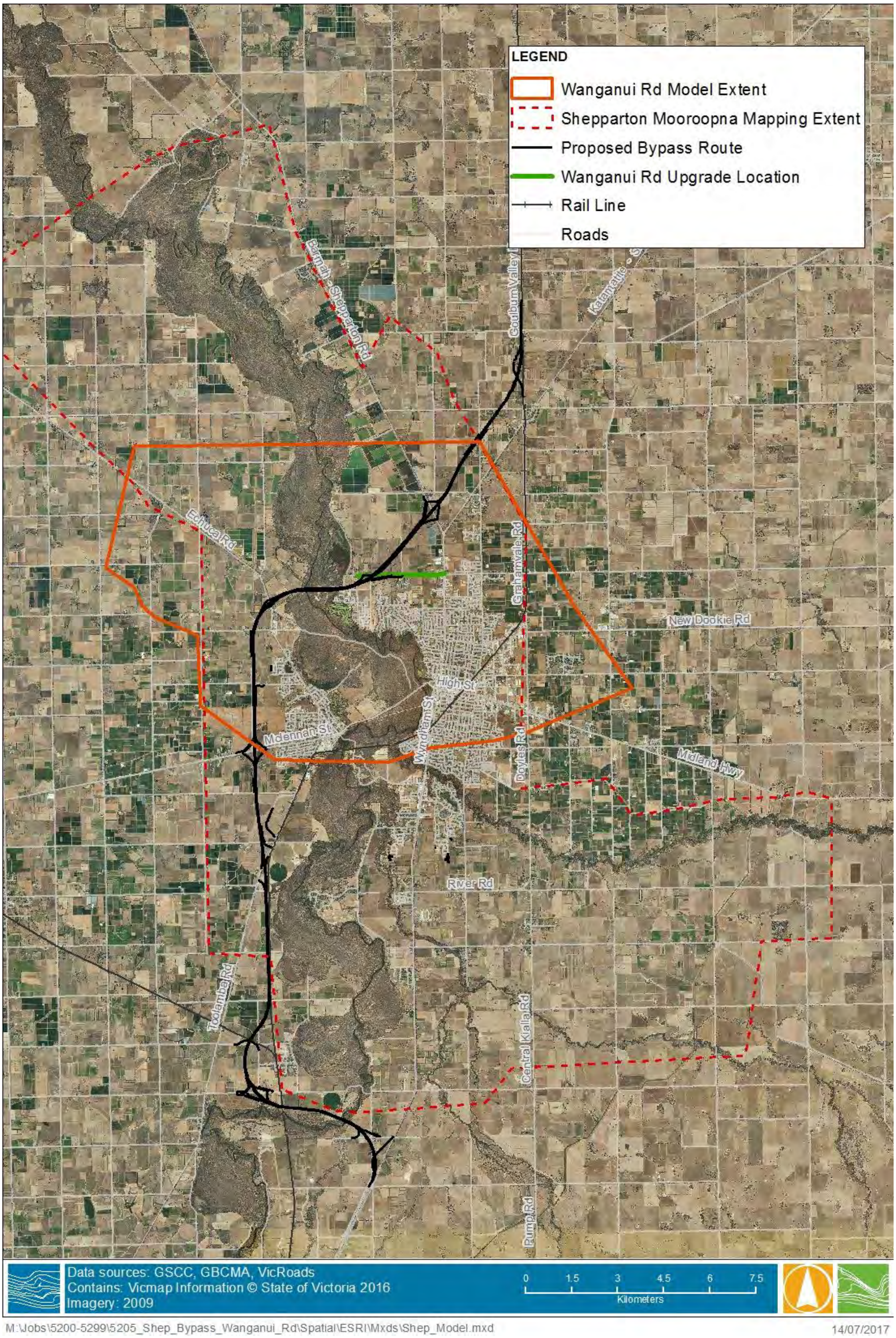

Figure 2-2 Flood Model Extents for Shepparton-Mooroopna Flood Mapping and Intelligence Study and the Wanganui Road Flood Modelling Investigation

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3 METHODOLOGY

The TUFLOW flood model from the Shepparton-Mooroopna Flood Mapping and Intelligence Study was trimmed to a smaller model of the Wanganui Road area, with the results validated back to results of the larger model.

3.1 Model Schematisation

The cut down TUFLOW model begins around 6 km upstream of Wanganui Road and incorporates inflows from the Shepparton-Mooroopna hydraulic model from the Broken River and Goulburn River at the upstream boundary inflow locations. The model extends 4 km downstream of Wanganui Road and uses tailwater data extracted from the Shepparton-Mooroopna hydraulic model. The model roughness parameters adopted in the Shepparton-Mooroopna hydraulic model were used in this model and are shown in Figure 3-1. A summary of the Mannings n values used are shown in Table 3-1.

Table 3-1 Materials Roughness Layer (Land Type & Manning's n)

Land Type	Roughness (Manning's 'n')
Roads	0.015
Crops	0.05
Medium Density Vegetation	0.07
High Density Vegetation	0.10
Stagnant Water Bodies	0.03
Industrial	0.06
Cleared Land/Open Space	0.04
1D River Channel	0.06
Broken River	0.10
Railway	0.10

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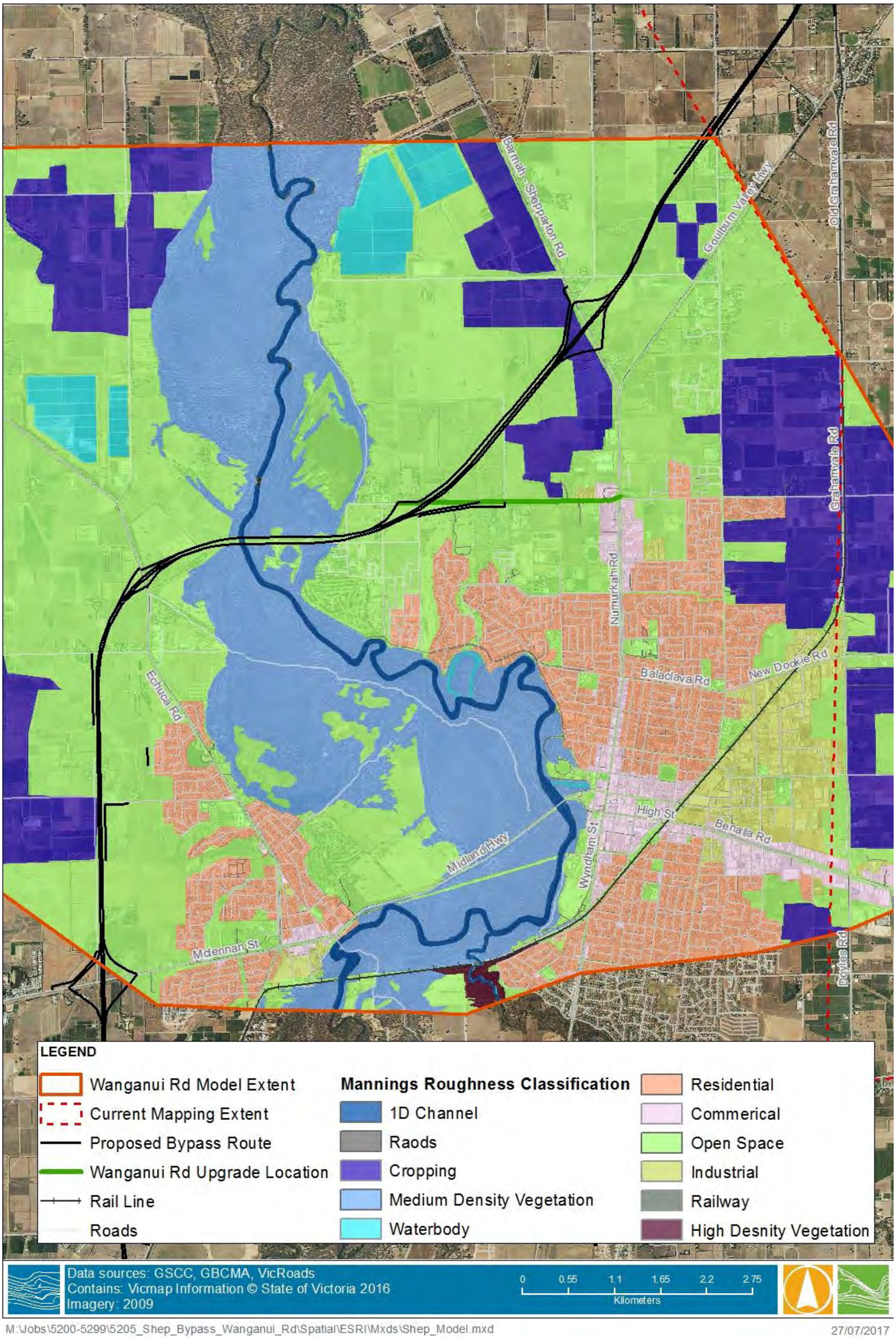

Figure 3-1 Cut down TUFLOW Model – Roughness Schematisation

3.2 Existing Conditions (Base Case)

The model was run to simulate a 1% AEP flood event at Shepparton with a streamflow gauge height of 12.3 m. This is above the current classification for a Major Flood Event as defined by the Bureau of Meteorology. The Flood Class Levels along with historical flood heights at the Shepparton streamflow gauge are shown in Table 3-2. The 1% AEP flood extent, depth and water surface elevation for existing conditions are shown in Figure 3-2 to Figure 3-4. A long section of the existing conditions water surface and topography along Wanganui Road is shown in Figure 3-5.

Table 3-2 Key Flood Levels (Shepparton Streamflow Gauge)

Flood Event	Gauge Height at Shepparton
Minor Flood	9.50m
2011	9.82 m
Moderate	10.70 m
Major	11.00 m
2010	11.09 m
1993	11.71 m
1974	12.09 m
1916	12.25 m
1% AEP Flood Event	12.30 m

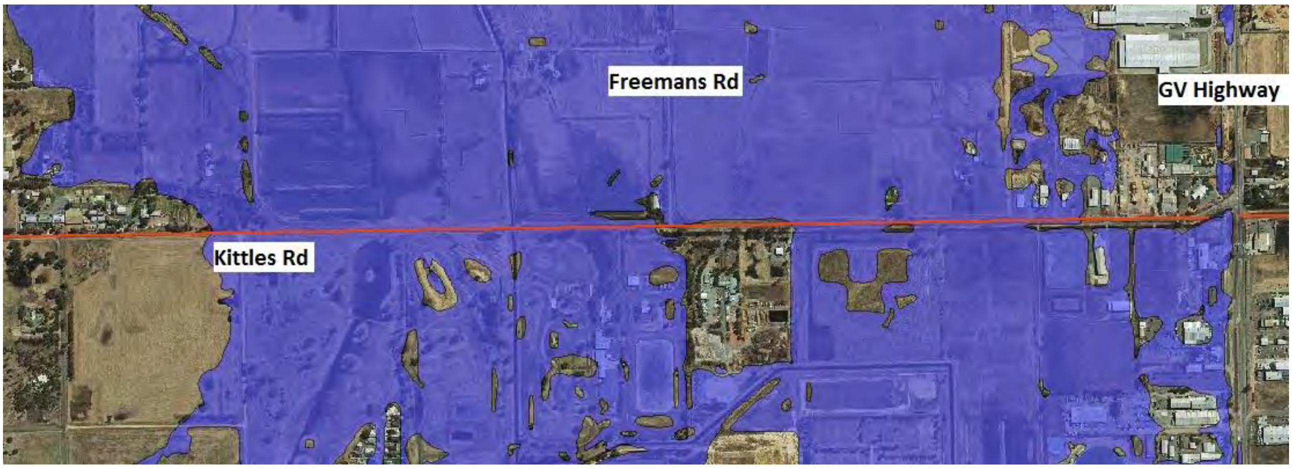

Figure 3-2 1% AEP Existing Conditions Flood Extent at the Site

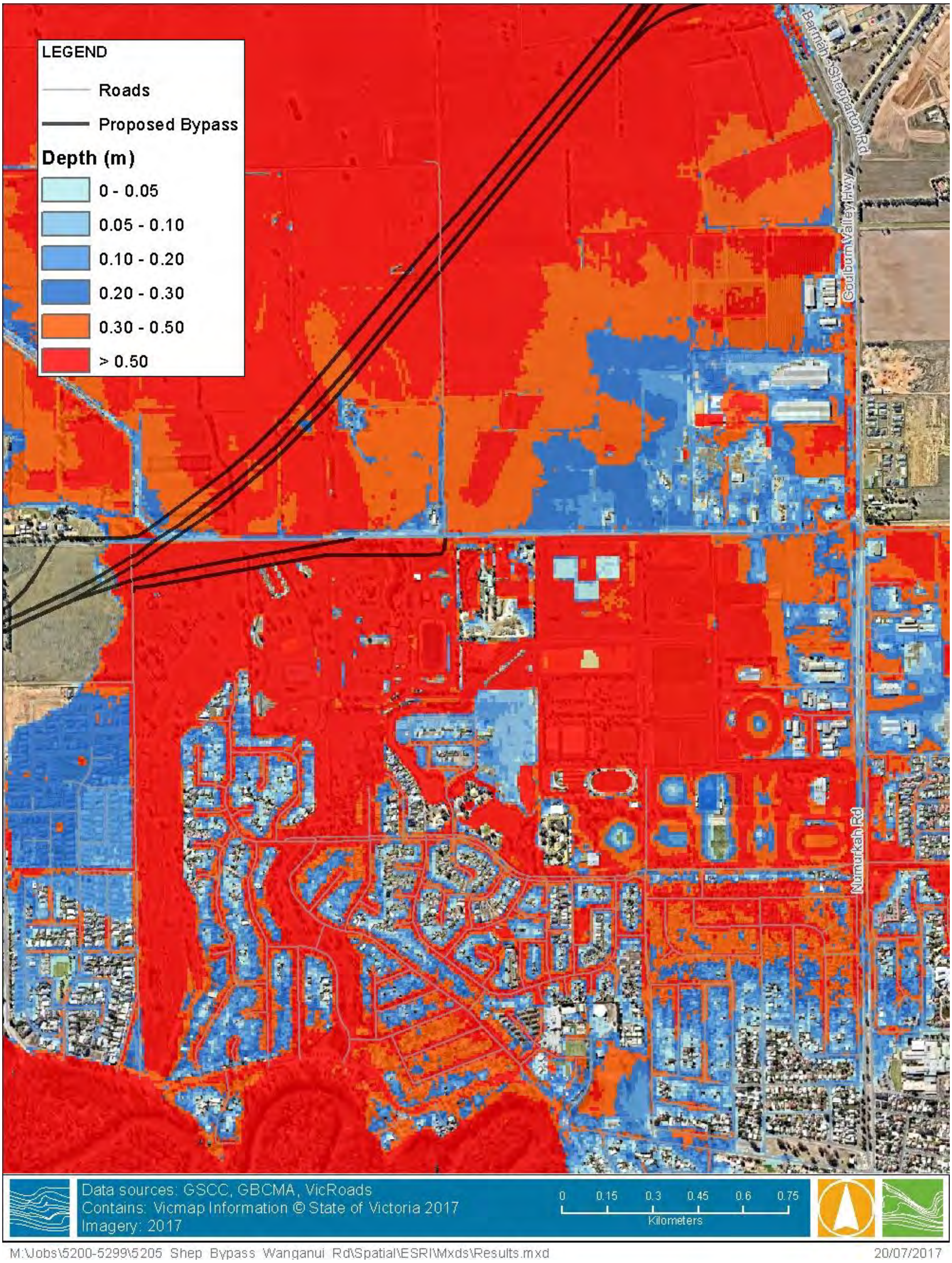

Figure 3-3 1% AEP Existing Conditions Flood Depth at the Site

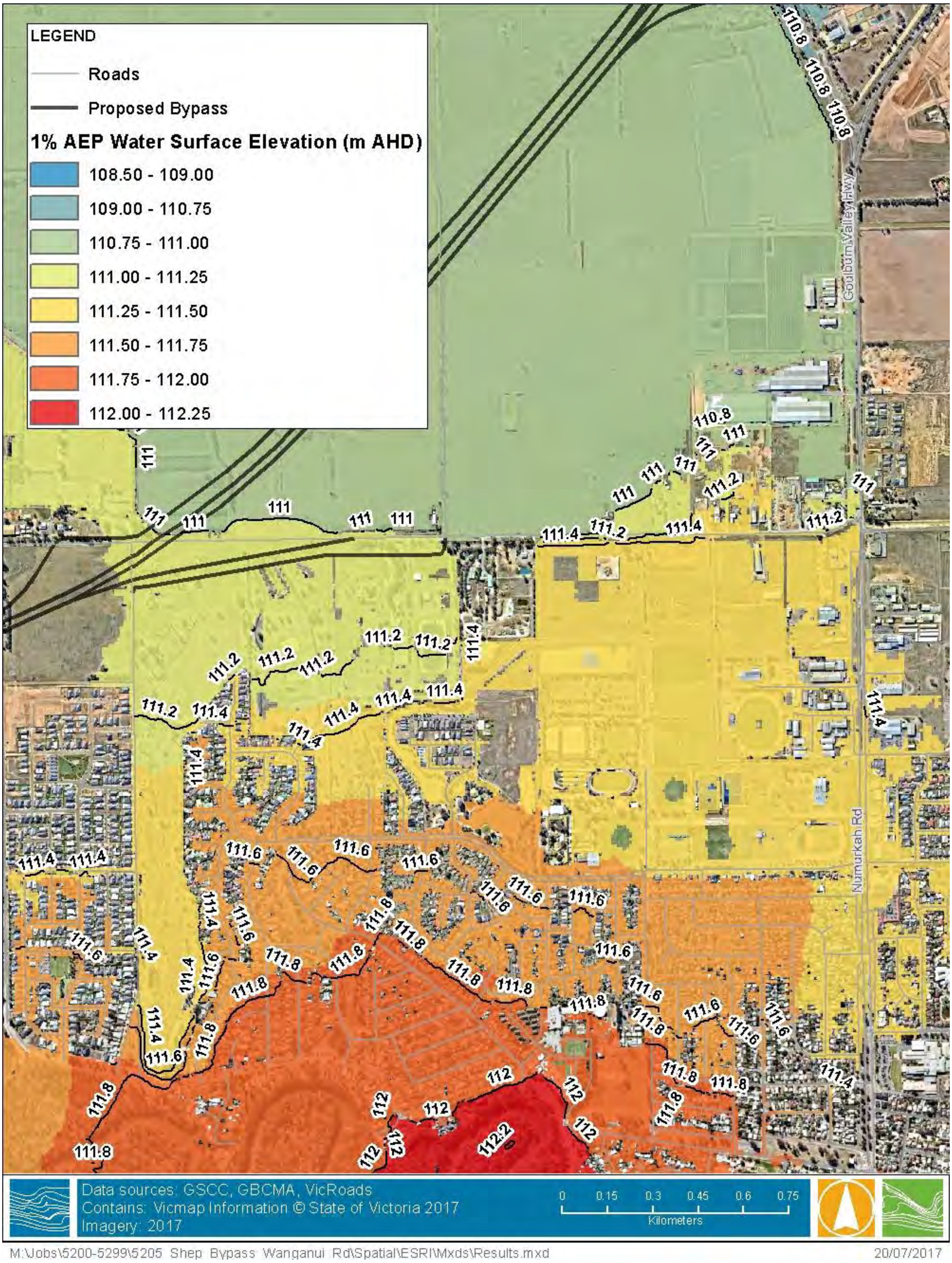

Figure 3-4 1% AEP Existing Conditions Water Surface Elevation at the Site

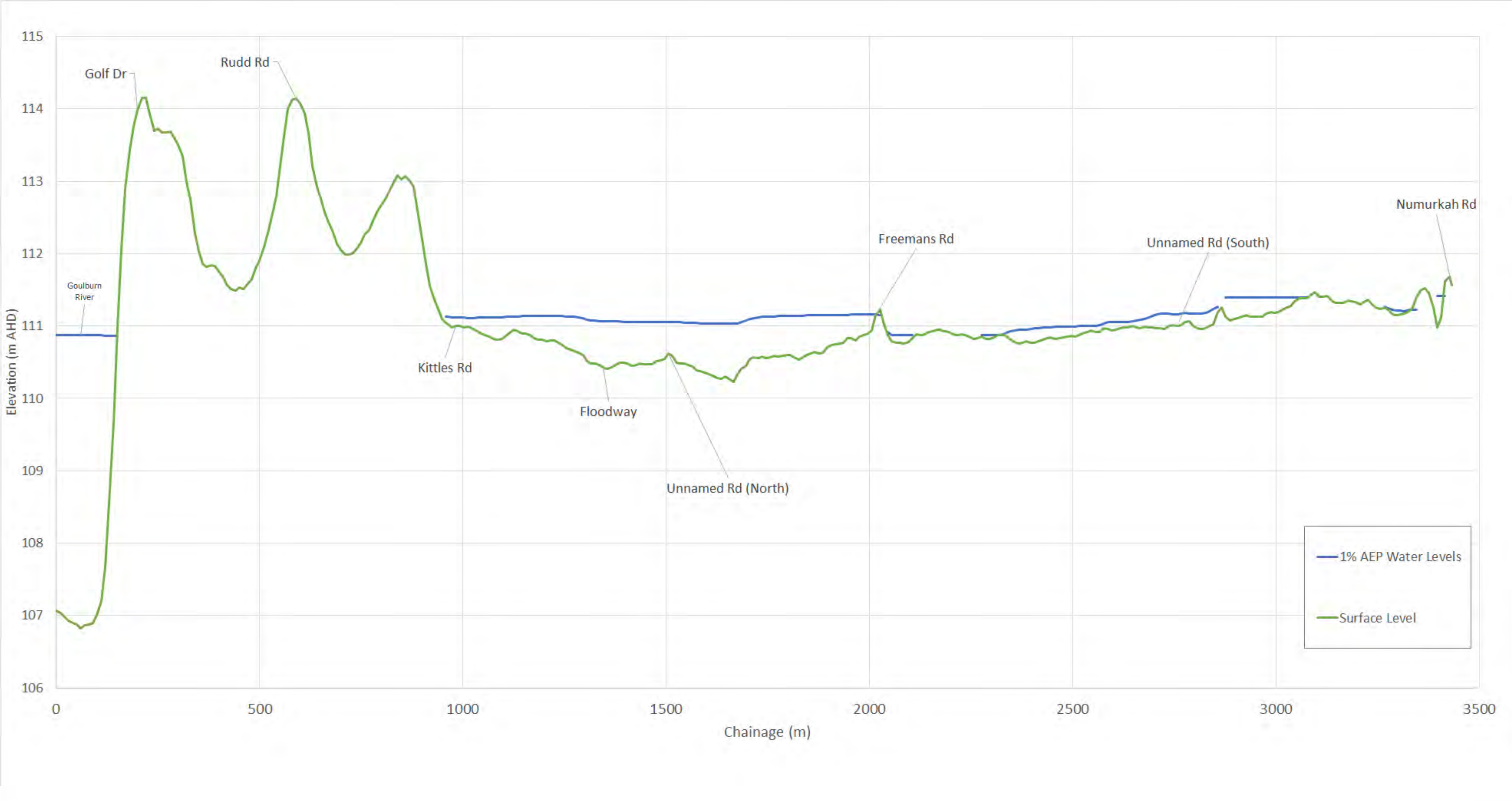

Figure 3-5 Long Section of Wanganui Road Existing Conditions 1% AEP Flood Levels

3.3 Austroad/VicRoads Guidelines

The following conditions regarding the guidelines for the Wanganui Road upgrade were supplied by GTA consultants and refer to Table 4.3 in the Austroads Guide to Road Design, Part 5: Drainage Design, noting the following:

- 1 in 100 year ARI flood level used as design level for Wanganui Road
- Apply a freeboard of 500 mm on top of design level given the flat terrain in the area
- Water sensitive urban design and retardation of stormwater requirement will be carried out as per VicRoads Water Sensitive Road Design guidelines
- Bridge design – 1 in 100 year ARI flood level

Based on the existing flood information, it is expected that the roadway would have a minimum elevation of 111.4 to 111.9 m AHD based on a minimum of 500 mm freeboard on the 1% AEP level. Given the extremely flat nature of the surrounding terrain, it was anticipated that this would generate higher water levels from ponding against the roadway. This will have significant implications to the residential areas upstream of Wanganui Road.

3.4 Goulburn Broken CMA Guidelines

The Goulburn Broken CMA were initially consulted regarding the upgrade of Wanganui Road and highlighted its concerns around location of the road and its orientation which is perpendicular to the flow path across the floodplain. It noted the roadway in its existing condition (along with a number of GMW irrigation channels) currently act like a levee, ponding flood water behind the roadway. The GBCMA recommended negotiating the level of protection for the roadway given any increase in the road level would likely result in increased flood levels on the upstream (southern) side of Wanganui Road. The GBCMA also recommended the use of a floodway or bridged structure if possible to increase the conveyance of flow across the roadway compared to the use of box culverts. The GBCMA are not likely to support a road design that results in increased flood levels to residential properties that result in above floor flooding.

4 RESULTS

Several design scenarios for the upgraded Wanganui Road were modelled, starting with the initial design of several box culverts, and ending with a floodway or bridged section of roadway to increase the conveyance across Wanganui Road. The results are presented below.

4.1 Developed Scenario 1

The initial mitigation option involved locating four sets of culverts at locations along Wanganui Road where the existing conditions modelling results showed high areas of flow. A total of 51 culverts with a combined waterway area of 35.6 m^2 were placed in the model with downstream invert levels often the limiting factor in providing the initial level at which the culverts will convey flow. The roadway was raised to an elevation of 111.5 m AHD as a conservative approach (this is below the required 500 mm freeboard outlined by GTA consultants). Initial cut and fill calculations which do not take into account batter slopes required for the filled roadway provide were undertaken to provide an estimate of earthworks for the road upgrade. Filling to this level requires approximately 28,000 m^3 of fill to be sourced to raise the Wanganui Road surface to 111.5 m AHD.

The model results show Wanganui Road is overtopped despite the increase in elevation to 111.5 m AHD and results in a significant increase in the flood extent to the south of Wanganui Road. The depth plot for this scenario is shown in Figure 4-1, while a flood level difference plot is shown in Figure 4-2. This shows a significant increase in flood levels immediately upstream of Wanganui Road along the length of the road (up to 0.56 m), and extends around 2 km upstream of the roadway along the floodway. This increase is significant and impacts around 2,000 properties, many of which would now be flooded above floor under this scenario.

All culverts modelled are running full and convey a maximum of 73 m^3/s, with around 86 m^3/s travelling over Wanganui Road. The maximum depth across the road is reduced to around 100 to 150 mm.

This scenario does not meet either Austroads/VicRoads or GBCMA requirements.

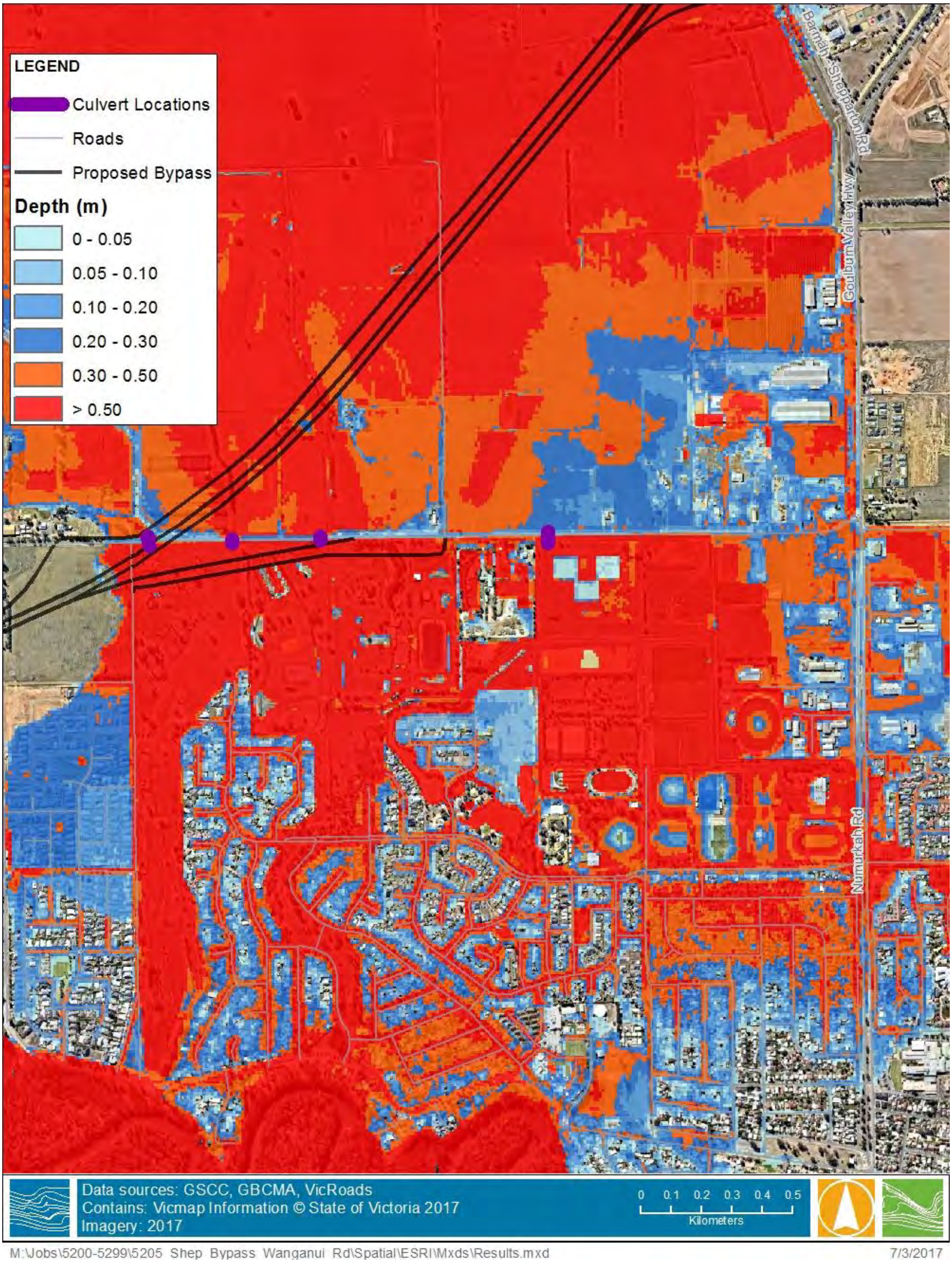

Figure 4-1 1% AEP Flood Depth for Developed Scenario 1

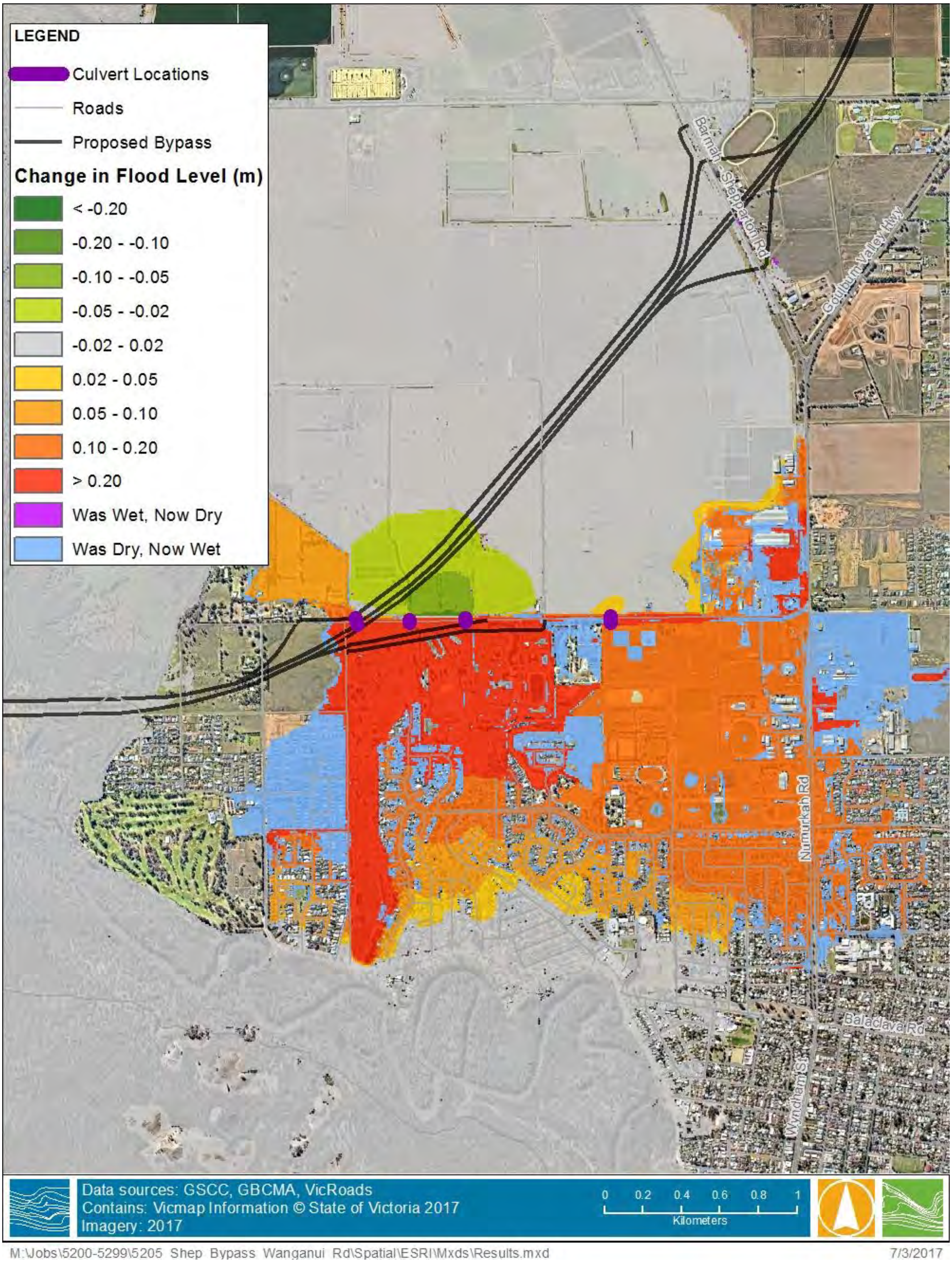

Figure 4-2 1% AEP Flood Level Change for Developed Scenario 1

4.2 Developed Scenario 2

The second mitigation option involved the addition of two sets of culverts increasing the total culverts to 84 with a combined waterway area of 58.0 m^2, an increase in conveyance area of 62% compared to scenario 1. The roadway was again raised to an elevation of 111.5 m AHD, same as Scenario 1.

The model results show Wanganui Road is overtopped despite the increase in road elevation to 111.5 m AHD and the increased culvert capacity as compared to Scenario 1. The flood extent upstream of Wanganui Road is significantly increased. The depth plot for this scenario is shown in Figure 4-3, while a flood level difference plot is shown in Figure 4-4. This shows a significant increase in flood levels immediately upstream of Wanganui Road along the length of the road (up to 0.53 m) and extends around 2 km upstream of the roadway along the floodway. This increase is significant and impacts around 2000 properties, many of which would now be flooded above floor under this scenario.

All culverts are running full and convey a maximum of 108 m^3/s, with around 50 m^3/s travelling over Wanganui Road. The maximum depth across the road is reduced to around 80 to 100 mm.

This scenario does not meet either Austroads/VicRoads or GBCMA requirements.

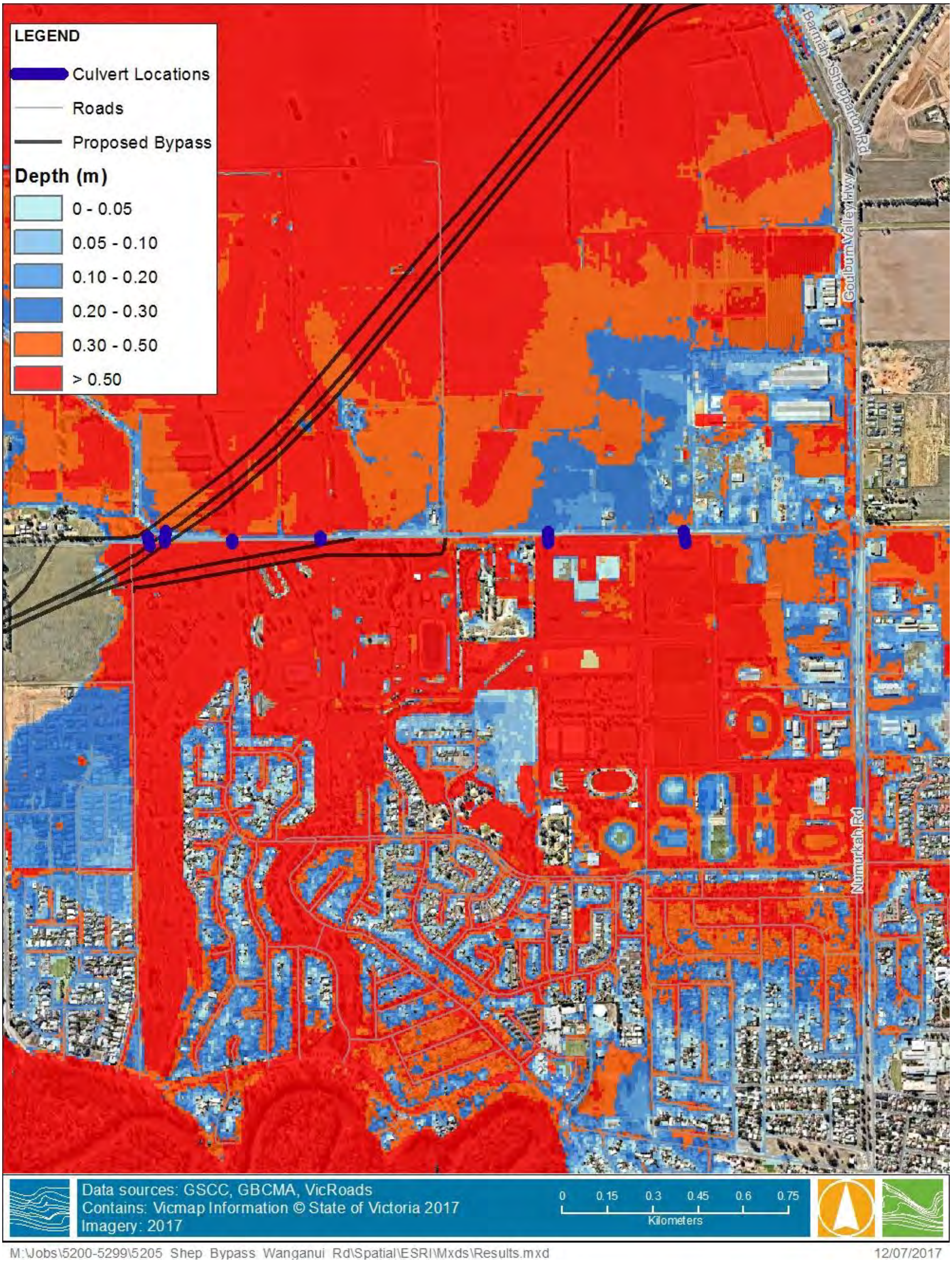

Figure 4-3 1% AEP Flood Depth for Developed Scenario 2

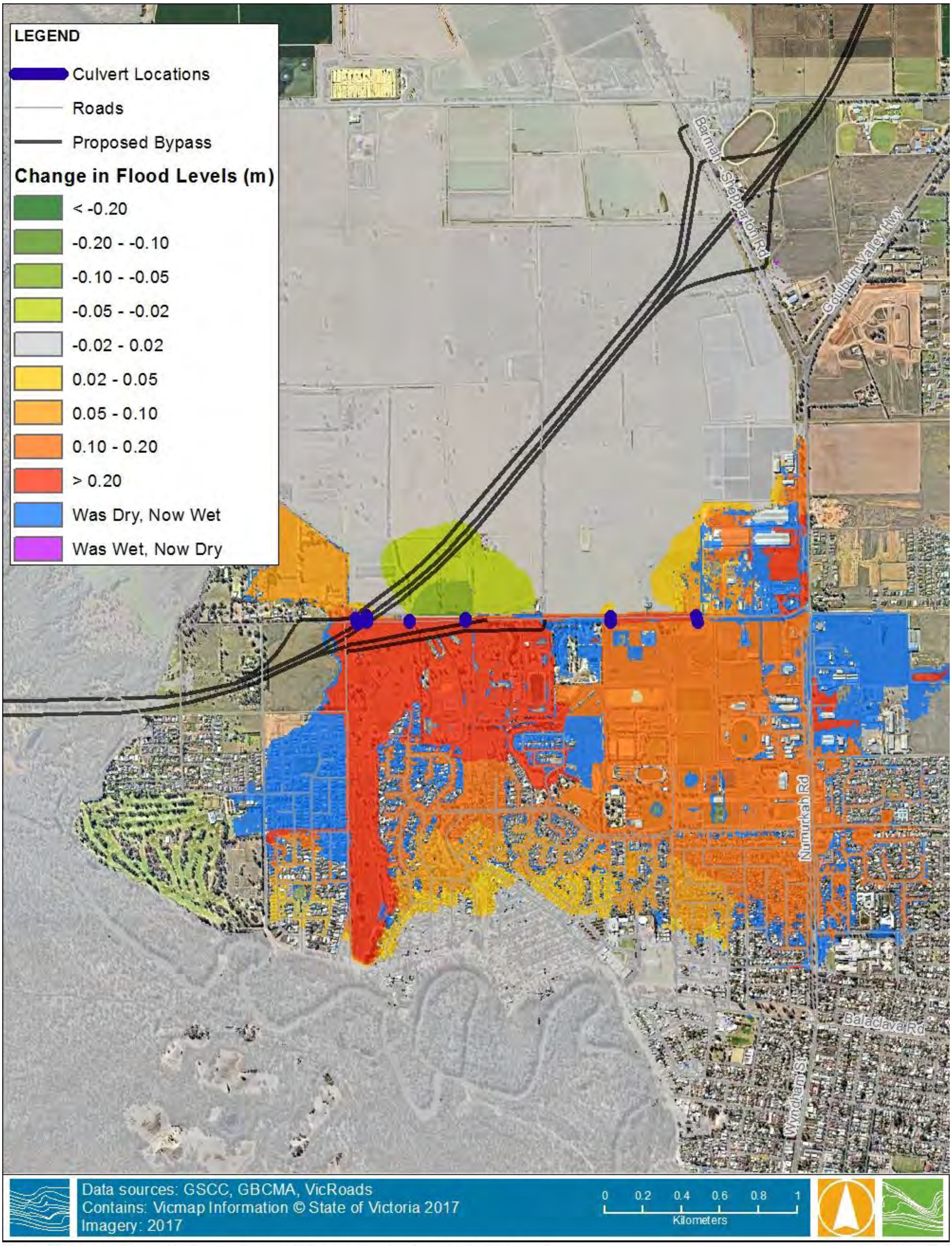

Figure 4-4 1% AEP Flood Level Change for Developed Scenario 2

4.3 Developed Scenario 3

The third mitigation option increased the total culverts to 121 with a combined waterway area of 82.2 m^2, an increase in conveyance area of 25% from scenario 2. The roadway was again raised to an elevation of 111.5 m AHD same as Scenario 1 and 2.

The model results show Wanganui Road is overtopped despite the increase in elevation to 111.5 m AHD and the further increases to culvert capacity. The flood extent upstream of Wanganui Road is significantly increased. The depth plot for this scenario is shown in Figure 4-5, while a flood level difference plot is shown in Figure 4-6. This shows a significant increase in flood levels immediately upstream of Wanganui Road along the length of the road (up to 0.49m) and extends around 2 km upstream of the roadway along the floodway. This increase is significant and impacts around 2,000 properties, many of which would now be flooded above floor under this scenario.

All culverts are running full and convey a maximum of 140 m^3/s, with only 20 m^3/s travelling over Wanganui Road. The maximum depth across the road is reduced to around 50 to 60 mm.

This scenario does not meet either Austroads/VicRoads or GBCMA requirements.

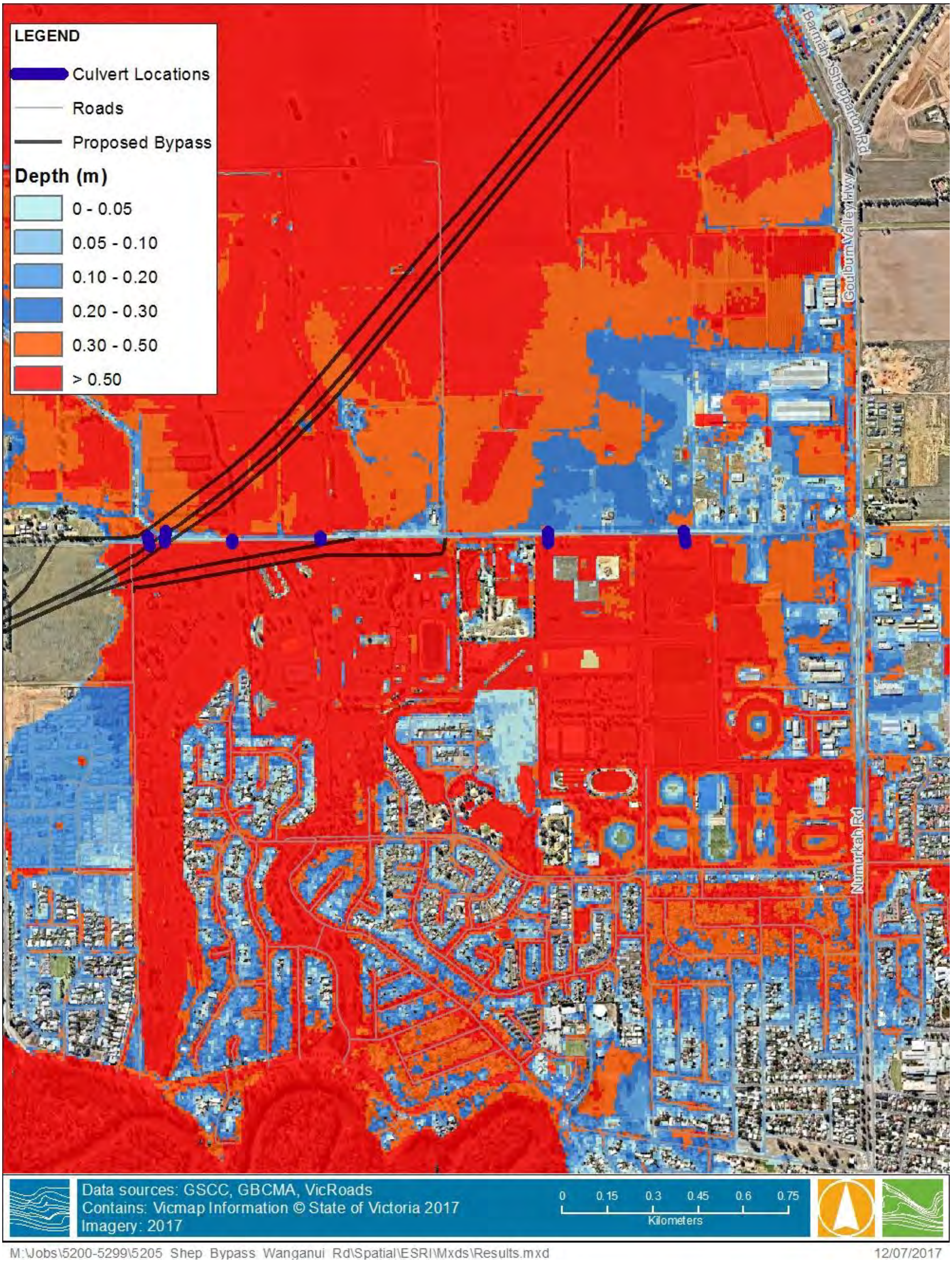

Figure 4-5 1% AEP Flood Depth for Developed Scenario 3

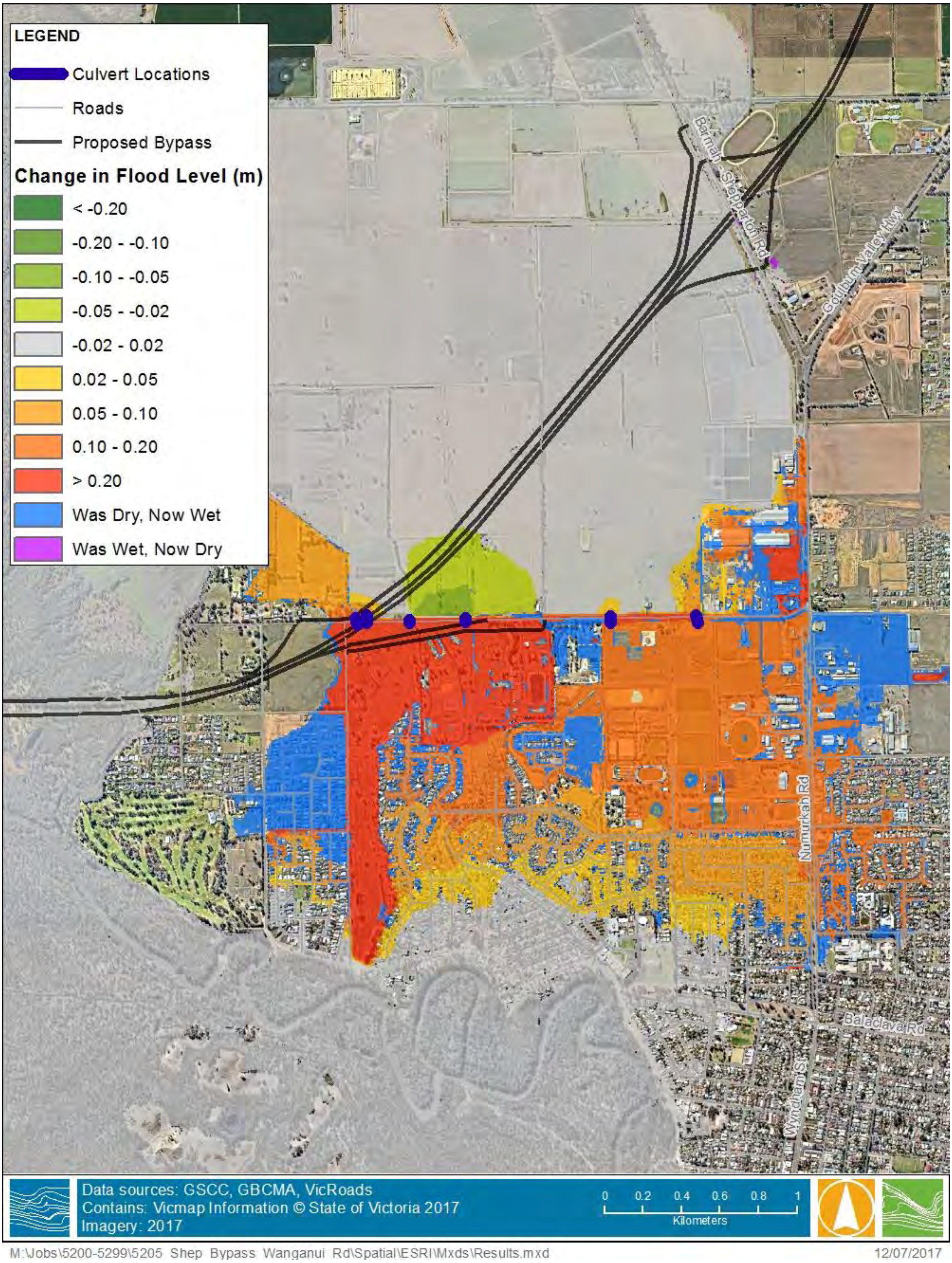

Figure 4-6 1% AEP Flood Level Change for Developed Scenario 3

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4.4 Developed Scenario 4

The fourth scenario involved raising the roadway to a level of 111.6 m AHD to ensure no water was able to overtop the roadway. Furthermore, the floodway to the south of Wanganui Road was extended around 1,200 metres through private property north of Wanganui Road, to provide a more defined flow path. The floodway was extended to flow into a flood runner located north of a GMW drain. The GMW Drain (Drain No. 3) was removed from the topography to allow for additional conveyance. This would require a syphon under the floodway. The extent of the floodway extension and the modified topography of the floodway which ties into the levels south of Wanganui Road and north of GMW Drain No. 3 is shown in Figure 4-7. The number of culverts was increased to 140 with an extra 8 culverts located at the floodway. This provided a combined waterway area of 95.4 m^2, an increase in conveyance area of 15% from scenario 3. It is estimated around 60,000 m^3 of earth would be excavated for the floodway extension while the increased roadway height would require approximately 35,000 m^3 of fill, an increase of 7000 m^3 compared to the previous three scenarios.

This shows a significant increase in flood levels immediately upstream of Wanganui Road along the length of the road (up to 0.39 m) but still extends around 2 km upstream of the roadway along the floodway. This increase is significant and impacts around 2,000 properties, many of which would now be flooded above floor under this scenario. The increased culvert capacity and floodway extension improved results compared with scenario 3 between 5-10 cm in most areas.

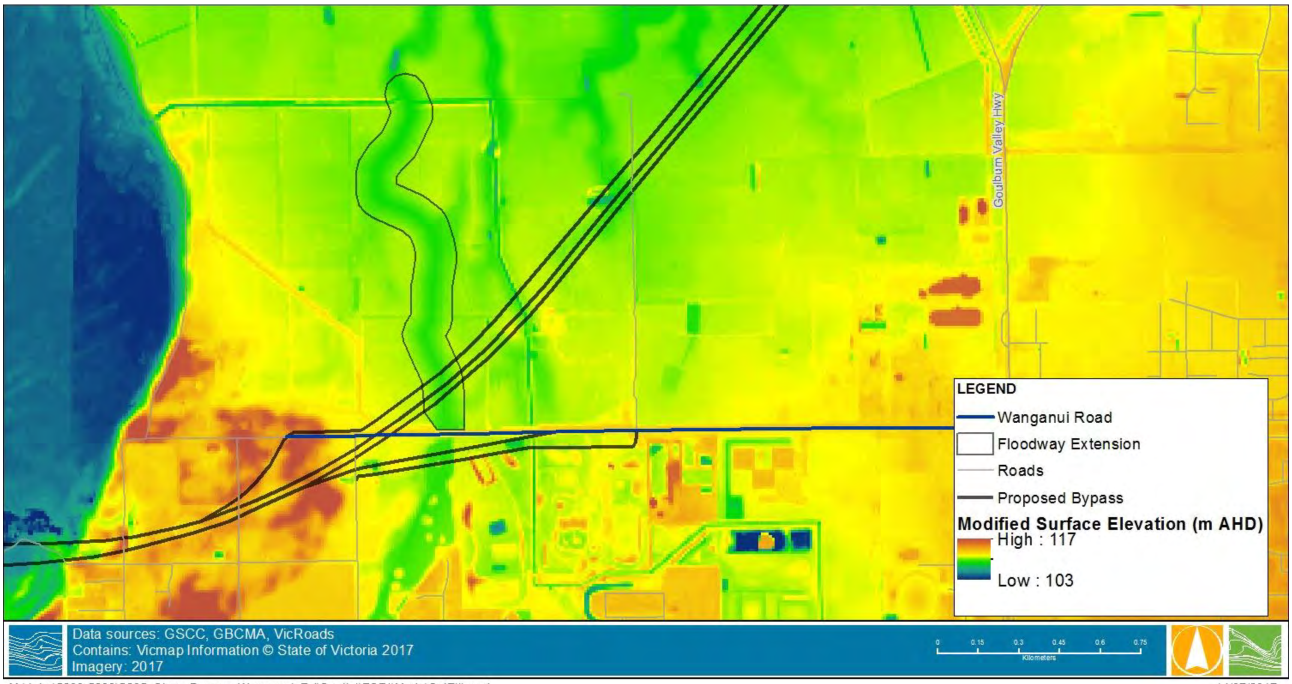

Figure 4-7 Scenario 4 – Modified Topography to include floodway extension

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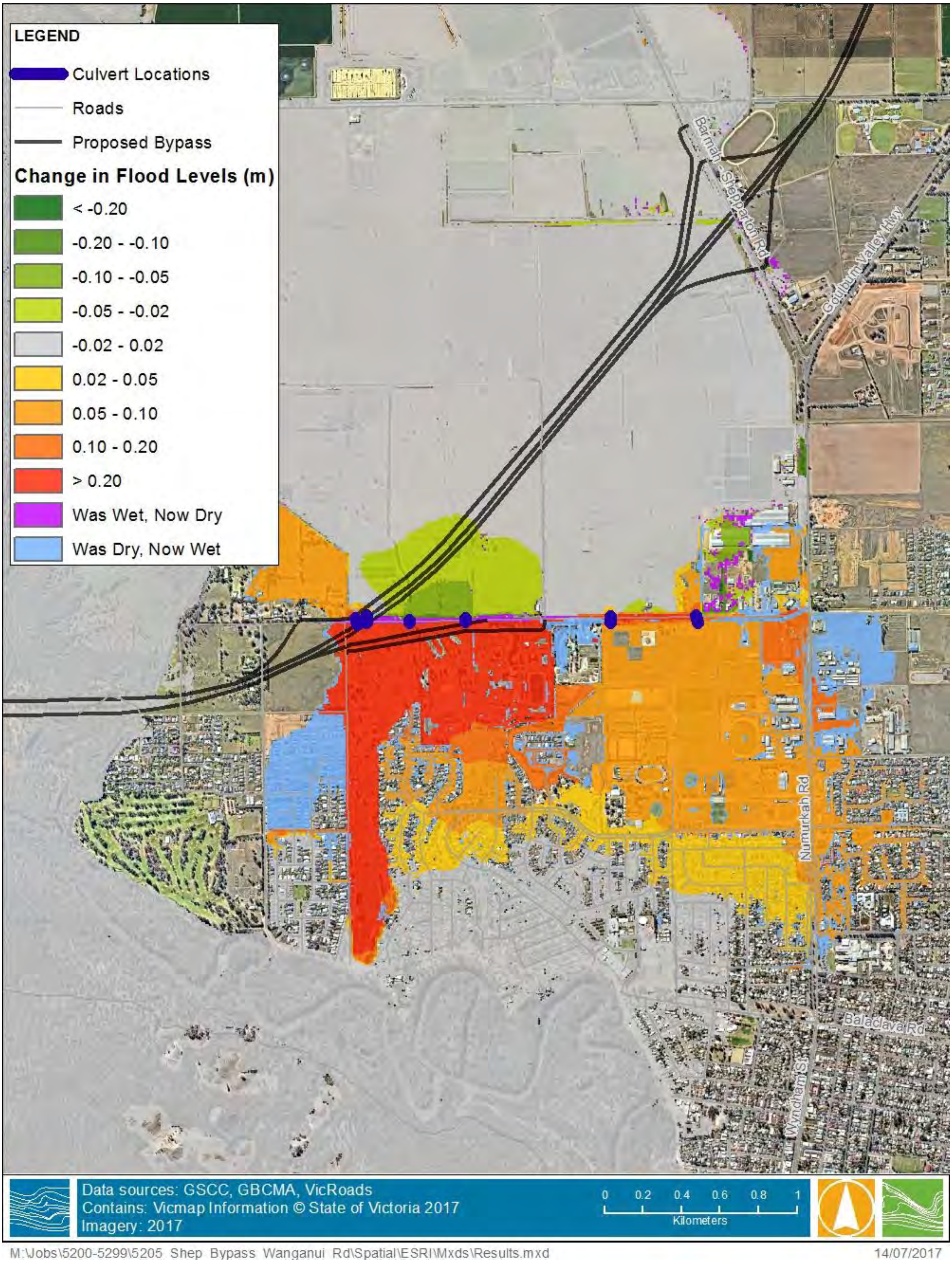

Figure 4-8 1% AEP Flood Level Change for Developed Scenario 4

4.5 Developed Scenario 5

Based on the improvements shown in Scenario 4, the floodway was shown to be important in ensuring flows were not held up. An approach was taken to remove around 200 m of the roadway at the floodway to provide a free opening. This was considered to be the best case scenario for a bridge structure, given no piers were modelled. The set of culverts at the floodway were removed along with the most westerly bank of culverts leaving four culvert banks with a total of 80 culverts with a combined waterway area of 52.2 m^2.

The depth plot is provided in Figure 4-9 and the flood level difference plot is provided in Figure 4-10. The results show an improvement not only compared to the other designs but also show a reduction in the existing condition flood levels. There is a reduction of around 4 cm in the 1% AEP flood level compared to existing conditions through the floodway to the south, with the flood extent slightly reduced upstream. There is a minor increase in flood levels to the north of Wanganui Road at a location of one of the culvert banks. This increase is in the order of 3-8 cm, with one property with several buildings having increased flood levels. It is likely that a realignment of the culvert locations or some changes the culvert capacity and/or the local topography levels north of Wanganui Road would remove the increased flood levels at this property. To the south of Wanganui Road, there is a minor increase in the flood extent into the Shepparton Waste Transfer & Recycling Centre. Similar to the increase north of Wanganui Road, this could be resolved easily with minor earthworks.

East of the southbound on ramp, the roadway remains above the 1% AEP Flood level but would rely upon a bridged section of around 400 to 8000 m to be included west of the southbound on ramp as well as excavation works at the floodway.

The most westerly located culvert set flowed at a maximum of 52% of capacity which would suggest a further reduction in the number of culverts could also be achieved, possibly reduced down to a total of 30 to 50 culverts.

This scenario also shows potential for a further reduction in flood extent to the south through refinement of the floodway including a possible extension of the floodway (similar to developed scenario 4). It is estimated around 5,000 m^3 of earth would be excavated for the floodway extension while the increased roadway height would require approximately 20,000 m^3 of fill (assuming no earthworks west of the floodway).

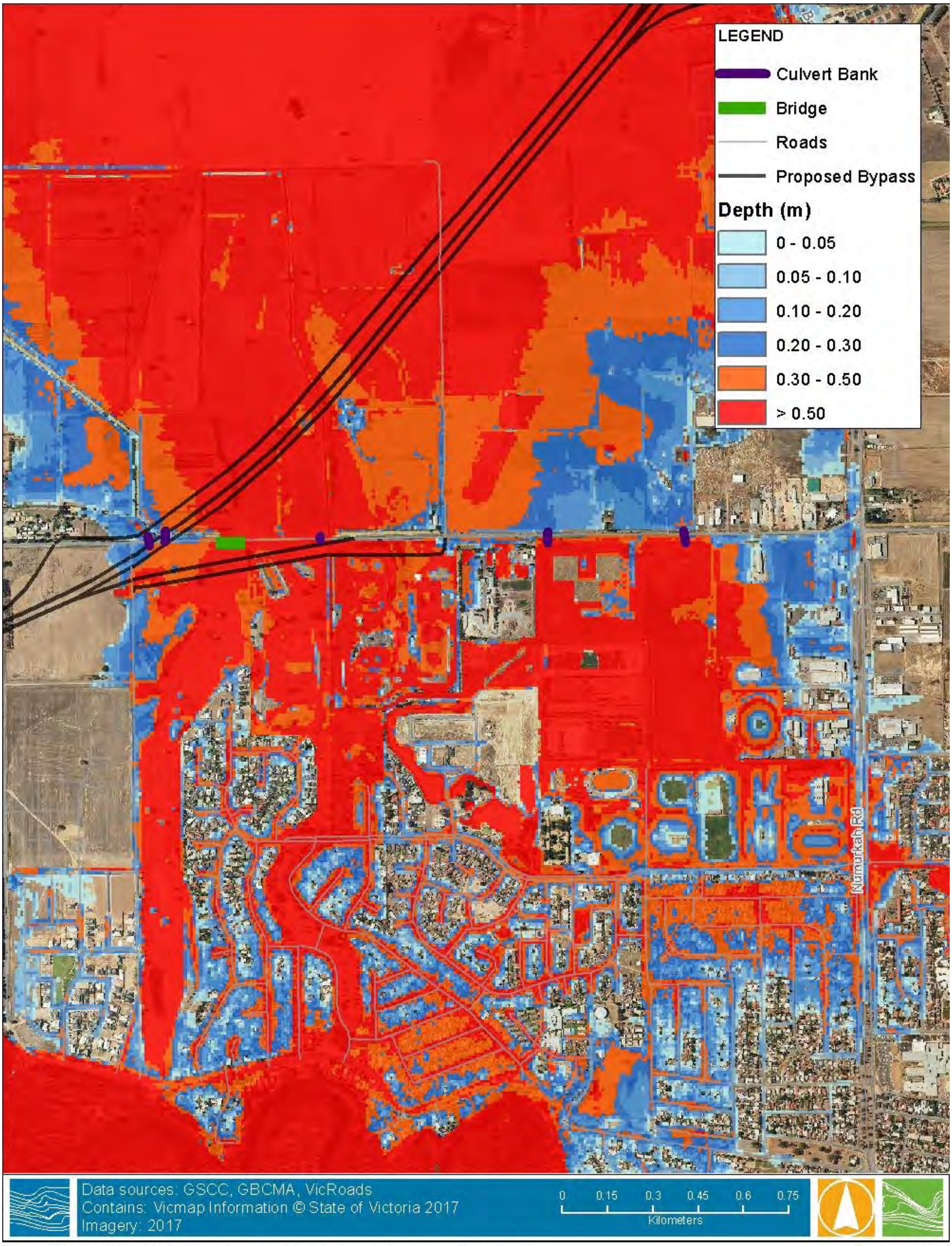

Figure 4-9 1% AEP Flood Depth for Developed Scenario 5

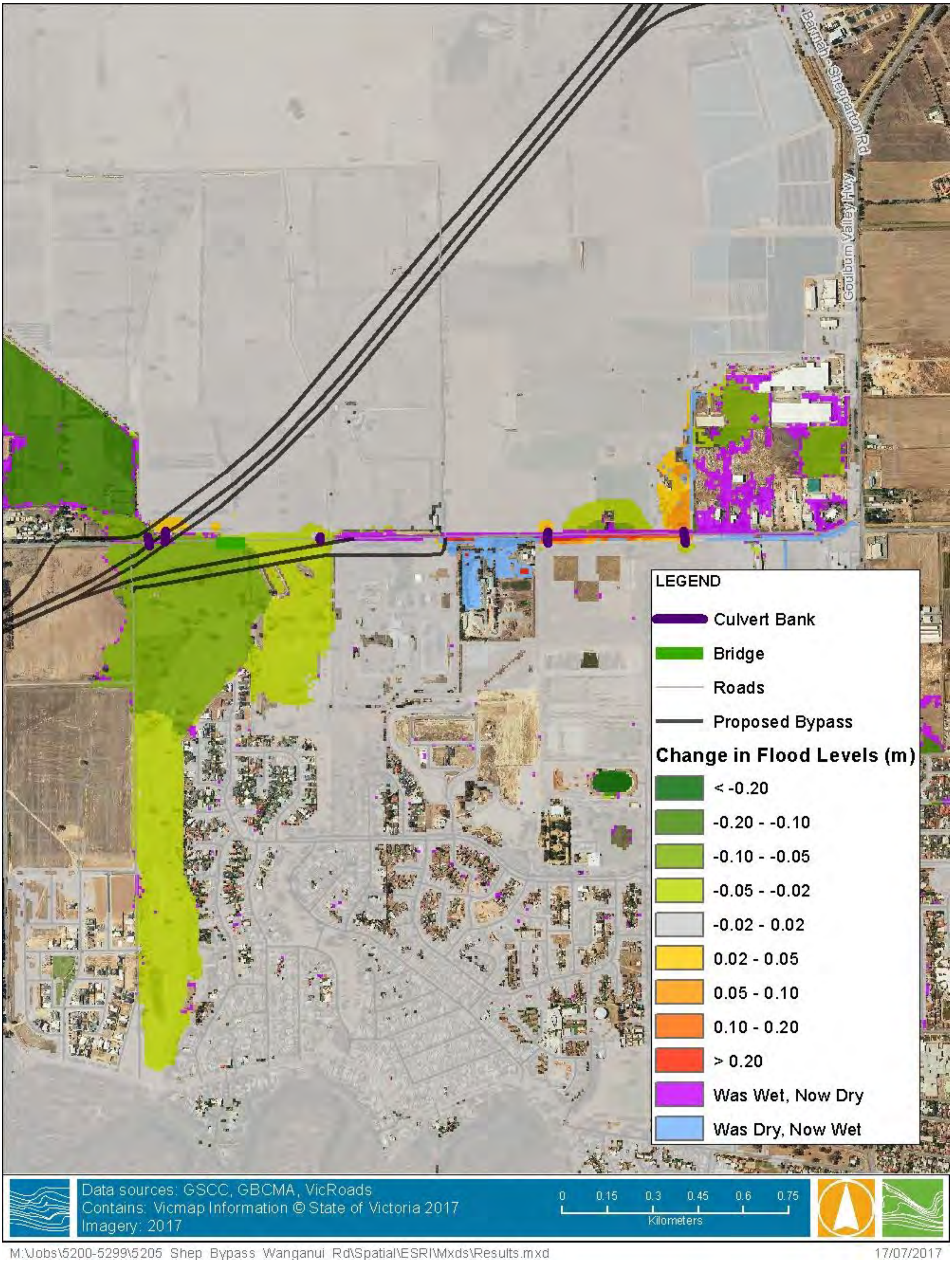

Figure 4-10 1% AEP Flood Level Change for Developed Scenario 5

4.6 Summary

None of the five scenarios modelled were able to meet both the VicRoads requirements to be flood free with appropriate freeboard above the 1% AEP flood level while also ensuring no increased flood levels as a result of the road design. The total flow conveyed through culverts or over Wanganui Road for the five scenarios assessed are summarised in Table 4-1. Developed Scenario 5 was able to show that the roadway east of the southbound on ramp could be raised above the flood level without having significant increases on flood levels. This appears to be the most promising scenario option to pursue further. All developed scenarios did not include the main bypass or on-off ramp alignments. It is anticipated that these alignments will be designed to have no increase in flood levels and maintain existing conveyance across the floodplain up to a 1% AEP flood event by bridging the floodplain.

A long section shown in Figure 4-11 shows the existing road surface level, the scenario 5 modelled road surface level, and the scenario 5 flood level. A recommended bridge or road deck height is also shown for the floodway area, this has been set at 300 mm above the flood level for scenario 5. Figure 4-11 shows the road levels east of the south bound on ramp that incorporates a 500 mm freeboard above the 1% AEP level. These levels then tie in to the bridge or floodway levels west of the south bound on ramp. It is estimated that this will require an additional 15,000 m^3 of fill to raise the roadway to this level of freeboard compared with the scenario 5 fill level. An example of a floodway height is also included in Figure 4-11.

Table 4-1 Summary of Pipe and Overland Flow at Wanganui Road.

	Road Elevation (m AHD)	Number of Culvert Banks	Total Culverts	Total Flow Culverts (m^3/s)	Flow Over Wanganui Road (m^3/s)	Maximum Depth on Wanganui Road (m)
Existing Conditions	110.2 to 111.5	N/A	N/A	N/A	167	0.70
Scenario 1	111.5	4	51	73	80	0.15
Scenario 2	111.5	6	84	108	60	0.09
Scenario 3	111.5	6	113	141	31	0.06
Scenario 4	111.6	6	140	161	1	0.02
Scenario 5	111.6 (East of Sth-Bnd on ramp)	4	80	33 excluding floodway	135 through floodway	1.40 m through floodway (this section could be bridged)

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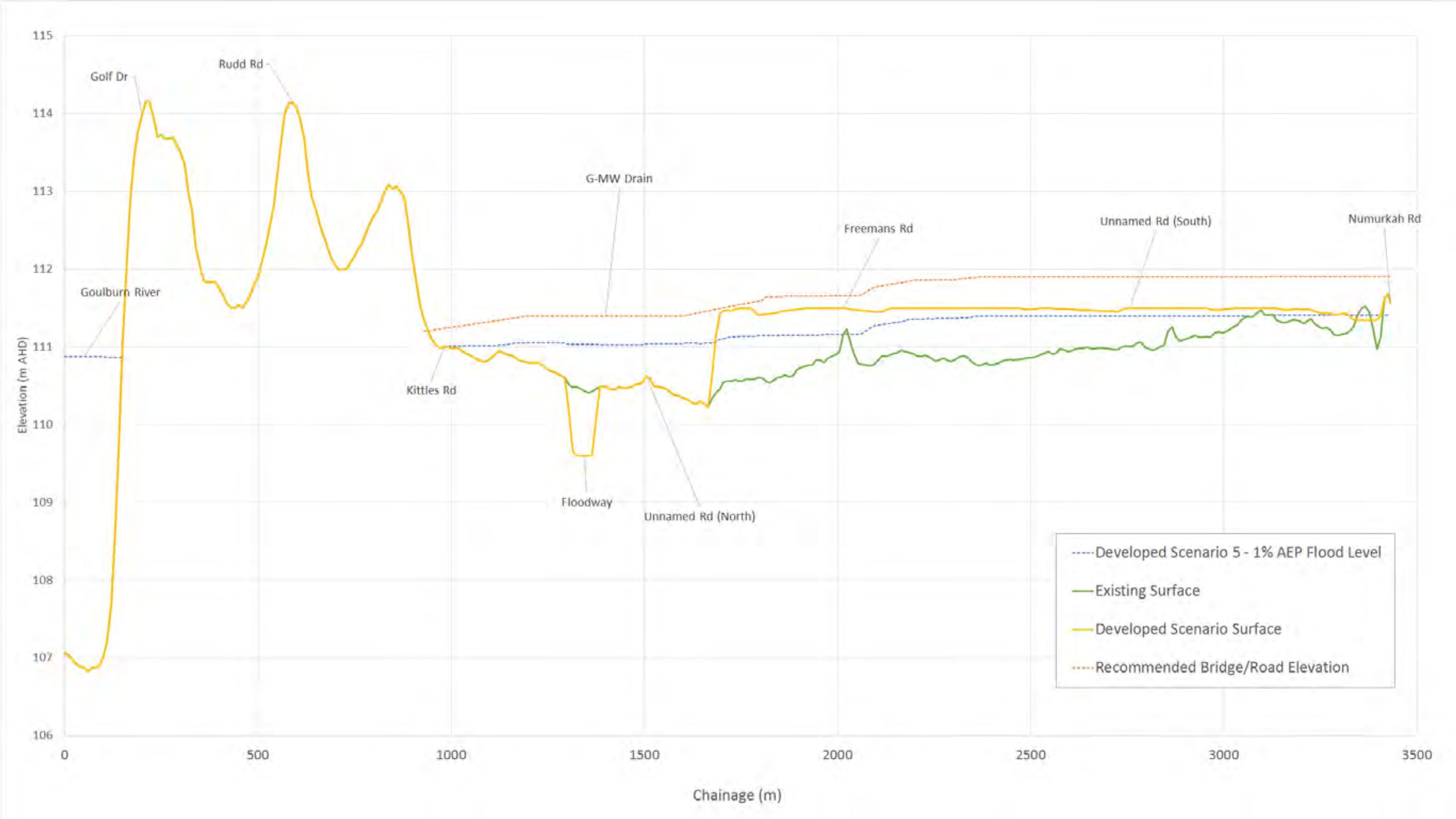

Figure 4-11 Wanganui Road Long Section for Developed Scenario 5

5 RECOMMENDATIONS

The project scope was to provide design flood levels, design road level (to cater for a 1% AEP flood event), freeboard design levels, culvert numbers, size and locations.

The road design initially aimed to raise Wanganui Road above the 1% AEP flood level to meet Austroad/VicRoads standards. The modelling found that conveying the extensive floodplain flow rate (approximately 170 m^3/s) through banks of culverts is not achievable without significant afflux impacting in excess of 2,000 upstream properties. Raising the road level to a freeboard of 300 mm above the existing 1% AEP flood level as per Austroad/VicRoads standards also does not appear practical or necessary given the surrounding roads (including parts of Numurkah Road) are inundated in a 1% AEP flood level. If designed to this standard, Wanganui Rd would become an island during a 1% AEP flood event.

After discussions with officers from the Greater Shepparton City Council and the Goulburn Broken CMA, Water Technology have developed and tested two alternative recommendations in a bid to proceed with the design of the Wanganui Road upgrade. These recommendations have been developed to balance the initial guidelines set out in the project scope with a feasible engineering outcome, that provides no adverse flood impacts for nearby residents. The recommendations may warrant further investigation or consultation with VicRoads.

The modelling to date has not included the main bypass route which currently travels through significantly flood prone land. The alignment of on and off ramps to the bypass have also not been assessed within this investigation and it is recommended that the full alignment including on and off ramps be incorporated into any future investigation. It is likely that the bypass and the on and off ramps will need to be bridged to result in no adverse impacts on nearby residents.

The two alternative options to maintain flow conveyance across Wanganui Road are discussed in more detail below.

Alternative Option 1

Extend the existing floodway located south of Wanganui Road further north of Wanganui Road. This is similar to Scenario 4 which provided a 150 m wide floodway from Wanganui Road north for 1,200 m to a flood runner located just north of GMW Drain No. 3. It is likely that this floodway would provide a suitable bridge crossing for the main bypass alignment (north of Wanganui Road) and could reduce the flood risk to many areas north and south of Wanganui Road, potentially opening up some land for future development. Modelling of this option with box culverts across the floodway still resulted in significant increases in flood levels upstream of Wanganui Road, however showed some improvement compared to the previous scenarios modelled.

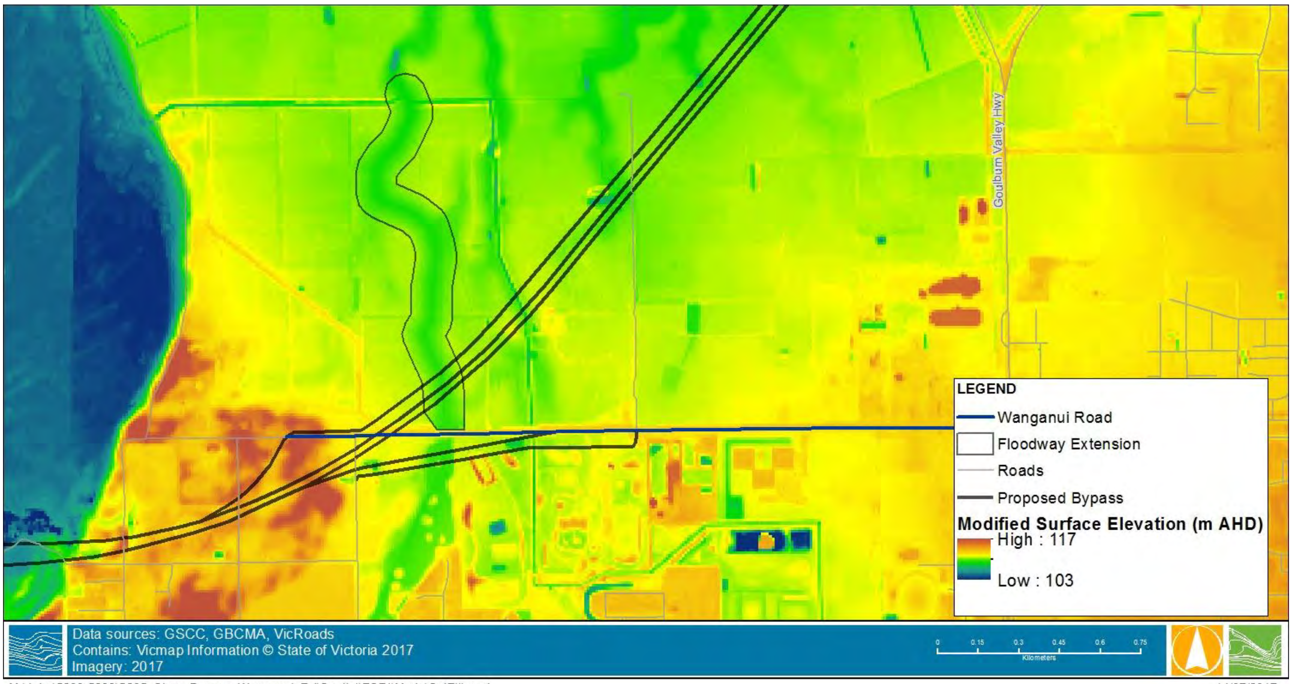

Figure 5-1 Recommendation 1 – Investigate possibility of extending the floodway North of Wanganui Road

Alternative Option 2

Maintaining the existing level of Wanganui Road between the northbound exit-ramp and the south bound on-ramp to provide similar flow conditions for the 'high flow zone'. This area, shown in green in Figure 5-2, currently conveys around 90% of the flow across Wanganui Road and is fed by two floodways through Shepparton North, adjacent to the Boulevard precinct. This option would rely upon the southbound on-ramp to be bridged using piers rather than an earthen embankment, it is estimated the bridge may be up to 800 m in length. This was tested as developed Scenario 5, and showed the most suitable results of all scenarios tested. An alternative option would allow the major flow path to be formalised into a floodway, with a ford crossing that would be inundated and closed once the Goulburn River has reached the Major Flood Level at Shepparton (11.0 m gauge height).

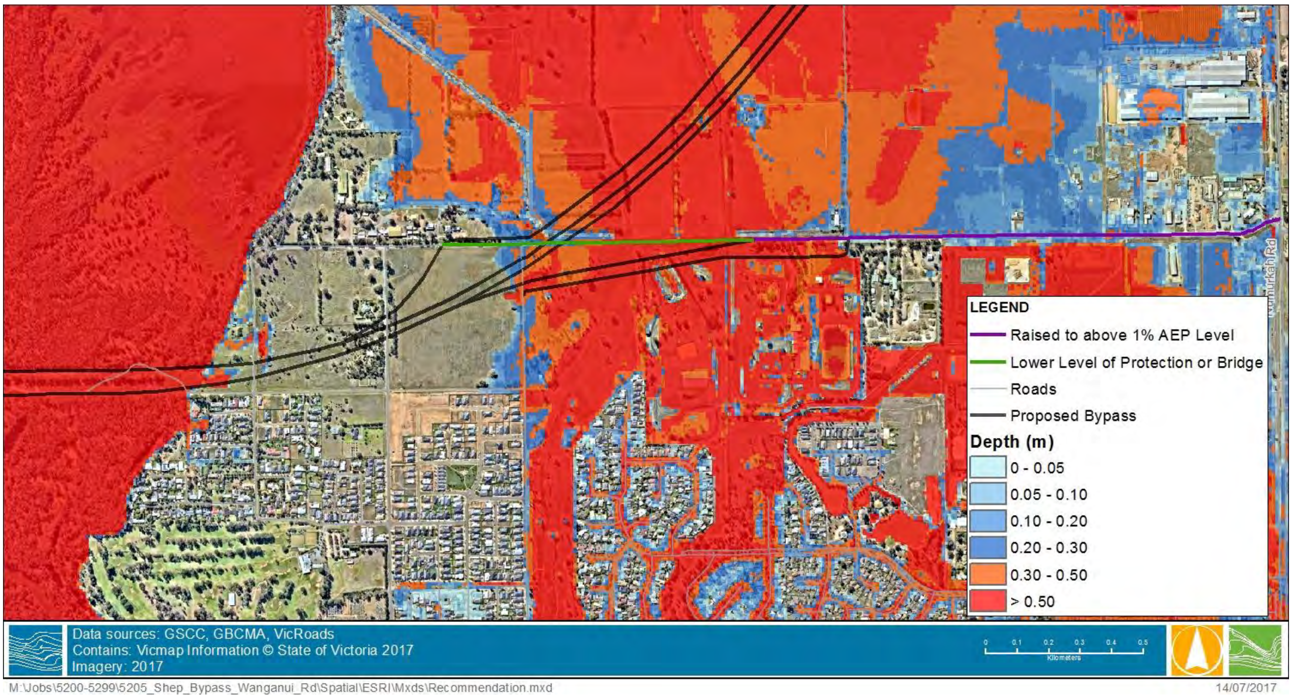

Figure 5-2 Recommendation 2 - Maintain existing flow conditions west of the Southbound on ramp or provide further flow conveyance through lowering Wanganui Road at the floodway

Despite there still being a need to investigate further options to refine the drainage design, the following recommendations based on flood modelling have been provided.

- Any design must be able to convey around 170m^3/s of flow across the length of Wanganui Road, with the bulk (85-90%) being conveyed in the area designated as the 'North Shepparton Floodway'
- The eastern end of Wanganui Road should be raised to a level of at least 111.6 m AHD to provide a freeboard of 200 to 300 mm above the 1% AEP flood level.
- The western end of Wanganui Road appears to have two options to convey the flow without significant increases in flood levels.
  - Construction of a large bridge section (up to 800 metres in length that will sit above the 1% AEP flood level (AustRoads/ VicRoads Design standards require 1 m freeboard above 1% AEP flood level)
  - Construction of a floodway with a low flow culvert and ford crossing as an alternative to a bridged section between Freemans Road and Kittles Road. This will likely be a much cheaper option, however this section of roadway to the west of the southbound on ramp will be closed during a 1% AEP flood event. The floodway is not engaged until the Shepparton streamflow gauge reaches 11.0 m which is considered a Major Flood with an approximate 10% AEP flood event. A low flow culvert beneath the ford would be recommended to convey local runoff flows from the upstream catchment.
- Further modelling should be undertaken to include the impact of the main bypass alignment as well as the on and off ramp alignments which cross significantly flood prone land.

6 SUMMARY

The flood modelling undertaken shows Wanganui Road is likely to be subject to extensive flooding during a 1% AEP flood event at Shepparton under existing conditions. This has implications for the design of the upgraded roadway to meet AustRoads/VicRoads guidelines which require the road to be above the 1% AEP flood level. Given the current flooding conditions in which close to 170 m^3/s travel over Wanganui Road, it does not appear practical to convey this flow through culvert banks without significant increases in flood levels upstream of the road.

Three scenarios which aimed to convey the total flow via banks of box culverts did not achieve either the flood free AustRoads/VicRoads guidelines and resulted in significant increases in flood levels across more than 2,000 upstream properties.

An alternative approach was tested and recommended for further investigation (Scenarios 4 & 5). These options which incorporated an extended floodway through Wanganui Road to convey the majority of the flow appear to be suitable for not increasing flood levels upstream of the road. This option allows for the road to the east of the southbound on ramp to be constructed above the 1% AEP flood level. West of the south bound on ramp there are two main options for the road design; either provide access to the western end of Wanganui Road and the north bound off ramp in a 1% AEP flood through the construction of a large bridge (up to 800 m) or the use of a floodway where this section of road would be closed once the Goulburn River exceeds the Major Flood level at Shepparton.

Further work should be undertaken to investigate the extension of the ‘North Shepparton Floodway’ beyond Wanganui Road as an option to allow the upgrade of Wanganui Road. Any further modelling should include the impact of the main bypass alignment including entry and exit ramps to the north and south of Wanganui Road which crosses significantly flood prone land.

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E.6 Appendix E6: Pavement Investigations

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Ford and Wanganui Roads—Shepparton: Pavement Condition Report (Draft_01a)

Contract Report

for GTA Consultants

31 May 2017

Contents

NOTE:

Cover Photograph: Wanganui Roads—view to west from GVH—20th March 2017

1. INTRODUCTION

This report contains the results of:

- Detailed inspections of Ford and Wanganui Roads in Shepparton from Grahamvale Road westwards to Golf Road over a distance of approximately 6 km—as shown in the Locality Plan in Appendix A;
- Deflection testing in both wheelpaths in both lanes for Ford and Wanganui Roads over their full length as described above;
- Geotechnical investigations at selected sites for Ford and Wanganui Roads.

Interpretive analysis of the above three tasks has been undertaken to assess the structural adequacy of these pavements to sustain substantially heavier loading should these roads serve as part of a heavy vehicle bypass of Shepparton.

The report concludes that substantial works are required to increase the structural capacity of both pavements.

A pavement design has also been prepared for the intersection of these roads with the Goulburn Valley Highway.

2. BACKGROUND

Ford and Wanganui Roads are 2-lane 2-way local roads with some sections having centre-line standard stripe and typically nil formed shoulders as shown by the photograph on the front of this report. The City of Greater Shepparton is examining options for a heavy vehicle bypass of the central business district and these two pavements are possible candidates for upgrading to sustain such bypass.

3. OBJECTIVES

The objectives of this report are to:

(i) Describe the surface characteristics of and also the environment in which the pavement operates;

(ii) Assess the strength of the pavement and its ability to sustain heavier loadings;

(iii) Recommend treatments—including new pavement designs—which may be required to provide for the expected design traffic loadings.

4. SITE

4.1 Site

The site was inspected in detail by the author on 20th March 2017 and diagrammatic annotations and photographs were taken to record the condition of the pavement and its attendant drainage characteristics. The annotated diagrams are contained in the rear of Appendix A and are referred to as *Distress Diagrams*.

The site (approximately 5.9 km in length) is very flat, with the exception of the western-most few hundred metres which lays on Goulburn River alluvium (Edwards & Slater 2001). Pavement is typically flanked by grassed verges without shoulder. Most of Ford and Wanganui Roads lay within a rural environment with housing developments abutting about 50% of the length of Ford Road under consideration.

Of particular note is a major irrigation channel located 15 m north of the eastern 700 m of Ford Road.

Most of the site lies within the floodplains which comprise fluvial[1] soils of the Shepparton formation. Closer to the Goulburn River the geology is classed as having younger alluvial soils.

4.2 Drainage

The eastern 1100 m of Ford Road was well-formed table drains, however these become less formalised the closer to the Goulburn Valley Highway. Wanganui Road has very little lengths of table drains and typically grassed verges provide an area to which surface run-off may drain.

4.3 Pavement

Ford Road has a size 14 seal of approximately 7.7 m width whereas Wanganui Road is a little narrower at about 6 m to 7 m in seal width and has a size 10 seal.

The major items of distress on Ford Road are:

- Numerous substantial zones of flushing of the seal; refer to Photographs 1 to 3 in Appendix A;
- Distress of asphalt surfacing at the approaches and departure zones to major intersections;
- Isolated zones of rutting with the very occasional shoving/shearing of the pavement.

The major items of distress on Wanganui Road are:

- Numerous substantial zones of flushing and some bleeding of the seal;
- Zones of poor condition edges/left wheelpaths with minor potholes, longitudinal cracking—some with grass and developing fatigue cracking; refer to Photographs 7 and 8 in Appendix A

Refer also to the Distress Diagrams (3 No. for each road) in Appendix A.

5. TRAFFIC LOADING

5.1 Current & Forecast Loading

VicRoads and Council developed traffic data forecasts (GTA 2017) of which relevant values are shown in Table 1 for Wanganui Road, Ford road and the Goulburn Valley Highway (GVH).

Also included in Table 1, are derived growth rates of Heavy Vehicles (HV) from 2021 to 2041 and also presumptive growth rates for the remaining 40 years in the requested 60-year Design Period.

[1] Formations associated with deposition by a river; e.g. floodplains

Table 1 Traffic volume data (GTA 2017) and predicted volumes at 60 years

Road	Start 2-way volumes			Intermediate 2-way volumes			Growth p.a.	Presumed Growth p.a.	End 2-way vols	Section
	2021			2041			2021 to 2041	2041 to 2081	2081	
	AADT	AADHV	%HV	AADT	AADHV	%HV	for HV	for HV	AADHV	
Wanganui Rd	9500	1130	11.9%	12500	1500	12.0%	1.4%	1.4%	22200	Golf to GVH
Ford Rd	4500	540	12.0%	7100	800	11.3%	2.0%	2.0%	14600	GVH to Verney
Ford Rd	4500	540	12.0%	4700	700	14.9%	1.3%	1.3%	9800	Verney to Grahamvale
GVH	17000	1420	8.4%	23200	2230	9.6%	2.3%	2.0%	51200	Intersection

Table 2 shows additional traffic characteristics such as the Cumulative Growth Factor (CGF; *fn*{Design Period and Growth per annum}), Load Factor (LF; ESAs/HV) and Direction Factor (DF). The resultant Design Traffic Loading (DTL) is shown for Wanganui Road, the two sections of Ford Road and the intersection with the GVH.

Table 2 Design Traffic Development

Road	2021 AADHV	growth p.a.	Design Period (yrs)	CGF	LF ESA/HV	DF	DTL ESA	Section
Wanganui Rd	1130	1.4%	60	93.9	2.5	0.5	**4.8E+07**	Golf to GVH
Ford Rd	540	2.0%	60	113.4	2.5	0.5	**2.8E+07**	GVH to Verney
Ford Rd	540	1.3%	60	90.2	2.5	0.5	**2.2E+07**	Verney to Grahamvale
GVH	1420	2.3%/2%	60	119.8	2.7	0.5	**8.4E+07**	Intersection

6. DEFLECTION TESTING

6.1 Deflection Testing

The pavements were deflection tested by VicRoads' PaSE deflectograph on 23 Feb. 2017. The author arranged this testing.

Deflection test charts and the analyses thereof—known as Defana[2] output—are contained in Appendix C for both Ford Road and Wanganui Road.

6.2 General Results

Ford Road East-bound lane

As with all deflection data for this project, the left wheelpath strength is lower than that of the right wheelpath, the latter of which is located further from the unsealed shoulder. Inspection of the deflection data (charts)—on which an indicative design deflection is shown by the horizontal dashed line—shows a very weak section of pavement as follows—

- from the Goulburn Valley Highway (GVH) 650 m east to Kakadu Drive.

[2] Name of VicRoads' software which analyses the data according to Austroads' overlay design procedures.

It is interesting to note that the presence of the irrigation channel over the eastern 700 m of this pavement (the other end to the above-described section) does not appear to have any pronounced effect on the pavement's strength.

All of Ford Road's east-bound lane requires substantial strengthening.

Ford Road West-bound lane

The same weak section as on the westbound lane is also present on the east-bound lane from the GVH to Kakadu Drive. A second weak zone of about 300 m in length is centred around Matilda Drive.

All of Ford Road's west-bound lane requires substantial strengthening.

Wanganui Road East-bound lane

The western-most 800 m (west of Kittles Road) has relatively low and uniform deflection compared to the eastern 2400 m of Wanganui Road. Given that the pavement thickness is reasonably uniform throughout, the likely reason for this is the sand subgrade which exists close to the Goulburn River.

As mentioned above, the pavement's left wheelpath is also much weaker than that of the right. This is likely due to the narrower seal width and the lesser drainage provision within Wanganui Road.

The 160 m of pavement largely immediately east of the waste transfer station entrance has relatively uniform and strong pavement—in both lanes.

Most of Wanganui Road's east-bound lane requires substantial strengthening.

Wanganui Road West-bound lane

The deflection charts show a similar strength pattern to those of the eastbound Wanganui Road lane. Again, the centrally-located (right) wheelpath has much greater strength than that of the wheelpath close to the seal edge.

Most of Wanganui Road's west-bound lane requires substantial strengthening.

6.3 Asphalt Overlay and Granular Resheet Requirements

Table 3 shows asphalt overlay and granular resheet thicknesses for Ford Road & Wanganui Road. The far-right column of 'Curvature" is used for further analysis which assists in determining the stiffening required for very heavy overlays; refer to Section 9.

Table 3: Asphalt Overlay & Granular Resheet thicknesses for Ford Road & Wanganui Road

	Ford Road				
	Chainage (PaSE)		**Granular**	**Asphalt**	**Curvature**
	from	to	**resheet**		
	(m)	(m)	(mm)	(mm)	(mm)
GVH	0	650	400+	150+	0.87
	650	2650	400	150+	0.62
		Grahamvale Rd			

	Wanganui Road				
	Chainage (PaSE)		**Granular**	**Asphalt**	**Curvature**
	from	to	**resheet**	**overlay**	
	(m)	(m)	(mm)	(mm)	(mm)
GVH	000	245	400	150+	0.64
	245	1090	400+	150+	0.80
	1090	1280	nil	40	0.14
	1280	1830	400	150+	0.61
	1830	2200	400+	150+	0.81
	2200	3240	300	150+	0.43
		Golf Rd			

Inspection of Table 3 shows:

- Granular resheet thicknesses in excess of 400 mm are required for about one quarter the length of Ford Road—at the GVH end, and nearly 40% of the length of Wanganui Road;
- Heavy granular resheeting thicknesses of 300 mm to 400 mm are required for the remainder of both pavements, with the exception of…
- The entrance to the waste transfer station located 1 km west of the GVH over a distance of nearly 200 m where a very strong pavement exists;
- Should an asphalt overlay be required, the full length of ford Road and all Wanganui Road with the exception of the 200 m section described above require asphalt overlays in excess of 200 mm.

7. PAVEMENT INVESTIGATION

Continent Geotechnical Services placed six pavement dippings within Ford Road and seven dippings within Wanganui Road on the 14th to 15th March 2017. A copy of the report (Continent Geotechnical Services 2017) is located in Appendix B (54 pages).

Testing comprised placing pits within the existing road pavement and sampling to subgrade, followed by Dynamic Cone Penetration tests to 1.5 m with accompanying samples to determine the field moisture contents. Results have been summarised and shown in the physical location order from near the Goulburn River wetlands (Golf Road) eastwards to the GVH and then further eastwards to Grahamvale Road.

Table 4 Geotechnical Data Summary

Pavement Dipping No.	Goulburn River Wetlands	WPD07	WPD06	WPD05	Kittles Road	WPD04	WPD03	WPD02	WPD01	GV Hwy	GV Hwy	FPD01	FPD02	FPD03	Verney Rd	FPD04	FPD05	FPD06	Grahamvale Rd	Pavement Dipping No.
Chainage		155	470	700		1200	1650	2230	2720			2480	2085	1605		1340	895	370		Chainage
Asphalt		25	25	30		50	50	50	50			50	50	50		30	30	25		Asphalt
crushed rock		195	195	190		130	150	175	175			100	100	50		-	-			crushed rock
NDCR												150	150	200		120	170	145		NDCR
RAP												-	-	-		50	50	-		RAP
Total pavement		220	220	220		180	200	225	225			300	300	300		200	250	170		Total pavement
Silt (clayey)		-	-	-		290	-	150	150			-	-	-				to 1500		Silt (clayey)
FMC						13	-	13	15									10		FMC
Subgrade (to 1500 mm)		sand	sand	sand		silty clay	silty clay	silty clay	silty clay			silty clay	silty clay	silty clay		silty clay	silty clay	silt (C)		Subgrade (to 1500 mm)
FE-CBR (clear of silt)		> 15	> 15	12		3	15	6	3			3	3	6		6	8	6 (in silt)		FE-CBR (clear of silt)
FMC		4	4	2		19	18	18	19			13	12	12		9	9	-		FMC
PL (%)		NP	NP	NP		-	9	-	-			9	?	10		11	-	9		PL (%)
LS-CBR (%)(clear of silt)		30	30	19		6	14	10	9			6	-	9		8	9	4 (silt)		LS-CBR (%)
OMC		12	12	13		14	11	12	15			11		13		10	11	11		OMC (%)
Swell (%)		0	0	0		1	1	1	0			1	-	1.5		0	0.5	0		Swell (%)
Chainage 060 is C/L of Reedy Swamp Rd and increases to the east												*Chainage 000 is western kerb line of Grahamvale Rd*								
Assigned CBR		10% (Likely Kittles Rd to Golf Rd)				4% (GVH to likely Kittles Road)						4%				4 (or a conditional 6%)				Assigned CBR

7.1 Pavement

Inspection of Table 4 shows:

- Surfacing comprises thin asphalt throughout with the thickness being very thin at both ends of the total pavement length; it is possible that these surfacings are multiple spray seals;
- Wanganui Road has a base of crushed rock—ranging from 130 mm to 195 mm in thickness, to produce a total pavement thickness of between 180 mm to 225 mm;
- Ford Road has a base of crushed rock from the GVH to (or close to) Verney Road. A 150 mm to 200 mm non-descript crushed rock (NDCR) forms the subbase of the GVH to Verney Road and 120 mm to 170 mm of granular material forms the base of Ford Road east of Verney Road;
- Total pavement thickness for Ford Road from the GVH to Verney Road is 300 mm, with the thickness to the east of Verney Road to Grahamvale Road being 170 mm to 250 mm.

7.2 Subgrade

Subgrade comprises materials typical of the geology including clayey silt, silty clays and non-plastic sands.

Inspection of Table 4 shows:

- Sand subgrade from Golf Road (Goulburn River wetlands) on Wanganui Road to or near to Kittles Road;
- East of (or near to) Kittles road to the GVH on Wanganui Road is a zone where a thin layer (150 mm to 290 mm) of clayey silt overlays silty clays;
- Ford Road comprises a silty-clay subgrade with the exception of the furthest east test pit (FPD06) where deep clayey silt was found.

Sand subgrade

Field-estimated CBR (FE-CBR) results and laboratory-soaked CBR (LS-CBR) are all well above 15% and thus a Design CBR of 10% may be assigned to this subgrade.

Silty Clay subgrade

Ignoring the thin layer of clayey silt, most test-sites have a subgrade comprising clay. FE-CBR results range from 3% to 15% with most being 6% and greater, but the 85th percentile value being 3%. LS-CBR values range from 6% to 14% with most being 8% and greater.

Inspection of the three sites where the FE-CBR is 3% and where Atterberg Limit or moisture density values are available, show these soils are well wet of their Plastic Limits/Optimum Moisture Contents. This may be due to the relatively poor drainage available to these pavements on the Shepparton floodplains, but it may be that effective and rapid drainage away from these sites is difficult to achieve. Thus, in the assignment of the Design CBR, this should be taken into account.

Based on the above data and the environment in which these pavements exist, a Design CBR of 4% is considered applicable for these soil types.

Clayey Silty subgrade

Test pit FPD06 shows the presence of clayey silt to 1500 mm. Its LS-CBR is 4% with a field-estimated value of 6%. It is recommended that for new construction, the top 200 mm of this material be removed and replaced by a more stable material such as NDCR.

For the section of pavement east of Verney Road—which has two of three test sites having a silty clay subgrade, if the top 200 mm of silt is removed from the subgrade it is considered that a Design CBR of 6% could be assigned to this section.

Summary

Table 5 summarises the above Design CBR discussion.

Table 5 Design CBR values

Section	Wanganui Road		Ford Road	
	Golf Road to Kittles Road	Kittles road to GVH	GVH to Verney Road	Verney Road to Grahamvale Road
D CBR	10%	4%	4%	4%, or 6% with silt removal

8. DESIGN OF NEW PAVEMENTS

Table 6 shows the Design Traffic Loadings, the Design CBRs and the Design Reliability adopted for Ford Road, Wanganui Road and the Goulburn Valley Highway intersection.

Table 6 Design Traffic Loadings, Design speed and Design CBRs

	Wanganui Road		GVH	Ford Road	
Section	Golf Road to Kittles Rd	Kittles road to GVH	Intersection	GVH to Verney Road	Verney Road to Grahamvale Rd
Reliability	95%	95%	95%	95%	95%
D CBR	10%	4%	4%	4%	4% or 6% with silt removal
DTL (ESA)	4.80E+07	4.80E+07	8.40E+07	2.80E+07	2.20E+07
Des speed (km/h)	60	60	10	40	40

8.1 Granular Pavements

Based on the key design parameters in Table 6, flexible pavements comprising unbound granular base and subbase with thin bituminous surfacings are shown in Table 7. Where the pavement intersects with local or minor roads a surfacing comprising a thin polymer-modified asphalt is recommended.

Table 7 Granular with thin bituminous surfaced pavements

	Wanganui Road		GVH	Ford Road			
Section	Golf Road to Kittles Rd	Kittles Road to GVH	Intersection	GVH to Verney Road	Verney Road to Grahamvale Rd		
D CBR	10%	4%	4%	4%	4%	6% (with silt removal)	
DTL (ESA)	4.80E+07	4.80E+07	8.40E+07	2.80E+07	2.20E+07		
Wearing course							
mid-block	10	10	n.a.	10	10	10	Double/double 14/7 S25E seal
	yes	yes	n.a.	yes	yes	yes	prime
at minor intersections	30	30	n.a.	30	30	30	Size 10 Type HP (A15E) asphalt
	5	5	n.a.	5	5	5	Size 10 S25E seal
	yes	yes	n.a.	yes	yes	yes	prime
Base	200	200	n.a.	200	200	200	Class 1 FCR (VicRoads current)
Subbase-lower	200	200	n.a.	180	180	180	Class 3 CR (VicRoads current)
Subbase-upper	100	100	n.a.	100	100	110	Class 4 CR (VicRoads current)
Improved subgrade	-	160	n.a.	150	140	-	Select Fill (CBR ≥ 8%)
Total (excluding surfacing) (mm)	**500**	**660**	**-**	**630**	**620**	**490**	

8.2 Bound Pavements

Based on the key design parameters in Table 6, flexible pavements comprising asphalt and bound granular subbase are shown in Table 8.

Table 8 Deep-strength asphalt pavements

	Wanganui Road		GVH	Ford Road			
Section	Golf Road to Kittles Rd	Kittles Road to GVH	Intersection	GVH to Verney Road	Verney Road to Grahamvale Rd		
D CBR	10%	4%	4%	4%	4%	6% (with silt removal)	
DTL (ESA)	4.80E+07	4.80E+07	8.40E+07	2.80E+07	2.20E+07		
Wearing course							
Major Intersection	-	-	40	-	-	-	Size 14 Type V asphalt
Other areas	40	40	-	40	40	40	Size 14 Type H asphalt
Intermediate	75	110	140	85	80	65	Size 20 Type SS asphalt
base	75	70	75	75	75	75	Size 20 Type SF asphalt
Subbase-upper	180	180	180	180	180	180	3% CTCR (Class 3 CR)(VR current)
Subbase-lower	150	150	150	150	150	150	Class 4 CR (VicRoads current)
Total (mm)	**520**	**550**	**585**	**530**	**525**	**510**	
	110	= placed in 2 layers					

Refer to Appendix D for the CIRCLY Job Summary sheets.

9. REHABILITATION

9.1 Asphalt Overlays

To assist in developing optimum asphalt overlay thicknesses for Ford and Wanganui Roads modelling was undertaken using:

- The existing pavement thickness as an equivalent thickness of granular material;
- The Design CBR for the subgrade; and
- Calculating the amount of asphalt (with nil CTCR layer) required to sustain the design traffic loading designed as a Full-depth Asphalt 9FDA) pavement.

The modelling Job Summary sheets (from CIRCLY) are contained at the rear of Appendix D.

Asphalt thicknesses derived from the modelling for each section of pavement are shown in Column 4 of Table 9.

Also shown in Table 9 are:

- The PaSE derived asphalt thicknesses (Column 3) which are all 150 mm+ with one exception—that being at the transfer station entrance in Wanganui Road;
- The Curvature function (Column 5) which provides a measure of the pavement's stiffness—used in the assessment of an appropriate asphalt overlay thickness; the lower the value, the closer towards 150 mm the overlay thickness can be.

Table 9 Asphalt Overlay thicknesses and overly design

	Ford Road						**Ford Road Asphalt Overlay Compositions**		
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
	Chainage from (m)	to (m)	**PaSE** total AC thickness (mm)	**FDA Design** total AC thickness (mm)	**Curvature** (mm)	**Recommended** total AC thickness (mm)	**Wearing** course size 14 Type H (mm)	**Intermediate** course size 20 Type SS (mm)	**Base** course size 20 Type SF (mm)
GVH	0	650	150+	255	0.87	**255**	40	140	75
	650	2650	150+	260	0.62	**255**	40	140	75
		Grahamvale Rd							

	Wanganui Road						**Wanganui Road Overlay Compositions**		
	Chainage from (m)	to (m)	**PaSE** total AC thickness (mm)	**FDA Design** total AC thickness (mm)	**Curvature** (mm)	**Recommended** total AC thickness (mm)	**Wearing** course size 14 Type H (mm)	**Intermediate** course size 20 Type SS (mm)	**Base** course size 20 Type SF (mm)
GVH	000	245	150+	270	0.64	**255**	40	140	75
	245	1090	150+	270	0.80	**270**	40	155	75
	1090	1280	40	n.a.	0.14	**40**	40	-	-
	1280	1830	150+	270	0.61	**255**	40	140	75
	1830	2200	150+	270	0.81	**270**	40	155	75
	2200	3240	150+	235	0.43	**210**	40	95	75
		Golf Rd							

Inspection of Columns 3 and 4 in Table 9 show a range in which asphalt overlays are required to provide the necessary structural life for Ford Road and Wanganui Road. Column 6 shows the assigned overlay thickness and Columns 7 to 9 inclusive provide the asphalt overlay designs for the individual sections of pavement.

9.2 Granular Resheets

Granular resheet thicknesses have been calculated using the PaSE data and these are shown in Table 3. Many of these thicknesses exceed the maximum thickness of 400 mm and thus other means are required to determine the overall resheet thickness. In much the same way as asphalt overlays were derived in Section 9.1, the new design thicknesses have been considered as an upper-bound resheet thickness with the existing granular component of the existing pavement being subtracted to provide an estimate of the resultant resheet thickness. Results of this approach are shown in Table 10.

Table 10 Granular Resheet thicknesses and resheet design

	Ford Road						**Ford Road Granular Resheet Compositions**		
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
	Chainage from (m)	to (m)	**PaSE** resheet thickness (mm)	**Design** 'granular' thickness (mm)	**Existing** granular thickness (mm)	**Recommended** resheet thickness (mm)	**Base course** Class 1 FCR (mm)	**Subbase** upper Class 3 CR (mm)	**Subbase** lower Class 4 CR (mm)
GVH	0	650	400+	630	250	**500**	200	200	100
	650	2650	400	620	120	**400**	200	200	-
		Grahamvale Rd							

	Wanganui Road						**Wanganui Road Granular Resheet Compositions**		
	Chainage from (m)	to (m)	**PaSE** resheet thickness (mm)	**Design** 'granular' thickness (mm)	**Existing** granular thickness (mm)	**Recommended** resheet thickness (mm)	**Base course** Class 1 FCR (mm)	**Subbase** upper Class 3 CR (mm)	**Subbase** lower Class 4 CR (mm)
GVH	000	245	400	660	150	**400**	200	200	-
	245	1090	400+	660	150	**500**	200	200	100
	1090	1280	nil	nil	?	**nil**	nil	nil	nil
	1280	1830	400	660	150	**400**	200	200	-
	1830	2200	400+	660	150	**500**	200	200	100
	2200	3240	300	500	200	**300**	200	100	-
		Golf Rd							

Inspection of Columns 3 and 4 in Table 10 show a range in which granular material thicknesses are required to provide the necessary structural life for Ford Road and Wanganui Road. Column 6 shows the assigned granular thickness and Columns 7 to 9 inclusive provide the compositional designs for the individual sections of pavement.

9.3 Additional Works to support structural rehabilitation

The asphalt overlay and granular resheet thicknesses are calculated using a Characteristic value of pavement stiffness and strength respectively. Thus, the strengthening will not pick up 100% of all 'weaknesses' within the existing pavement. Therefore, it is necessary for all highly distressed surfacing or pavement to be removed and replaced with similar material (asphalt or crushed rock) prior to any resheeting or overlaying.

<u>Prior to placing asphalt overlays:</u>

- Mill off any badly fatigue-cracked asphalt surfacing which still has good shape and replace with fresh asphalt to existing level;
- Dig out any sheared zones or 'soft spots' and replace with granular and asphalt back to the existing surface;
- For rutted pavement or localised shape loss (free of fatigue cracking)—regulate with either a gap-graded size 7 Type H asphalt or larger size if appropriate.

<u>Prior to placing granular resheets:</u>

- Dig out any sheared zones or 'soft spots' and replace with granular material to existing surface level;
- Granulate existing bituminous surfacing and mix into the top 100 mm of existing base.

10. RECOMMENDATION

It is recommended that:

1. Any new pavement required for effecting the truck bypass be selected from those shown in Section 8;
2. Rehabilitation be undertaken via either asphalt overlays or by granular resheets as described in Section 9;
3. Prior to any rehabilitation works, that preparatory works as described in Section 9 also be undertaken.

REFERENCES

Austroads (2008). *Guide to Pavement Technology; Part 2: Pavement Structural Design*. AGPT02/08. May 2008, Austroads Inc. Sydney.

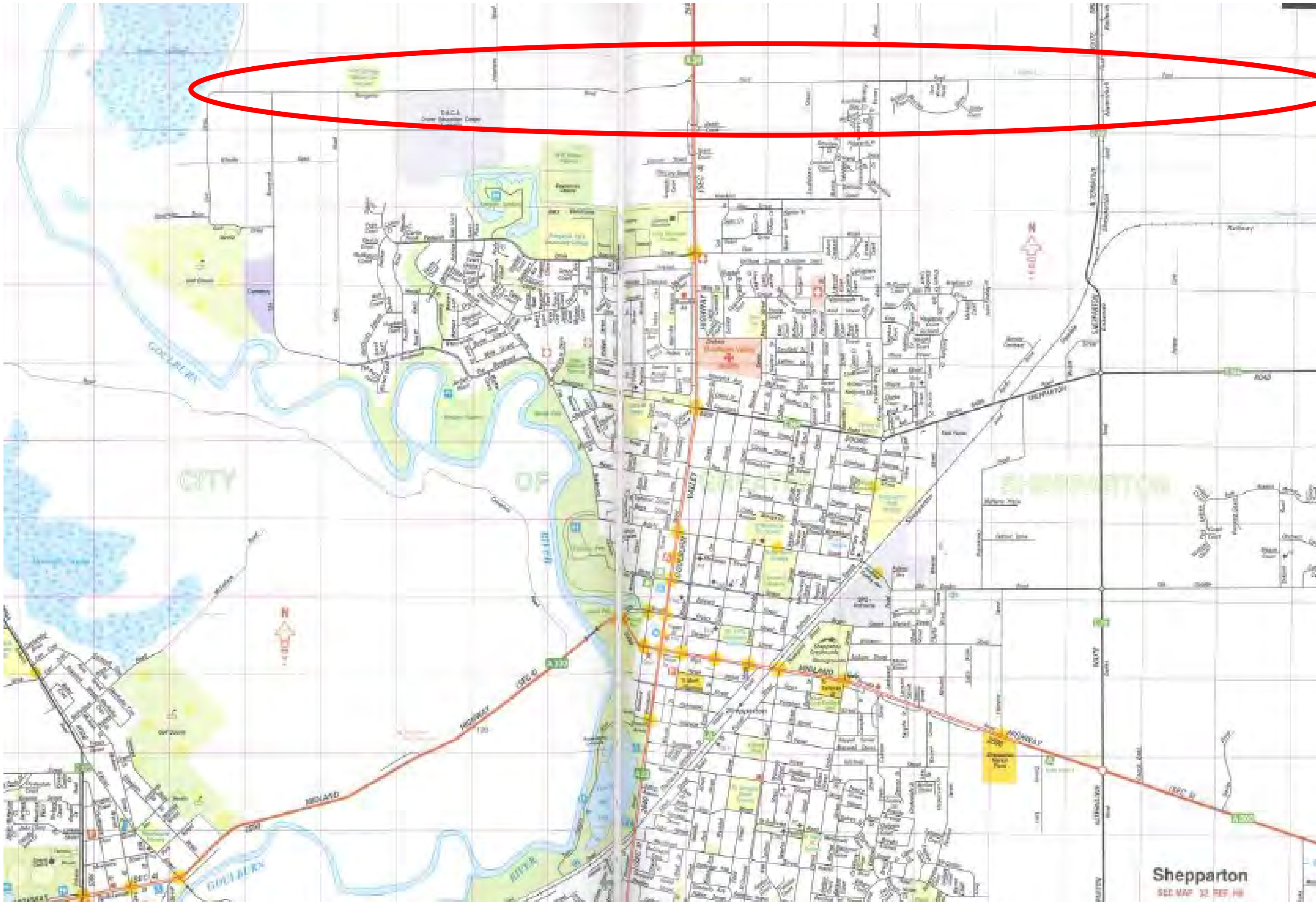
Continent Geotechnical Services (2017). *Pavement Investigation Report; Ford Road and Wanganui Road;* Ref: 6035-RO, April 2017; Continent Geotechnical Services, Thomastown.

Edwards, J. & Slater, K.R. (compilers) (2001). *Bendigo 1:250,000 geological map*. Geological Survey of Victoria.

GTA (2017). *Ford and Wanganui Road Shepparton: … Geotech & pavement works CRM:0024060*; e-mail to author dated 23 May 2017; GTA, Melbourne.

RACV (2002). *RACV VicRoads Country Street Directory: Edition 5* 2002*;* RACV Publications Dept. Noble Park.

APPENDIX A: LOCALITY PLAN, PHOTOGRAPH & DISTRESS DIAGRAM



Locality Plan: Wanganui Road and Ford Road—(RACV 2002)

Photograph 1 Ford Road; general view to west at Ch. 100[3]; pavement is in generally fair condition with some flushing in wheelpaths

Photograph 2 Ford Road; view to west at Ch. 1380 on approach to Verney Road roundabout; widening pavement showing distress

[3] Ch. 000 is the WKL of Grahamvale Road

Photograph 3 Ford Road; view to west at Ch. 2500 approaching the GV Hwy; severe flushing in west-bound lane

Photograph 4 View to east at Ch. 2660—intersection bellmouth at Goulburn Valley Hwy

Photograph 5 Wanganui Road western end at Ch. 000[i];[4] view to east.

[4] Ch. 000 is 60 m west of Reedy Swamp Rd C/L

Photograph 6 View to east at Ch. 700 ; car in background is near Kittles Road intersection

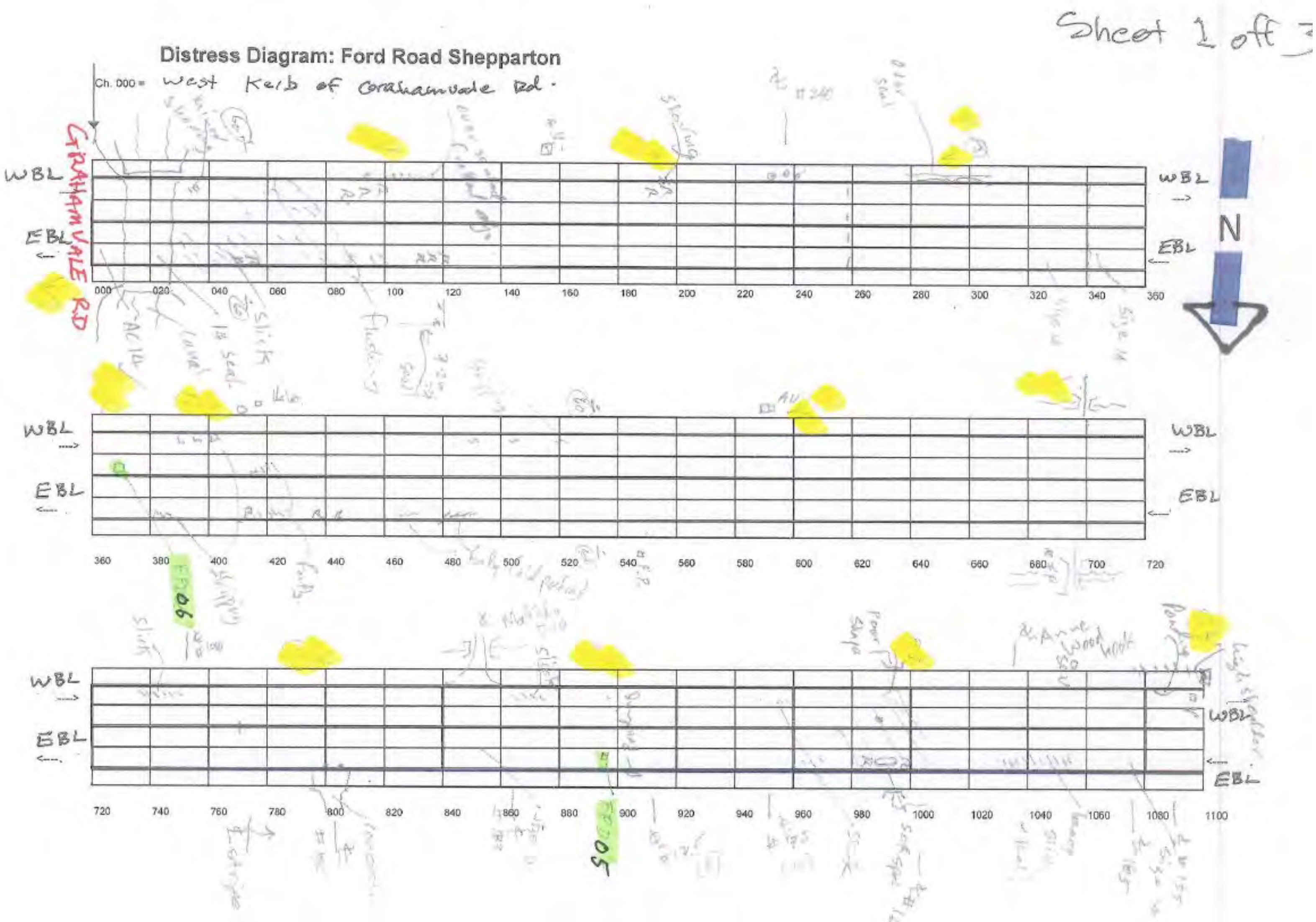
Photograph 7 Wanganui Road: Edge cracking at Ch. 1140; view to east

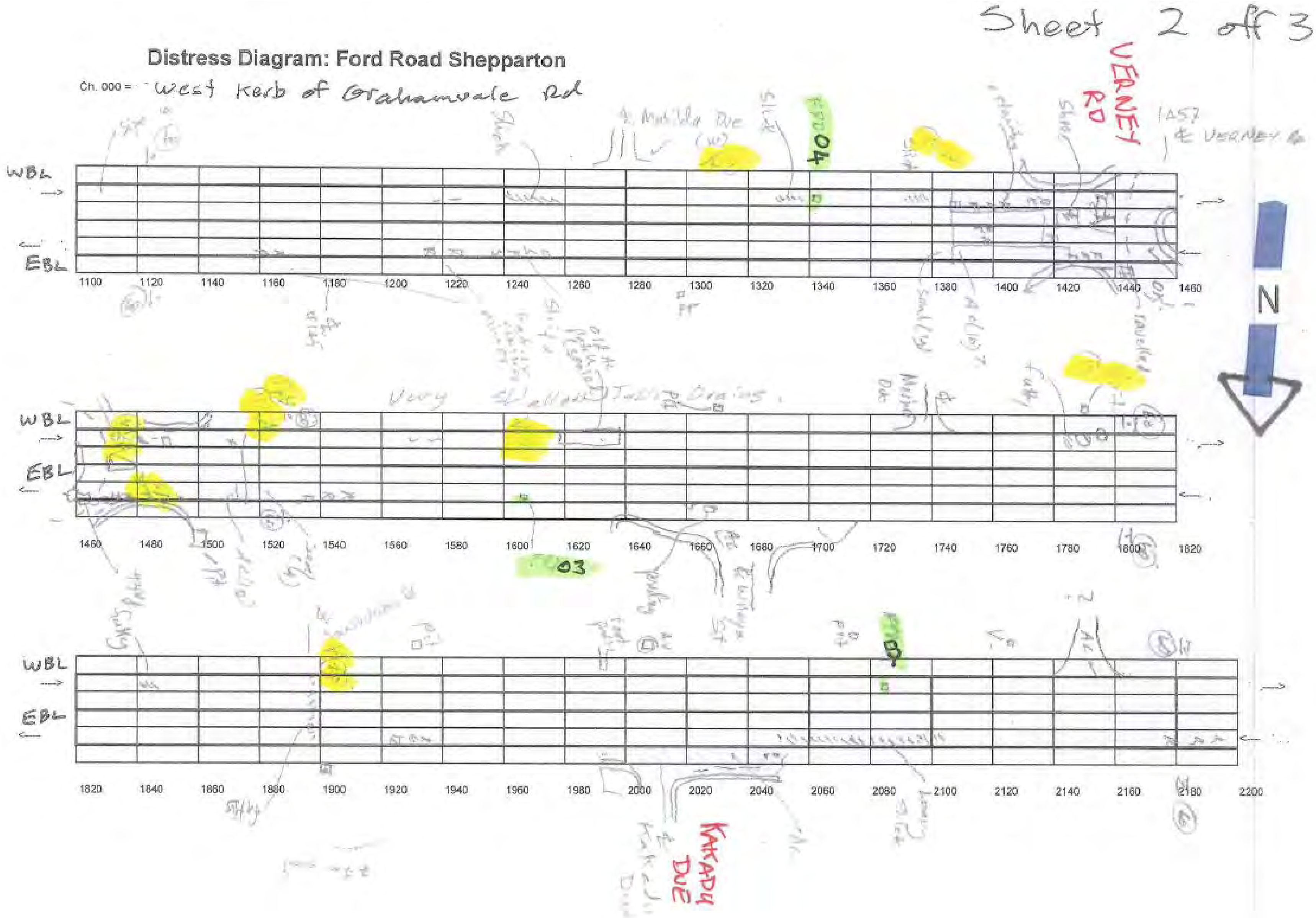
Photograph 8 Wanganui Road: Depressed edges with bleeding coming through the spray seal; Ch. 2000; view to east

Photograph 9 Wanganui Road: at Ch. 2500; view to east

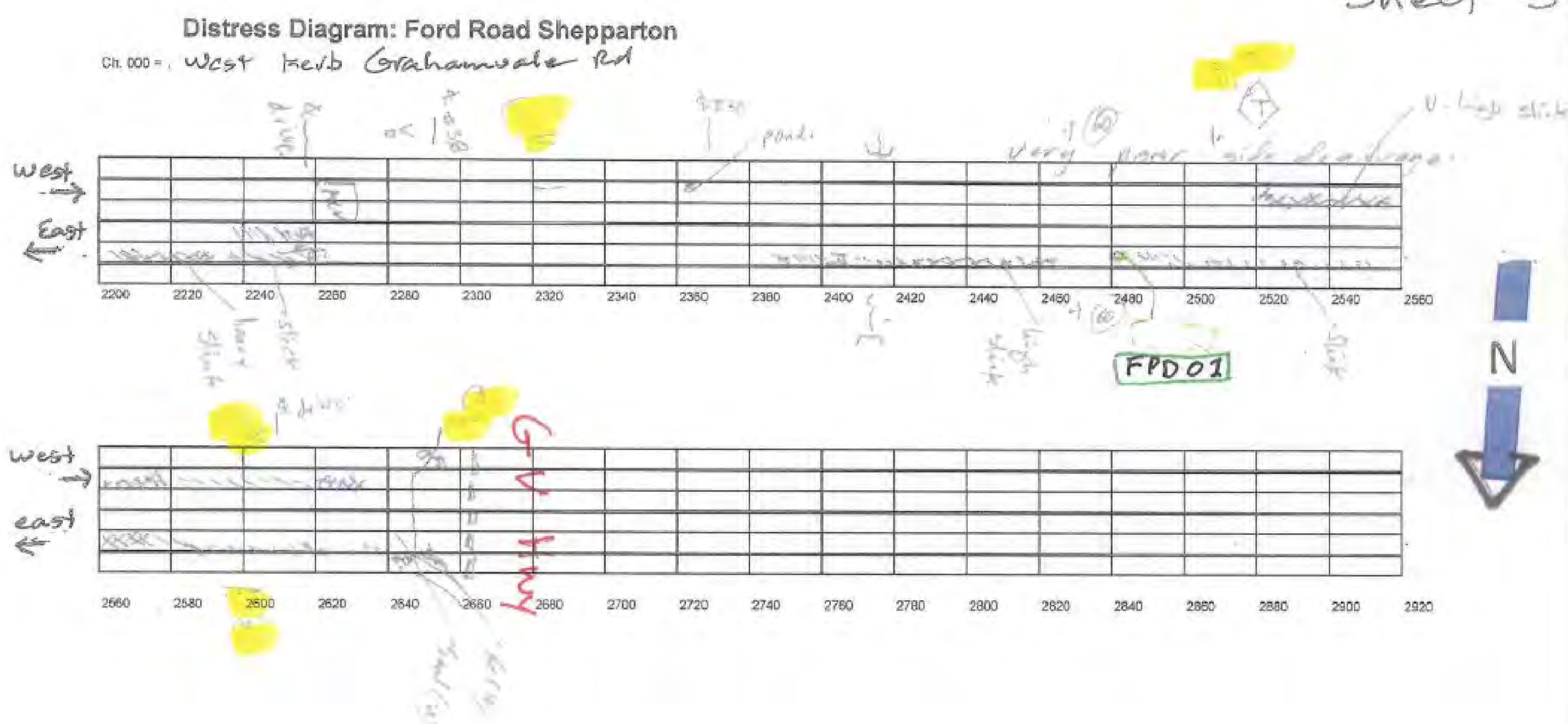
Photograph 9 Wanganui Road: At intersection with Goulburn Valley Hwy; Ch. 3280; view to west

DISTRESS DIAGRAM—FORD ROAD

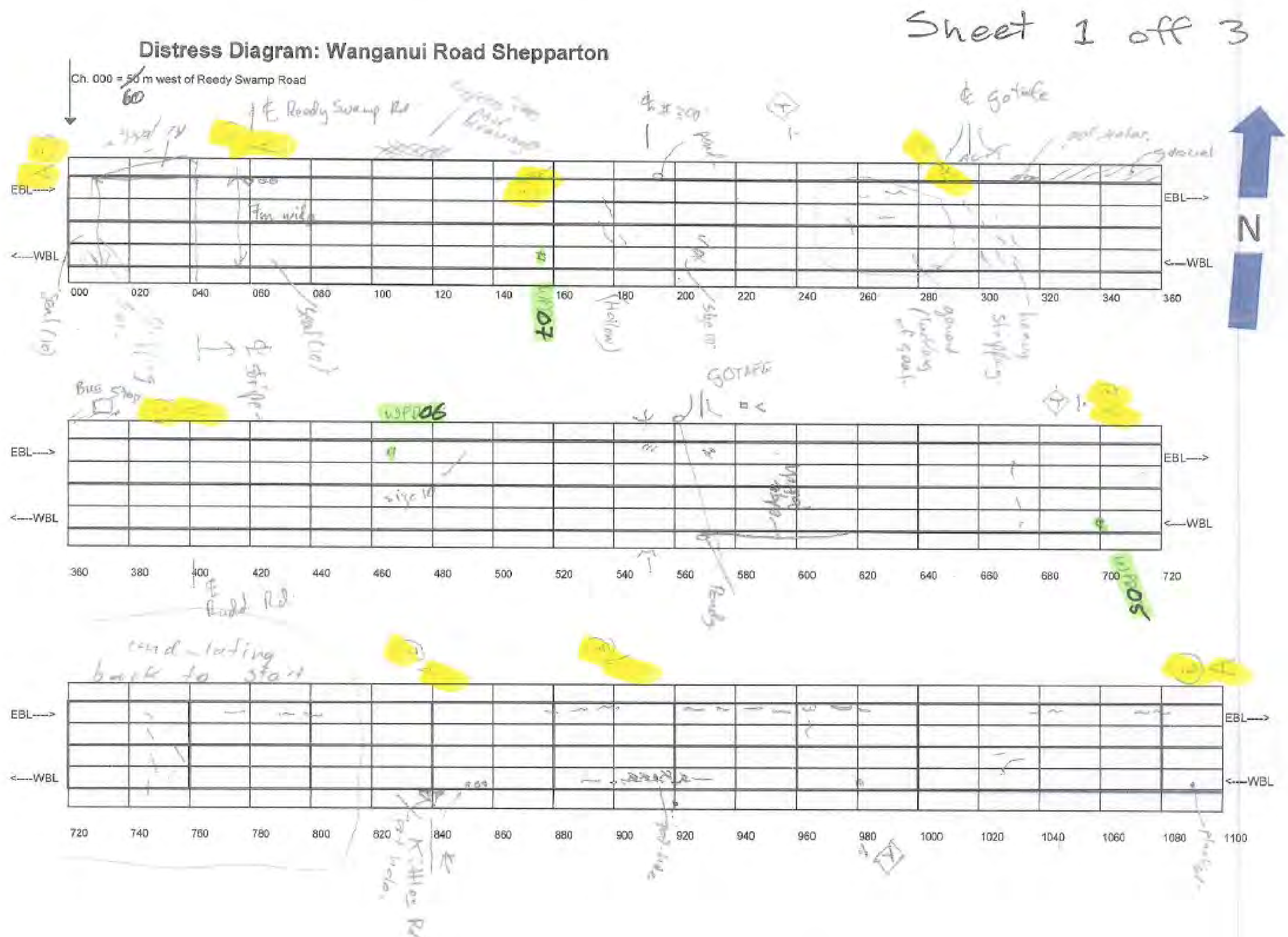



Sheet 2 off 3
Distress Diagram: Ford Road Shepparton
Ch. 000 = West Kerb of Grahamvale Rd
WBL
EBL
VERNEY RD
1457 ℄ VERNEY Rd
N
1100
1120
1140
1160
1180
1200
1220
1240
1260
1280
1300
1320
1340
1360
1380
1400
1420
1440
1460
1480
1500
1520
1540
1560
1580
1600
1620
1640
1660
1680
1700
1720
1740
1760
1780
1800
1820
1840
1860
1880
1900
1920
1940
1960
1980
2000
2020
2040
2060
2080
2100
2120
2140
2160
2180
2200
04
03
KAKADU DVE

Sheet 3 off 3


Distress Diagram: Ford Road Shepparton
Ch. 000 = West Kerb Grahamvale Rd
West
East
2200
2220
2240
2260
2280
2300
2320
2340
2360
2380
2400
2420
2440
2460
2480
2500
2520
2540
2560
FPD01
N
2580
2600
2620
2640
2660
2680
2700
2720
2740
2760
2780
2800
2820
2840
2860
2880
2900
2920
GV Hwy

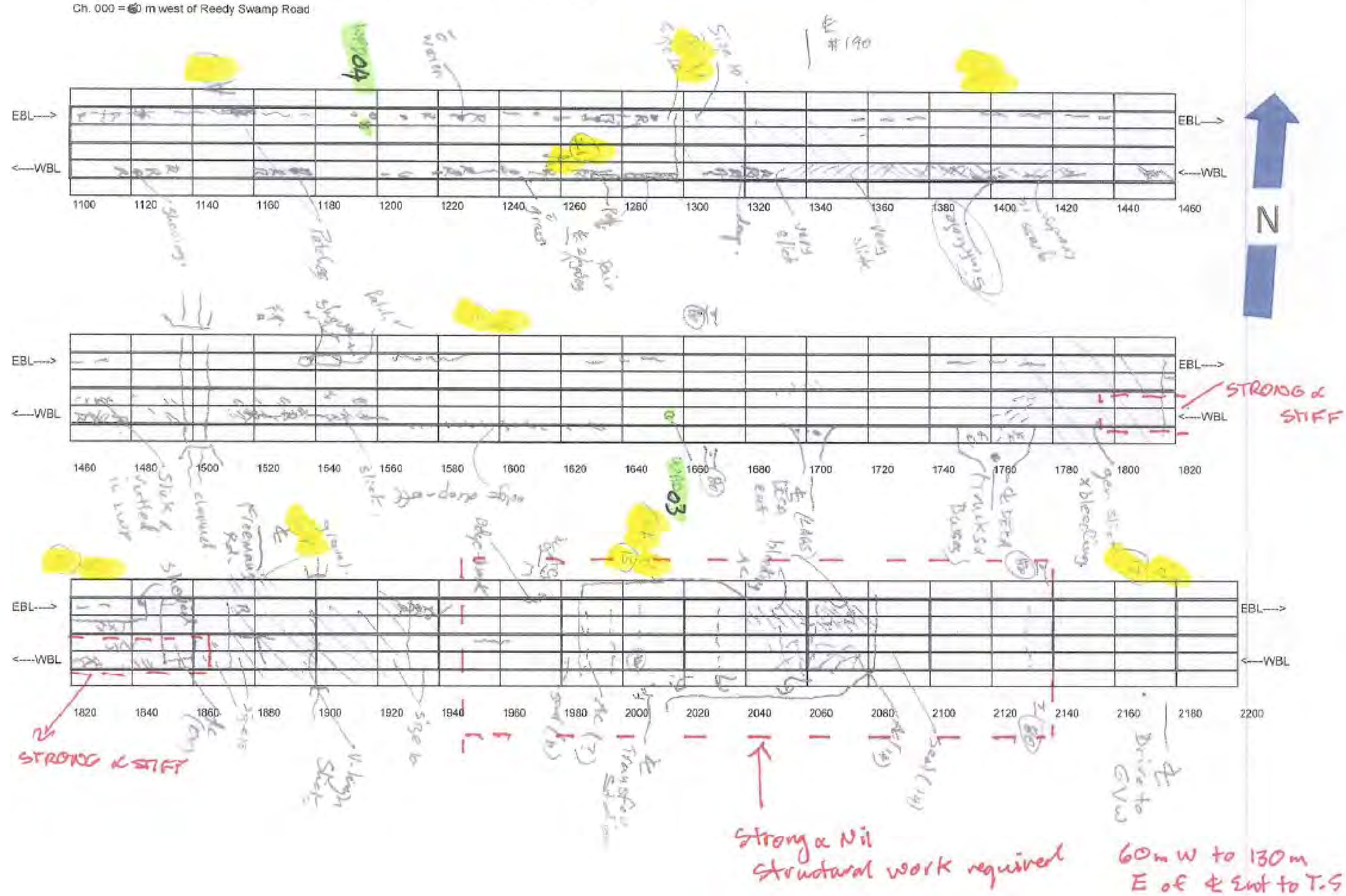
DISTRESS DIAGRAM—WANGANUI ROAD

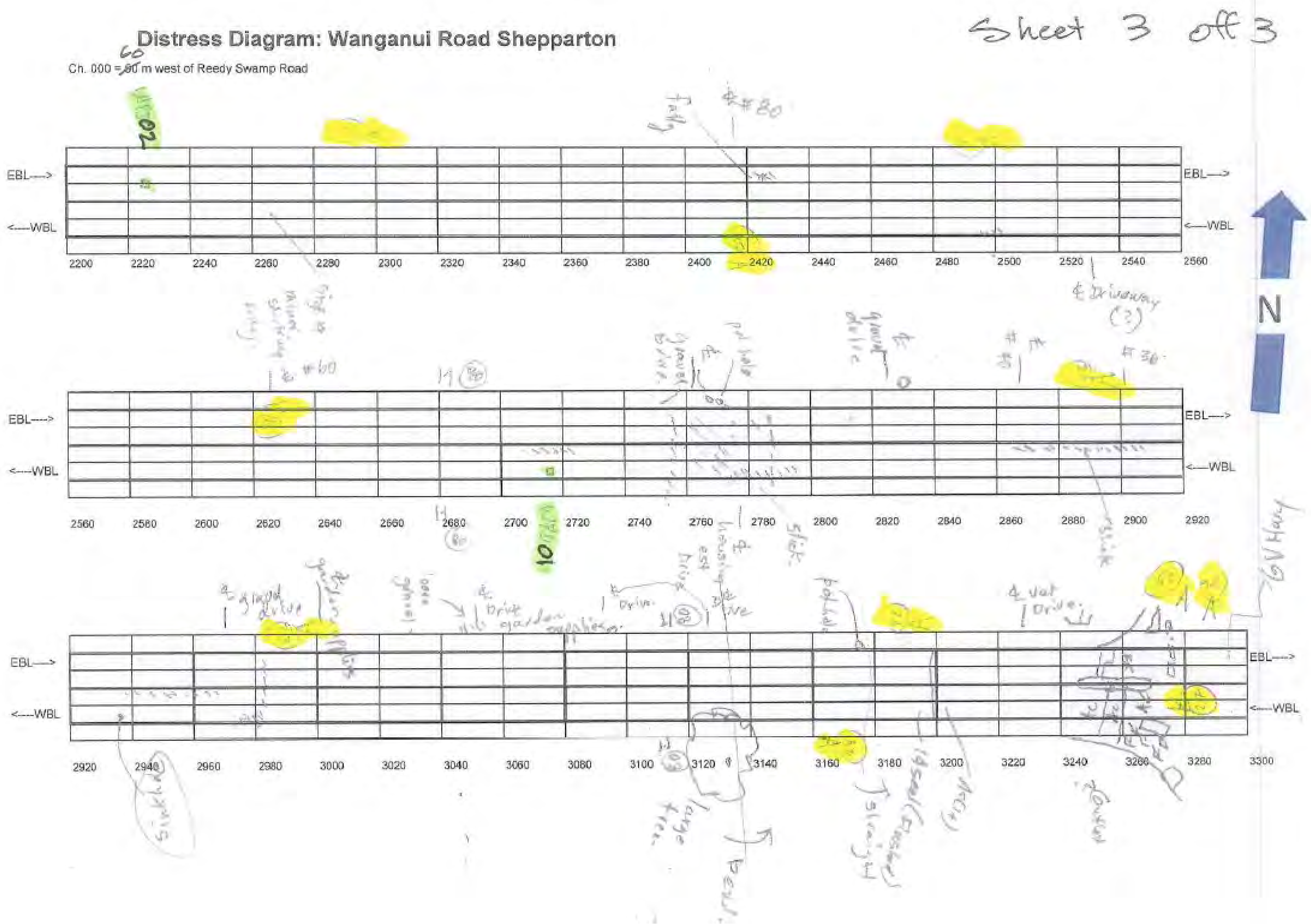


Sheet 2 off 3

Distress Diagram: Wanganui Road Shepparton

Ch. 000 = 60 m west of Reedy Swamp Road




Sheet 3 of 3
Distress Diagram: Wanganui Road Shepparton
Ch. 000 = 60 m west of Reedy Swamp Road
EBL--->
<---WBL
2200
2220
2240
2260
2280
2300
2320
2340
2360
2380
2400
2420
2440
2460
2480
2500
2520
2540
2560
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2660
2680
2700
2720
2740
2760
2780
2800
2820
2840
2860
2880
2900
2920
2940
2960
2980
3000
3020
3040
3060
3080
3100
3120
3140
3160
3180
3200
3220
3240
3260
3280
3300
N
02
01
₵ Driveway
₵ #60
₵ #80
#30
GV Hwy
garden supplies
Sinkers
large tree
Bend

APPENDIX B GEOTECHNICAL REPORT

Continent Geotechnical Services (2017).

APPENDIX C DEFLECTION TEST DATA & ANALYSIS

APPENDIX D CIRCLY JOB SUMMARY SHEETS

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CIRCLY Version 5.1c (15 January 2015)
```

Job Title: Wanganui Rd west

```
Damage Factor Calculation

Assumed number of damage pulses per movement:
   One pulse per axle (i.e. use NROWS)

Traffic Spectrum Details:

   ID: Wang_Ford Title: Wanganui Rd & Ford Rd

   Load    Load          Movements
    No.    ID
    1      ESA75-Full    4.80E+07

Details of Load Groups:

   Load    Load        Load        Load             Radius    Pressure/    Exponent
    No.    ID          Category    Type                       Ref. stress
    1      ESA75-Full  SA750-Full  Vertical Force     92.1     0.75          0.00

   Load Locations:
   Location    Load        Gear          X          Y      Scaling     Theta
    No.        ID          No.                             Factor
    1          ESA75-Full   1          -165.0       0.0    1.00E+00      0.00
    2          ESA75-Full   1           165.0       0.0    1.00E+00      0.00
    3          ESA75-Full   1          1635.0       0.0    1.00E+00      0.00
    4          ESA75-Full   1          1965.0       0.0    1.00E+00      0.00

Layout of result points on horizontal plane:
   Xmin:  0    Xmax:  165    Xdel:  165
   Y:     0

Details of Layered System:

   ID: Wang_W Title: Wanganui Rd west

   Layer  Lower    Material     Isotropy    Modulus    P.Ratio
    No.   i/face   ID                       (or Ev)    (or vvh)  F          Eh          vh
    1     rough    H_14_60      Iso.        3.20E+03   0.40
    2     rough    SS_20_60     Iso.        4.50E+03   0.40
    3     rough    SF_20_60     Iso.        3.40E+03   0.40
    4     rough    Cem500A      Aniso.      5.00E+02   0.35      3.70E+02   2.50E+02    0.35
    5     rough    Gran_150     Aniso.      1.50E+02   0.35      1.11E+02   7.50E+01    0.35
    6     rough    Sub_CBR10    Aniso.      1.00E+02   0.45      6.90E+01   5.00E+01    0.45

   Performance Relationships:
   Layer  Location Performance  Component   Perform.   Perform.  Traffic
    No.            ID                       Constant   Exponent  Multiplier
    1     bottom   H-14_60      ETH          0.003810    5.000     1.100
    2     bottom   SS_20_60     ETH          0.003340    5.000     1.100
    3     bottom   SF_20_60     ETH          0.004460    5.000     1.100
    6     top      Sub_2004     EZZ          0.009300    7.000     1.500

   Reliability Factors:
   Project Reliability: Error - Not defined - please notify Mincad Systems.
   Layer  Reliability  Material
    No.   Factor       Type
    1       1.00       Asphalt as per CoP RC 500.22
    2       1.00       Asphalt as per CoP RC 500.22
    3       1.00       Asphalt as per CoP RC 500.22
    6       1.00       Subgrade (Austroads 2004)

   Details of Layers to be sublayered:
   Layer no.  5:  Austroads (2004) sublayering

Results:

   Layer  Thickness  Material     Load          Critical      CDF
```

No.		ID	ID	Strain	
1	40.00	H_14_60	ESA75-Full	1.36E-05	5.28E-30
2	60.00	SS_20_60	ESA75-Full	-4.79E-05	3.21E-02
3	75.00	SF_20_60	ESA75-Full	-1.25E-04	9.00E-01
4	180.00	Cem500A		n/a	n/a
5	150.00	Gran_150		n/a	n/a
6	0.00	Sub_CBR10	ESA75-Full	2.60E-04	9.67E-04

CIRCLY Version 5.1c (15 January 2015)

Job Title: Wanganui Rd east

Damage Factor Calculation

Assumed number of damage pulses per movement:
One pulse per axle (i.e. use NROWS)

Traffic Spectrum Details:

ID: Wang_Ford Title: Wanganui Rd & Ford Rd

Load No.	Load ID	Movements
1	ESA75-Full	4.80E+07

Details of Load Groups:

Load No.	Load ID	Load Category	Load Type	Radius	Pressure/ Ref. stress	Exponent
1	ESA75-Full	SA750-Full	Vertical Force	92.1	0.75	0.00

Load Locations:

Location No.	Load ID	Gear No.	X	Y	Scaling Factor	Theta
1	ESA75-Full	1	-165.0	0.0	1.00E+00	0.00
2	ESA75-Full	1	165.0	0.0	1.00E+00	0.00
3	ESA75-Full	1	1635.0	0.0	1.00E+00	0.00
4	ESA75-Full	1	1965.0	0.0	1.00E+00	0.00

Layout of result points on horizontal plane:
Xmin: 0 Xmax: 165 Xdel: 165
Y: 0

Details of Layered System:

ID: Wang_E Title: Wanganui Rd east

Layer No.	Lower i/face	Material ID	Isotropy	Modulus (or Ev)	P.Ratio (or vvh)	F	Eh	vh
1	rough	H_14_60	Iso.	3.20E+03	0.40			
2	rough	SS_20_60	Iso.	4.50E+03	0.40			
3	rough	SF_20_60	Iso.	3.40E+03	0.40			
4	rough	Cem500A	Aniso.	5.00E+02	0.35	3.70E+02	2.50E+02	0.35
5	rough	Gran_150	Aniso.	1.50E+02	0.35	1.11E+02	7.50E+01	0.35
6	rough	Sub_CBR4	Aniso.	4.00E+01	0.45	2.76E+01	2.00E+01	0.45

Performance Relationships:

Layer No.	Location	Performance ID	Component	Perform. Constant	Perform. Exponent	Traffic Multiplier
1	bottom	H-14_60	ETH	0.003810	5.000	1.100
2	bottom	SS_20_60	ETH	0.003340	5.000	1.100
3	bottom	SF_20_60	ETH	0.004460	5.000	1.100
6	top	Sub_2004	EZZ	0.009300	7.000	1.500

Reliability Factors:
Project Reliability: Austroads 95%

Layer No.	Reliability Factor	Material Type
1	1.00	Asphalt as per CoP RC 500.22
2	1.00	Asphalt as per CoP RC 500.22

3	1.00	Asphalt as per CoP RC 500.22
6	1.00	Subgrade (Austroads 2004)

Details of Layers to be sublayered:
Layer no. 5: Austroads (2004) sublayering

Results:

Layer No.	Thickness	Material ID	Load ID	Critical Strain	CDF
1	40.00	H_14_60	ESA75-Full	1.81E-05	5.28E-30
2	95.00	SS_20_60	ESA75-Full	-5.68E-05	7.54E-02
3	70.00	SF_20_60	ESA75-Full	-1.25E-04	8.97E-01
4	180.00	Cem500A		n/a	n/a
5	150.00	Gran_150		n/a	n/a
6	0.00	Sub_CBR4	ESA75-Full	3.74E-04	1.22E-02

CIRCLY Version 5.1c (15 January 2015)

Job Title: GVH intersection

Damage Factor Calculation

Assumed number of damage pulses per movement:
One pulse per axle (i.e. use NROWS)

Traffic Spectrum Details:

ID: Wang_Ford Title: Wanganui Rd & Ford Rd

Load No.	Load ID	Movements
1	ESA75-Full	8.40E+07

Details of Load Groups:

Load No.	Load ID	Load Category	Load Type	Radius	Pressure/ Ref. stress	Exponent
1	ESA75-Full	SA750-Full	Vertical Force	92.1	0.75	0.00

Load Locations:

Location No.	Load ID	Gear No.	X	Y	Scaling Factor	Theta
1	ESA75-Full	1	-165.0	0.0	1.00E+00	0.00
2	ESA75-Full	1	165.0	0.0	1.00E+00	0.00
3	ESA75-Full	1	1635.0	0.0	1.00E+00	0.00
4	ESA75-Full	1	1965.0	0.0	1.00E+00	0.00

Layout of result points on horizontal plane:
Xmin: 0 Xmax: 165 Xdel: 165
Y: 0

Details of Layered System:

ID: GVH Title: GVH intersection

Layer No.	Lower i/face	Material ID	Isotropy	Modulus (or Ev)	P.Ratio (or vvh)	F	Eh	vh
1	rough	V_14_10	Iso.	1.60E+03	0.40			
2	rough	SS_20_10	Iso.	2.40E+03	0.40			
3	rough	SF_20_10	Iso.	1.80E+03	0.40			
4	rough	Cem500A	Aniso.	5.00E+02	0.35	3.70E+02	2.50E+02	0.35
5	rough	Gran_150	Aniso.	1.50E+02	0.35	1.11E+02	7.50E+01	0.35
6	rough	Sub_CBR4	Aniso.	4.00E+01	0.45	2.76E+01	2.00E+01	0.45

Performance Relationships:

Layer No.	Location	Performance ID	Component	Perform. Constant	Perform. Exponent	Traffic Multiplier
1	bottom	V_14_10	ETH	0.004680	5.000	1.100
2	bottom	SS_20_10	ETH	0.004190	5.000	1.100
3	bottom	SF_20_10	ETH	0.005610	5.000	1.100
6	top	Sub_2004	EZZ	0.009300	7.000	1.500

Reliability Factors:
Project Reliability: Austroads 95%

Layer No.	Reliability Factor	Material Type
1	1.00	Asphalt as per CoP RC 500.22
2	1.00	Asphalt as per CoP RC 500.22
3	1.00	Asphalt as per CoP RC 500.22
6	1.00	Subgrade (Austroads 2004)

Details of Layers to be sublayered:
Layer no. 5: Austroads (2004) sublayering

Results:

Layer No.	Thickness	Material ID	Load ID	Critical Strain	CDF
1	40.00	V_14_10	ESA75-Full	9.57E-06	9.24E-30
2	125.00	SS_20_10	ESA75-Full	-7.88E-05	2.18E-01
3	75.00	SF_20_10	ESA75-Full	-1.41E-04	9.31E-01
4	180.00	Cem500A		n/a	n/a
5	150.00	Gran_150		n/a	n/a
6	0.00	Sub_CBR4	ESA75-Full	3.89E-04	2.83E-02

CIRCLY Version 5.1c (15 January 2015)

Job Title: Ford Rd west

Damage Factor Calculation

Assumed number of damage pulses per movement:
One pulse per axle (i.e. use NROWS)

Traffic Spectrum Details:

ID: Wang_Ford Title: Wanganui Rd & Ford Rd

Load No.	Load ID	Movements
1	ESA75-Full	2.80E+07

Details of Load Groups:

Load No.	Load ID	Load Category	Load Type	Radius	Pressure/ Ref. stress	Exponent
1	ESA75-Full	SA750-Full	Vertical Force	92.1	0.75	0.00

Load Locations:

Location No.	Load ID	Gear No.	X	Y	Scaling Factor	Theta
1	ESA75-Full	1	-165.0	0.0	1.00E+00	0.00
2	ESA75-Full	1	165.0	0.0	1.00E+00	0.00
3	ESA75-Full	1	1635.0	0.0	1.00E+00	0.00
4	ESA75-Full	1	1965.0	0.0	1.00E+00	0.00

Layout of result points on horizontal plane:
Xmin: 0 Xmax: 165 Xdel: 165
Y: 0

Details of Layered System:

ID: Ford_West Title: Ford Rd west

Layer No.	Lower i/face	Material ID	Isotropy	Modulus (or Ev)	P.Ratio (or vvh)	F	Eh	vh
1	rough	H-14_40	Iso.	2.80E+03	0.40			
2	rough	SS_20_40	Iso.	3.90E+03	0.40			
3	rough	SF_20_40	Iso.	2.90E+03	0.40			
4	rough	Cem500A	Aniso.	5.00E+02	0.35	3.70E+02	2.50E+02	0.35
5	rough	Gran_150	Aniso.	1.50E+02	0.35	1.11E+02	7.50E+01	0.35
6	rough	Sub_CBR4	Aniso.	4.00E+01	0.45	2.76E+01	2.00E+01	0.45

Performance Relationships:

Layer No.	Location	Performance ID	Component	Perform. Constant	Perform. Exponent	Traffic Multiplier
1	bottom	H-14_40	ETH	0.004000	5.000	1.100
2	bottom	SS_20_40	ETH	0.003520	5.000	1.100
3	bottom	SF_20_40	ETH	0.004720	5.000	1.100
6	top	Sub_2004	EZZ	0.009300	7.000	1.500

Reliability Factors:
Project Reliability: Austroads 95%

Layer No.	Reliability Factor	Material Type
1	1.00	Asphalt as per CoP RC 500.22
2	1.00	Asphalt as per CoP RC 500.22
3	1.00	Asphalt as per CoP RC 500.22
6	1.00	Subgrade (Austroads 2004)

Details of Layers to be sublayered:
Layer no. 5: Austroads (2004) sublayering

Results:

Layer No.	Thickness	Material ID	Load ID	Critical Strain	CDF
1	40.00	H-14_40	ESA75-Full	2.14E-05	3.08E-30
2	70.00	SS_20_40	ESA75-Full	-5.84E-05	3.87E-02
3	75.00	SF_20_40	ESA75-Full	-1.50E-04	9.88E-01
4	180.00	Cem500A		n/a	n/a
5	150.00	Gran_150		n/a	n/a
6	0.00	Sub_CBR4	ESA75-Full	4.39E-04	2.19E-02

CIRCLY Version 5.1c (15 January 2015)

Job Title: Ford Rd east_CBR 4

Damage Factor Calculation

Assumed number of damage pulses per movement:
One pulse per axle (i.e. use NROWS)

Traffic Spectrum Details:

ID: Wang_Ford Title: Wanganui Rd & Ford Rd

Load No.	Load ID	Movements
1	ESA75-Full	2.20E+07

Details of Load Groups:

Load No.	Load ID	Load Category	Load Type	Radius	Pressure/ Ref. stress	Exponent
1	ESA75-Full	SA750-Full	Vertical Force	92.1	0.75	0.00

Load Locations:

Location No.	Load ID	Gear No.	X	Y	Scaling Factor	Theta
1	ESA75-Full	1	-165.0	0.0	1.00E+00	0.00
2	ESA75-Full	1	165.0	0.0	1.00E+00	0.00
3	ESA75-Full	1	1635.0	0.0	1.00E+00	0.00
4	ESA75-Full	1	1965.0	0.0	1.00E+00	0.00

Layout of result points on horizontal plane:
Xmin: 0 Xmax: 165 Xdel: 165
Y: 0

Details of Layered System:

ID: Ford_E_4 Title: Ford Rd east_CBR 4

Layer No.	Lower i/face	Material ID	Isotropy	Modulus (or Ev)	P.Ratio (or vvh)	F	Eh	vh
1	rough	H-14_40	Iso.	2.80E+03	0.40			
2	rough	SS_20_40	Iso.	3.90E+03	0.40			
3	rough	SF_20_40	Iso.	2.90E+03	0.40			
4	rough	Cem500A	Aniso.	5.00E+02	0.35	3.70E+02	2.50E+02	0.35
5	rough	Gran_150	Aniso.	1.50E+02	0.35	1.11E+02	7.50E+01	0.35
6	rough	Sub_CBR4	Aniso.	4.00E+01	0.45	2.76E+01	2.00E+01	0.45

Performance Relationships:

Layer No.	Location	Performance ID	Component	Perform. Constant	Perform. Exponent	Traffic Multiplier
1	bottom	H-14_40	ETH	0.004000	5.000	1.100
2	bottom	SS_20_40	ETH	0.003520	5.000	1.100
3	bottom	SF_20_40	ETH	0.004720	5.000	1.100
6	top	Sub_2004	EZZ	0.009300	7.000	1.500

Reliability Factors:
Project Reliability: Austroads 95%

Layer No.	Reliability Factor	Material Type
1	1.00	Asphalt as per CoP RC 500.22
2	1.00	Asphalt as per CoP RC 500.22
3	1.00	Asphalt as per CoP RC 500.22
6	1.00	Subgrade (Austroads 2004)

Details of Layers to be sublayered:
Layer no. 5: Austroads (2004) sublayering

Results:

Layer No.	Thickness	Material ID	Load ID	Critical Strain	CDF
1	40.00	H-14_40	ESA75-Full	2.23E-05	2.42E-30
2	65.00	SS_20_40	ESA75-Full	-5.72E-05	2.75E-02
3	75.00	SF_20_40	ESA75-Full	-1.54E-04	8.93E-01
4	180.00	Cem500A		n/a	n/a
5	150.00	Gran_150		n/a	n/a
6	0.00	Sub_CBR4	ESA75-Full	4.52E-04	2.10E-02

CIRCLY Version 5.1c (15 January 2015)

Job Title: Ford Rd east_CBR 6

Damage Factor Calculation

Assumed number of damage pulses per movement:
One pulse per axle (i.e. use NROWS)

Traffic Spectrum Details:

ID: Wang_Ford Title: Wanganui Rd & Ford Rd

Load No.	Load ID	Movements
1	ESA75-Full	2.20E+07

Details of Load Groups:

Load No.	Load ID	Load Category	Load Type	Radius	Pressure/ Ref. stress	Exponent
1	ESA75-Full	SA750-Full	Vertical Force	92.1	0.75	0.00

Load Locations:

Location No.	Load ID	Gear No.	X	Y	Scaling Factor	Theta
1	ESA75-Full	1	-165.0	0.0	1.00E+00	0.00
2	ESA75-Full	1	165.0	0.0	1.00E+00	0.00
3	ESA75-Full	1	1635.0	0.0	1.00E+00	0.00
4	ESA75-Full	1	1965.0	0.0	1.00E+00	0.00

Layout of result points on horizontal plane:

Xmin: 0 Xmax: 165 Xdel: 165
Y: 0

Details of Layered System:

ID: Ford_E_6 Title: Ford Rd east_CBR 6

Layer No.	Lower i/face	Material ID	Isotropy	Modulus (or Ev)	P.Ratio (or vvh)	F	Eh	vh
1	rough	H-14_40	Iso.	2.80E+03	0.40			
2	rough	SS_20_40	Iso.	3.90E+03	0.40			
3	rough	SF_20_40	Iso.	2.90E+03	0.40			
4	rough	Cem500A	Aniso.	5.00E+02	0.35	3.70E+02	2.50E+02	0.35
5	rough	Gran_150	Aniso.	1.50E+02	0.35	1.11E+02	7.50E+01	0.35
6	rough	Sub_CBR6	Aniso.	6.00E+01	0.45	4.14E+01	3.00E+01	0.45

Performance Relationships:

Layer No.	Location	Performance ID	Component	Perform. Constant	Perform. Exponent	Traffic Multiplier
1	bottom	H-14_40	ETH	0.004000	5.000	1.100
2	bottom	SS_20_40	ETH	0.003520	5.000	1.100
3	bottom	SF_20_40	ETH	0.004720	5.000	1.100
6	top	Sub_2004	EZZ	0.009300	7.000	1.500

Reliability Factors:
Project Reliability: Austroads 95%

Layer No.	Reliability Factor	Material Type
1	1.00	Asphalt as per CoP RC 500.22
2	1.00	Asphalt as per CoP RC 500.22
3	1.00	Asphalt as per CoP RC 500.22
6	1.00	Subgrade (Austroads 2004)

Details of Layers to be sublayered:
Layer no. 5: Austroads (2004) sublayering

Results:

Layer No.	Thickness	Material ID	Load ID	Critical Strain	CDF
1	40.00	H-14_40	ESA75-Full	1.92E-05	2.42E-30
2	50.00	SS_20_40	ESA75-Full	-5.14E-05	1.60E-02
3	75.00	SF_20_40	ESA75-Full	-1.54E-04	9.04E-01
4	180.00	Cem500A		n/a	n/a
5	150.00	Gran_150		n/a	n/a
6	0.00	Sub_CBR6	ESA75-Full	3.94E-04	8.03E-03

ASPHALT OVERLAY ANALYSES

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CIRCLY Version 5.1c (15 January 2015)

Job Title: Wanganui Rd west_Overlay

Damage Factor Calculation

Assumed number of damage pulses per movement:
   One pulse per axle (i.e. use NROWS)

Traffic Spectrum Details:

   ID: Wang_Ford Title: Wanganui Rd & Ford Rd

   Load   Load         Movements
    No.   ID
    1     ESA75-Full   4.80E+07

Details of Load Groups:

   Load   Load        Load        Load             Radius    Pressure/    Exponent
    No.   ID          Category    Type                       Ref. stress
    1     ESA75-Full  SA750-Full  Vertical Force     92.1     0.75          0.00

   Load Locations:
   Location   Load        Gear          X          Y      Scaling     Theta
    No.       ID          No.                             Factor
    1         ESA75-Full   1          -165.0        0.0   1.00E+00      0.00
    2         ESA75-Full   1           165.0        0.0   1.00E+00      0.00
    3         ESA75-Full   1          1635.0        0.0   1.00E+00      0.00
    4         ESA75-Full   1          1965.0        0.0   1.00E+00      0.00

Layout of result points on horizontal plane:
   Xmin:  0   Xmax:  165   Xdel:  165
   Y:     0

Details of Layered System:

   ID: Wang_W Title: Wanganui Rd west

   Layer  Lower    Material     Isotropy   Modulus    P.Ratio
    No.   i/face   ID                      (or Ev)    (or vvh)  F          Eh         vh
    1     rough    H_14_60      Iso.       3.20E+03   0.40
    2     rough    SS_20_60     Iso.       4.50E+03   0.40
    3     rough    SF_20_60     Iso.       3.40E+03   0.40
    4     rough    Cem500A      Aniso.     5.00E+02   0.35      3.70E+02   2.50E+02   0.35
    5     rough    Gran_150     Aniso.     1.50E+02   0.35      1.11E+02   7.50E+01   0.35
    6     rough    Sub_CBR10    Aniso.     1.00E+02   0.45      6.90E+01   5.00E+01   0.45

   Performance Relationships:
   Layer  Location Performance  Component  Perform.   Perform.  Traffic
    No.            ID                      Constant   Exponent  Multiplier
    1     bottom   H-14_60      ETH         0.003810    5.000     1.100
    2     bottom   SS_20_60     ETH         0.003340    5.000     1.100
    3     bottom   SF_20_60     ETH         0.004460    5.000     1.100
    6     top      Sub_2004     EZZ         0.009300    7.000     1.500

   Reliability Factors: Not Used.

   Details of Layers to be sublayered:
   Layer no.  5:  Austroads (2004) sublayering

Results:

   Layer  Thickness  Material     Load          Critical      CDF
    No.              ID           ID            Strain
    1        40.00   H_14_60      ESA75-Full     1.39E-05     5.28E-30
    2       105.00   SS_20_60     ESA75-Full    -5.76E-05     8.03E-02
    3        75.00   SF_20_60     ESA75-Full    -1.27E-04     9.82E-01
    4         0.00   Cem500A                     n/a          n/a
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    5      150.00    Gran_150                      n/a           n/a
    6        0.00    Sub_CBR10    ESA75-Full     2.65E-04      1.09E-03




CIRCLY Version 5.1c (15 January 2015)

Job Title: Wanganui Rd east: AC Overlay thickness

Damage Factor Calculation

Assumed number of damage pulses per movement:
   One pulse per axle (i.e. use NROWS)

Traffic Spectrum Details:

   ID: Wang_Ford Title: Wanganui Rd & Ford Rd

   Load   Load         Movements
    No.   ID
    1     ESA75-Full   4.80E+07

Details of Load Groups:

   Load   Load        Load        Load            Radius    Pressure/    Exponent
    No.   ID          Category    Type                      Ref. stress
    1     ESA75-Full  SA750-Full  Vertical Force     92.1    0.75         0.00

   Load Locations:
   Location    Load        Gear          X          Y      Scaling     Theta
    No.        ID          No.                             Factor
    1          ESA75-Full   1          -165.0        0.0   1.00E+00      0.00
    2          ESA75-Full   1           165.0        0.0   1.00E+00      0.00
    3          ESA75-Full   1          1635.0        0.0   1.00E+00      0.00
    4          ESA75-Full   1          1965.0        0.0   1.00E+00      0.00

Layout of result points on horizontal plane:
   Xmin:  0   Xmax:  165   Xdel:  165
   Y:     0

Details of Layered System:

   ID: Wang_E Title: Wanganui Rd east

   Layer  Lower    Material     Isotropy   Modulus    P.Ratio
    No.   i/face   ID                      (or Ev)    (or vvh)  F          Eh         vh
    1     rough    H_14_60      Iso.       3.20E+03   0.40
    2     rough    SS_20_60     Iso.       4.50E+03   0.40
    3     rough    SF_20_60     Iso.       3.40E+03   0.40
    4     rough    Cem500A      Aniso.     5.00E+02   0.35      3.70E+02   2.50E+02   0.35
    5     rough    Gran_150     Aniso.     1.50E+02   0.35      1.11E+02   7.50E+01   0.35
    6     rough    Sub_CBR4     Aniso.     4.00E+01   0.45      2.76E+01   2.00E+01   0.45

   Performance Relationships:
   Layer  Location Performance  Component  Perform.   Perform.  Traffic
    No.            ID                      Constant   Exponent  Multiplier
    1     bottom   H-14_60      ETH         0.003810    5.000     1.100
    2     bottom   SS_20_60     ETH         0.003340    5.000     1.100
    3     bottom   SF_20_60     ETH         0.004460    5.000     1.100
    6     top      Sub_2004     EZZ         0.009300    7.000     1.500

   Reliability Factors:
   Project Reliability: Austroads 95%
   Layer  Reliability  Material
    No.   Factor       Type
    1       1.00       Asphalt as per CoP RC 500.22
    2       1.00       Asphalt as per CoP RC 500.22
    3       1.00       Asphalt as per CoP RC 500.22
    6       1.00       Subgrade (Austroads 2004)

   Details of Layers to be sublayered:
   Layer no.  5:  Austroads (2004) sublayering
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Results:

Layer No.	Thickness	Material ID	Load ID	Critical Strain	CDF
1	40.00	H_14_60	ESA75-Full	1.65E-05	5.28E-30
2	145.00	SS_20_60	ESA75-Full	-6.41E-05	1.38E-01
3	70.00	SF_20_60	ESA75-Full	-1.25E-04	9.30E-01
4	0.00	Cem500A		n/a	n/a
5	220.00	Gran_150		n/a	n/a
6	0.00	Sub_CBR4	ESA75-Full	3.28E-04	4.93E-03

CIRCLY Version 5.1c (15 January 2015)

Job Title: Ford Rd west_Overlay

Damage Factor Calculation

Assumed number of damage pulses per movement:
One pulse per axle (i.e. use NROWS)

Traffic Spectrum Details:

ID: Wang_Ford Title: Wanganui Rd & Ford Rd

Load No.	Load ID	Movements
1	ESA75-Full	2.80E+07

Details of Load Groups:

Load No.	Load ID	Load Category	Load Type	Radius	Pressure/ Ref. stress	Exponent
1	ESA75-Full	SA750-Full	Vertical Force	92.1	0.75	0.00

Load Locations:

Location No.	Load ID	Gear No.	X	Y	Scaling Factor	Theta
1	ESA75-Full	1	-165.0	0.0	1.00E+00	0.00
2	ESA75-Full	1	165.0	0.0	1.00E+00	0.00
3	ESA75-Full	1	1635.0	0.0	1.00E+00	0.00
4	ESA75-Full	1	1965.0	0.0	1.00E+00	0.00

Layout of result points on horizontal plane:
Xmin: 0 Xmax: 165 Xdel: 165
Y: 0

Details of Layered System:

ID: Ford_West Title: Ford Rd west

Layer No.	Lower i/face	Material ID	Isotropy	Modulus (or Ev)	P.Ratio (or vvh)	F	Eh	vh
1	rough	H-14_40	Iso.	2.80E+03	0.40			
2	rough	SS_20_40	Iso.	3.90E+03	0.40			
3	rough	SF_20_40	Iso.	2.90E+03	0.40			
4	rough	Cem500A	Aniso.	5.00E+02	0.35	3.70E+02	2.50E+02	0.35
5	rough	Gran_150	Aniso.	1.50E+02	0.35	1.11E+02	7.50E+01	0.35
6	rough	Sub_CBR4	Aniso.	4.00E+01	0.45	2.76E+01	2.00E+01	0.45

Performance Relationships:

Layer No.	Location	Performance ID	Component	Perform. Constant	Perform. Exponent	Traffic Multiplier
1	bottom	H-14_40	ETH	0.004000	5.000	1.100
2	bottom	SS_20_40	ETH	0.003520	5.000	1.100
3	bottom	SF_20_40	ETH	0.004720	5.000	1.100
6	top	Sub_2004	EZZ	0.009300	7.000	1.500

Reliability Factors:
Project Reliability: Austroads 95%

Layer No.	Reliability Factor	Material Type
1	1.00	Asphalt as per CoP RC 500.22

2	1.00	Asphalt as per CoP RC 500.22
3	1.00	Asphalt as per CoP RC 500.22
6	1.00	Subgrade (Austroads 2004)

Details of Layers to be sublayered:
Layer no. 5: Austroads (2004) sublayering

Results:

Layer No.	Thickness	Material ID	Load ID	Critical Strain	CDF
1	40.00	H-14_40	ESA75-Full	1.88E-05	3.08E-30
2	125.00	SS_20_40	ESA75-Full	-7.02E-05	9.73E-02
3	75.00	SF_20_40	ESA75-Full	-1.48E-04	9.22E-01
4	0.00	Cem500A		n/a	n/a
5	300.00	Gran_150		n/a	n/a
6	0.00	Sub_CBR4	ESA75-Full	3.56E-04	5.11E-03

CIRCLY Version 5.1c (15 January 2015)

Job Title: Ford Rd east_CBR 6 Overlay

Damage Factor Calculation

Assumed number of damage pulses per movement:
One pulse per axle (i.e. use NROWS)

Traffic Spectrum Details:

ID: Wang_Ford Title: Wanganui Rd & Ford Rd

Load No.	Load ID	Movements
1	ESA75-Full	2.20E+07

Details of Load Groups:

Load No.	Load ID	Load Category	Load Type	Radius	Pressure/ Ref. stress	Exponent
1	ESA75-Full	SA750-Full	Vertical Force	92.1	0.75	0.00

Load Locations:

Location No.	Load ID	Gear No.	X	Y	Scaling Factor	Theta
1	ESA75-Full	1	-165.0	0.0	1.00E+00	0.00
2	ESA75-Full	1	165.0	0.0	1.00E+00	0.00
3	ESA75-Full	1	1635.0	0.0	1.00E+00	0.00
4	ESA75-Full	1	1965.0	0.0	1.00E+00	0.00

Layout of result points on horizontal plane:
Xmin: 0 Xmax: 165 Xdel: 165
Y: 0

Details of Layered System:

ID: Ford_E_6 Title: Ford Rd east_CBR 6

Layer No.	Lower i/face	Material ID	Isotropy	Modulus (or Ev)	P.Ratio (or vvh)	F	Eh	vh
1	rough	H-14_40	Iso.	2.80E+03	0.40			
2	rough	SS_20_40	Iso.	3.90E+03	0.40			
3	rough	SF_20_40	Iso.	2.90E+03	0.40			
4	rough	Cem500A	Aniso.	5.00E+02	0.35	3.70E+02	2.50E+02	0.35
5	rough	Gran_150	Aniso.	1.50E+02	0.35	1.11E+02	7.50E+01	0.35
6	rough	Sub_CBR6	Aniso.	6.00E+01	0.45	4.14E+01	3.00E+01	0.45

Performance Relationships:

Layer No.	Location	Performance ID	Component	Perform. Constant	Perform. Exponent	Traffic Multiplier

1	bottom	H-14_40	ETH	0.004000	5.000	1.100
2	bottom	SS_20_40	ETH	0.003520	5.000	1.100
3	bottom	SF_20_40	ETH	0.004720	5.000	1.100
6	top	Sub_2004	EZZ	0.009300	7.000	1.500

Reliability Factors:
Project Reliability: Austroads 95%

Layer No.	Reliability Factor	Material Type
1	1.00	Asphalt as per CoP RC 500.22
2	1.00	Asphalt as per CoP RC 500.22
3	1.00	Asphalt as per CoP RC 500.22
6	1.00	Subgrade (Austroads 2004)

Details of Layers to be sublayered:
Layer no. 5: Austroads (2004) sublayering

Results:

Layer No.	Thickness	Material ID	Load ID	Critical Strain	CDF
1	40.00	H-14_40	ESA75-Full	1.87E-05	2.42E-30
2	110.00	SS_20_40	ESA75-Full	-7.01E-05	7.58E-02
3	75.00	SF_20_40	ESA75-Full	-1.53E-04	8.76E-01
4	0.00	Cem500A		n/a	n/a
5	170.00	Gran_150		n/a	n/a
6	0.00	Sub_CBR6	ESA75-Full	3.61E-04	4.41E-03

CIRCLY Version 5.1c (15 January 2015)

Job Title: Ford Rd east_CBR 4 Overlay

Damage Factor Calculation

Assumed number of damage pulses per movement:
One pulse per axle (i.e. use NROWS)

Traffic Spectrum Details:

ID: Wang_Ford Title: Wanganui Rd & Ford Rd

Load No.	Load ID	Movements
1	ESA75-Full	2.20E+07

Details of Load Groups:

Load No.	Load ID	Load Category	Load Type	Radius	Pressure/ Ref. stress	Exponent
1	ESA75-Full	SA750-Full	Vertical Force	92.1	0.75	0.00

Load Locations:

Location No.	Load ID	Gear No.	X	Y	Scaling Factor	Theta
1	ESA75-Full	1	-165.0	0.0	1.00E+00	0.00
2	ESA75-Full	1	165.0	0.0	1.00E+00	0.00
3	ESA75-Full	1	1635.0	0.0	1.00E+00	0.00
4	ESA75-Full	1	1965.0	0.0	1.00E+00	0.00

Layout of result points on horizontal plane:
Xmin: 0 Xmax: 165 Xdel: 165
Y: 0

Details of Layered System:

ID: Ford_E_4 Title: Ford Rd east_CBR 4

Layer No.	Lower i/face	Material ID	Isotropy	Modulus (or Ev)	P.Ratio (or vvh)	F	Eh	vh
1	rough	H-14_40	Iso.	2.80E+03	0.40			
2	rough	SS_20_40	Iso.	3.90E+03	0.40			
3	rough	SF_20_40	Iso.	2.90E+03	0.40			
4	rough	Cem500A	Aniso.	5.00E+02	0.35	3.70E+02	2.50E+02	0.35

5	rough	Gran_150	Aniso.	1.50E+02	0.35	1.11E+02	7.50E+01	0.35
6	rough	Sub_CBR4	Aniso.	4.00E+01	0.45	2.76E+01	2.00E+01	0.45

Performance Relationships:

Layer No.	Location	Performance ID	Component	Perform. Constant	Perform. Exponent	Traffic Multiplier
1	bottom	H-14_40	ETH	0.004000	5.000	1.100
2	bottom	SS_20_40	ETH	0.003520	5.000	1.100
3	bottom	SF_20_40	ETH	0.004720	5.000	1.100
6	top	Sub_2004	EZZ	0.009300	7.000	1.500

Reliability Factors:
Project Reliability: Austroads 95%

Layer No.	Reliability Factor	Material Type
1	1.00	Asphalt as per CoP RC 500.22
2	1.00	Asphalt as per CoP RC 500.22
3	1.00	Asphalt as per CoP RC 500.22
6	1.00	Subgrade (Austroads 2004)

Details of Layers to be sublayered:
Layer no. 5: Austroads (2004) sublayering

Results:

Layer No.	Thickness	Material ID	Load ID	Critical Strain	CDF
1	40.00	H-14_40	ESA75-Full	2.00E-05	2.42E-30
2	130.00	SS_20_40	ESA75-Full	-7.30E-05	9.31E-02
3	75.00	SF_20_40	ESA75-Full	-1.53E-04	8.64E-01
4	0.00	Cem500A		n/a	n/a
5	170.00	Gran_150		n/a	n/a
6	0.00	Sub_CBR4	ESA75-Full	3.88E-04	7.22E-03

		WPD01	WPD02	WPD03	WPD04		WPD05	WPD06	WPD07
Chainage	GV Hwy	2720	2230	1650	1200	Kittles Road	700	470	155
Asphalt		50	50	50	50		30	25	25
crushed rock		175	175	150	130		190	195	195
Total pavement		225	225	200	180		220	220	220
Silt (clayey)		150	150	-	290		-	-	-
Subgrade (to 1500 mm)		silty clay	silty clay	silty clay	silty clay		sand	sand	sand

		FPD01	FPD02	FPD03		FPD04	FPD05	FPD06	
Chainage	GV Hwy	2480	2085	1605	Verney Rd	1340	895	370	Grahamvale Rd
Asphalt		50	50	50		30	30	25	
crushed rock		100	100	50		-	-		
NDCR		150	150	200		120	170	145	
RAP		-	-	-		50	50	-	
Total pavement		300	300	300		200	250	170	
Silt (clayey)		-	-	-				to 1500	
Subgrade (to 1500 mm)		silty clay	silty clay	silty clay		silty clay	silty clay	silt (C)	

3240
- 1070
2170

Continent Geotech Services

TEST PIT LOG

TEST PIT No.	FPD01
SHEET:	1 of 1

CLIENT:	*Graham Foley & Associates*	DATE COMMENCED	15-03-17
PROJECT:	Pavement Investigations Wanganui Road & Ford Road	DATE COMPLETED	15-03-17
LOCATION	Shepparton	LOGGED BY	*JW*
JOB NUMBER:	6035	CHECKED BY	*SK*

Trench Length	0.4m	Easting		Chainage	-
Trench Width	0.3m	Northing		Lane	East Bound

Method	Depth or RL	Depth of Unit	Graphic Log	Classification Symbol	Material Description	Moisture Condition	Consistency / Strength	Sample ID	Sample Type	DCP	Field CBR	PP (kPa)	SV (kPa)	MC (%)	LL(%)	PI	LS	Swell	CBR	Field Records / Comments	Water
Jack Hammer		0.050			ASPHALT, 50mm																
Jack Hammer		0.15			CRUSHED ROCK: Sandy GRAVEL,dark grey, fine to coarse to fine grain, angular to sub-angular; sand, fine to coarse grain; (20mm)	D-M		7028	Disturbed												
Jack Hammer		0.3			Non Descriptive CRUSHED ROCK: Sandy silty GRAVEL,Light Brown, Coarse to fine grained, angular; sand: fine to coarse grained (40mm, Type A)	D-M		7029	Disturbed												
Hand Auger	0.5	0.85			Silty CLAY, yellow-brown, mottled red,medium plastic, traces of sand: fine grained;	D-M	Stiff	7030	Disturbed	5, 2, 2, 3, 3											
Hand Auger	1.0	1.3			0.85m grades to sandy silty clay mottled black medium plastic			7031	Disturbed	3, 3, 3, 4, 4											
Hand Auger	1.5				1.3m traces of gravel: sub-rounded	D-M	Firm	7032	Disturbed	5, 6											
	2.0				**End of FPD01 at 1.50m, Sandy Silty Clay with gravel**					7, 25R											

Photos to be inserted

Continent Geotech Services

TEST PIT LOG

TEST PIT No.	FPD02
SHEET:	1 of 1

CLIENT:	*Graham Foley & Associates*	DATE COMMENCED	15-03-17
PROJECT:	Pavement Investigations Wanganui Road & Ford Road	DATE COMPLETED	15-03-17
LOCATION	Shepparton	LOGGED BY	*JW*
JOB NUMBER:	6035	CHECKED BY	*SK*

Trench Length	0.4m	Easting		Chainage	-
Trench Width	0.3m	Northing		Lane	West Bound

Method	Depth or RL	Depth of Unit	Graphic Log	Classification Symbol	Material Description	Moisture Condition	Consistency / Strength	Sample ID	Sample Type	DCP	Field CBR	PP (kPa)	SV (kPa)	M/C (%)	LL (%)	PI	LS	Swell	CBR	Field Records / Comments	Water
Jack Hammer		0.050			ASPHALT, 50mm																
		0.15			CRUSHED ROCK: Sandy GRAVEL,dark grey, fine to coarse to fine grain, angular to sub-angular; sand, fine to coarse grain; (20mm)	D-M		7033													
		0.3			Non Descriptive CRUSHED ROCK: Sandy silty GRAVEL,Light Brown, Coarse to fine grained, angular; sand: fine to coarse grained (40mm, Type A)	D-M		7034													
Hand Auger	0.5	0.85			Silty CLAY, yellow-brown, mottled red,medium plastic, traces of sand: fine grained;	D-M	Stiff	7035	Disturbed	5 3 3 2 2											
	1.0 1.5	1.5			0.85m grades to sandy silty clay mottled black medium plastic			7036		3 4 4 5 4 6 6											
	2.0				**End of FPD02 at 1.50m, Silty Clay**					7 7 17											

Photos to be inserted

Continent Geotech Services

TEST PIT LOG

TEST PIT No.	FPD03
SHEET:	1 of 1

CLIENT:	*Graham Foley & Associates*	DATE COMMENCED	15-03-17
PROJECT:	Pavement Investigations Wanganui Road & Ford Road	DATE COMPLETED	15-03-17
LOCATION	Shepparton	LOGGED BY	*JW*
JOB NUMBER:	6035	CHECKED BY	*SK*

Trench Length	0.4m	Easting		Chainage	-
Trench Width	0.3m	Northing		Lane	East Bound

Method	Depth or RL	Depth of Unit	Graphic Log	Classification Symbol	Material Description	Moisture Condition	Consistency / Strength	Sample ID	Sample Type	Field Records / Comments	Water
Jack Hammer		0.050			ASPHALT, 50mm						
Jack Hammer		0.10			CRUSHED ROCK: Sandy GRAVEL,dark grey, fine to coarse to fine grain, angular to sub-angular; sand,	D-M		7042			
Jack Hammer		0.3			Non Descriptive CRUSHED ROCK: Sandy silty GRAVEL, yellow Brown, Coarse to fine grained, angular; sand: fine to coarse grained (40mm, Type A)	D-M		7043			
Hand Auger	0.5, 1.0, 1.5	1.5			Silty CLAY, red-brown, mottled red,medium plastic, traces of sand: fine grained;	D-M	Firm	7044	Disturbed		
	2.0				**End of FPD03 at 1.50m, Silty Clay**						

DCP
6
5
4
3
4
3
4
5
6
6
9
7
6
7
8

Columns with no entries: Field CBR, PP (kPa), SV (kPa), MC (%), LL(%), PI, LS, Swell, CBR

Photos to be inserted

Continent Geotech Services

TEST PIT LOG

TEST PIT No.	FPD04
SHEET:	1 of 1

CLIENT:	*Graham Foley & Associates*	DATE COMMENCED	15-03-17
PROJECT:	**Pavement Investigations Wanganui Road & Ford Road**	DATE COMPLETED	15-03-17
LOCATION	**Shepparton**	LOGGED BY	*JW*
JOB NUMBER:	**6035**	CHECKED BY	*SK*

Trench Length	0.4m	Easting		Chainage	-		
Trench Width	0.3m	Northing		Lane		West Bound	

Method	Depth or RL	Depth of Unit	Graphic Log	Classification Symbol	Material Description	Moisture Condition	Consistency / Strength	Sample ID	Sample Type	DCP	Field CBR	PP (kPa)	SV (kPa)	MC (%)	LL(%)	PI	LS	Swell	CBR	Field Records / Comments	Water
Jack Hammer		0.030			ASPHALT, 30mm																
		0.15			Non Descriptive CRUSHED ROCK: Sandy silty GRAVEL, yellow Brown, Coarse to fine grained, angular; sand: fine to coarse grained (40mm, Type A)	D-M		7045													
		0.2			Asphalt Profilings; with fine gravel; angular	D		7046													
Hand Auger	0.5				Silty CLAY, yello-brown,medium plastic, silt: medium plastic, traces of sand: fine grained;	M	Firm	7044		5, 9, 8, 5											
	1.0	0.7			0.7m grades to dark brown motled brown; high plastic	D-M	Stiff	7048	Disturbed	9, 5, 3, 3, 3, 3, 3, 4											
	1.5	1.5			**End of FPD04 at 1.50m, Silty Clay**					3, 5, 4											
	2.0																				

Photos to be inserted

Continent Geotech Services

TEST PIT LOG

TEST PIT No.	FPD05
SHEET:	1 of 1

CLIENT:	*Graham Foley & Associates*	DATE COMMENCED	15-03-17
PROJECT:	Pavement Investigations Wanganui Road & Ford Road	DATE COMPLETED	15-03-17
LOCATION	Shepparton	LOGGED BY	*JW*
JOB NUMBER:	6035	CHECKED BY	*SK*

Trench Length	0.4m	Easting		Chainage	-
Trench Width	0.3m	Northing		Lane	East Bound

Method	Depth or RL	Depth of Unit	Graphic Log	Classification Symbol	Material Description	Moisture Condition	Consistency / Strength	Sample ID	Sample Type	DCP	Field CBR	PP (kPa)	SV (kPa)	MC (%)	LL(%)	PI	LS	Swell	CBR	Field Records / Comments	Water
Jack Hammer		0.030			ASPHALT, 30mm																
		0.20			Non Descriptive CRUSHED ROCK: Sandy silty GRAVEL, yellow Brown, Coarse to fine grained, angular, sand: fine to coarse grained (40mm, Type A)	D-M		7049													
		0.25			Asphalt Profilings; with fine gravel; angular	D		7050													
Hand Auger	0.5	0.7			Silty CLAY, yello-brown,medium plastic, silt: medium plastic, traces of sand; fine grained;	D	Firm	7051		13, 11, 5, 5											
	1.0, 1.5	1.5			0.7m grades to dark brown motled brown; high plastic	D-M	Stiff	7052	Disturbed	5, 5, 4, 4, 6, 6, 5, 6											
	2.0				**End of FPD05 at 1.50m, Silty Clay**					6, 6, 7											

Photos to be inserted

Continent Geotech Services

TEST PIT LOG

TEST PIT No.	FPD06
SHEET:	1 of 1

CLIENT:	*Graham Foley & Associates*	DATE COMMENCED	15-03-17
PROJECT:	**Pavement Investigations Wanganui Road & Ford Road**	DATE COMPLETED	15-03-17
LOCATION	**Shepparton**	LOGGED BY	*JW*
JOB NUMBER:	**6035**	CHECKED BY	*SK*

Trench Length	0.4m	Easting		Chainage	-
Trench Width	0.3m	Northing		Lane	West Bound

Method	Depth or RL	Depth of Unit	Graphic Log	Classification Symbol	Material Description	Moisture Condition	Consistency / Strength	Sample ID	Sample Type	DCP	Field CBR	PP (kPa)	SV (kPa)	MC (%)	LL(%)	PI	LS	Swell	CBR	Field Records / Comments	Water
Jack Hammer		0.025			ASPHALT, 25mm																
Jack Hammer		0.17			Non Descriptive CRUSHED ROCK: Sandy silty GRAVEL, yellow Brown, Coarse to fine grained, angular; sand: fine to coarse grained (40mm, Type A)	D-M		7053													
Hand Auger	0.5	0.8			clayey SILT, yello-brown,medium plastic, silt: medium plastic, traces of sand: fine grained;	D-M	Soft	7054	Disturbed	8, 11, 7, 3, 3, 3											
Hand Auger	1.0, 1.5	1.5			0.8m grades to dark brown motled red; traces of gravel: sub-angular	D-M	Firm	7055	Disturbed	4, 4, 4, 4, 5, 6, 8											
	2.0				**End of FPD06 at 1.50m, Silty Clay**					9, 7, 8											

Photos to be inserted

Continent Geotech Services

TEST PIT LOG

TEST PIT No.	WPD01
SHEET:	1 of 1

CLIENT:	*Graham Foley & Associates*	DATE COMMENCED	14-03-17
PROJECT:	**Pavement Investigations Wanganui Road & Ford Road**	DATE COMPLETED	14-03-17
LOCATION	Shepparton	LOGGED BY	*JW*
JOB NUMBER:	6035	CHECKED BY	*SK*

Trench Length	0.4m	Easting		Chainage	-
Trench Width	0.3m	Northing		Lane	West Bound

Method	Depth or RL	Depth of Unit	Graphic Log	Classification Symbol	Material Description	Moisture Condition	Consistency / Strength	Sample ID	Sample Type	DCP	Field CBR	PP (kPa)	SV (kPa)	MC (%)	LL(%)	PI	LS	Swell	CBR	Field Records / Comments	Water
Jack Hammer		0.050			ASPHALT, 50mm																
Jack Hammer		0.25			Non Descriptive CRUSHED ROCK: Sandy GRAVEL,Light Brown, Coarse to fine grained, angular; sand: fine to coarse grained (40mm, Type A)	D-M		7005													
Jack Hammer		0.4			Clayey SILT,dark grey, medium plastic, traces of fine sand	D-M	Firm	7006	Disturbed	5											
Hand Auger									Disturbed	6											
Hand Auger	0.5	1.50			Silty CLAY, dark brown, medium plastic, traces of fine sand	M	Stiff	7007	Disturbed	6											
Hand Auger									Disturbed	3											
Hand Auger									Disturbed	2											
Hand Auger									Disturbed	2											
Hand Auger									Disturbed	2											
Hand Auger	1.0								Disturbed	2											
Hand Auger									Disturbed	3											
Hand Auger									Disturbed	4											
Hand Auger									Disturbed	6											
Hand Auger									Disturbed	6											
Hand Auger	1.5								Disturbed	7											
					End of WPD01 at 1.50m, Silty Clay					10											
	2.0																				

Photos to be inserted

Continent Geotech Services

TEST PIT LOG

TEST PIT No.	WPD02
SHEET:	1 of 1

CLIENT:	*Graham Foley & Associates*	DATE COMMENCED	14-03-17
PROJECT:	Pavement Investigations Wanganui Road & Ford Road	DATE COMPLETED	14-03-17
LOCATION	Shepparton	LOGGED BY	*JW*
JOB NUMBER:	6035	CHECKED BY	*SK*

Trench Length	0.4m	Easting		Chainage	-
Trench Width	0.3m	Northing		Lane	East Bound

Method	Depth or RL	Depth of Unit	Graphic Log	Classification Symbol	Material Description	Moisture Condition	Consistency / Strength	Sample ID	Sample Type	DCP	Field CBR	PP (kPa)	SV (kPa)	MC (%)	LL(%)	PI	LS	Swell	CBR	Field Records / Comments	Water
Jack Hammer		0.050			ASPHALT, 50mm																
Jack Hammer		0.25			Non Descriptive CRUSHED ROCK: Sandy GRAVEL,Light Brown, Coarse to fine grained, angular; sand: fine to coarse grained (40mm, Type A)	D-M		7008	Disturbed												
Hand Auger		0.4			Clayey SILT,dark grey, medium plastic, traces of fine sand, traces of rock:fine sub-rouned	D-M	Stiff	7009	Disturbed	5, 3											
Hand Auger	0.5, 1.0	1.20			Silty CLAY, red-brown, medium plastic, traces of fine sand,	M	F-St	7010	Disturbed	4, 4, 4, 4, 5, 6, 7											
Hand Auger	1.5				1.2m grades to sandy Clay, red-brown, traces of rock/sand	D-M	F-St	7011	Disturbed	10, 12, 16, 16											
	2.0				**End of WPD02 at 1.50m, Silty Clay**					17											

Photos to be inserted

Continent Geotech Services

TEST PIT LOG

TEST PIT No.	WPD03
SHEET:	1 of 1

CLIENT:	*Graham Foley & Associates*	DATE COMMENCED	14-03-17
PROJECT:	Pavement Investigations Wanganui Road & Ford Road	DATE COMPLETED	14-03-17
LOCATION	Shepparton	LOGGED BY	*JW*
JOB NUMBER:	6035	CHECKED BY	*SK*

Trench Length	0.4m	Easting		Chainage	-
Trench Width	0.3m	Northing		Lane	West Bound

Method	Depth or RL	Depth of Unit	Graphic Log	Classification Symbol	Material Description	Moisture Condition	Consistency / Strength	Sample ID	Sample Type	DCP	Field CBR	PP (kPa)	SV (kPa)	MC (%)	LL(%)	PI	LS	Swell	CBR	Field Records / Comments	Water
Jack Hammer		0.050			ASPHALT, 50mm																
		0.20			Non Descriptive CRUSHED ROCK: Sandy GRAVEL,Light Brown, Coarse to fine grained, angular; sand: fine to coarse grained (40mm, Type A)	D-M		7012													
					Silty CLAY, light-brown, medium plastic, traces of fine sand,	D	Stiff	7013		16											
Hand Auger										12											
	0.5	0.55								13											
					0.55m grades to silty sandy CLAY, dark-brown, traces of rock/sand, traces of roots, medium plastic	D-M	Stiff	7014	Disturbed	7											
										9											
										5											
										7											
	1.0									8											
										7											
										9											
										9											
										9											
	1.5									7											
					End of WPD03 at 1.50m, Silty Clay					9											
										10											
	2.0																				

Photos to be inserted

Continent Geotech Services

TEST PIT LOG

TEST PIT No.	WPD04
SHEET:	1 of 1

CLIENT:	*Graham Foley & Associates*	DATE COMMENCED	14-03-17
PROJECT:	**Pavement Investigations Wanganui Road & Ford Road**	DATE COMPLETED	14-03-17
LOCATION	**Shepparton**	LOGGED BY	*JW*
JOB NUMBER:	**6035**	CHECKED BY	*SK*

Trench Length	0.4m	Easting		Chainage	-
Trench Width	0.3m	Northing		Lane	East Bound

Method	Depth or RL	Depth of Unit	Graphic Log	Classification Symbol	Material Description	Moisture Condition	Consistency / Strength	Sample ID	Sample Type	DCP	Field CBR	PP (kPa)	SV (kPa)	MC (%)	LL(%)	PI	LS	Swell	CBR	Field Records / Comments	Water
Jack Hammer		0.050			ASPHALT, 50mm																
		0.18			Non Descriptive CRUSHED ROCK: Sandy GRAVEL,Light Brown, Coarse to fine grained, angular; sand: fine to coarse grained (40mm, Type A)	D-M		7015													
					Clayey SILT,dark grey, medium plastic, traces of fine sand	D-M	S-F	7016		6											
		0.47								4											
Hand Auger	0.5				Silty sandy CLAY, dark-brown, traces of rock/sand, traces of roots, medium plastic	D-M	S	7017	Disturbed	3											
										2											
										2											
										2											
										2											
	1.0									3											
		1.1								3											
					1.1m Grades to light-gray, low plastic	D-M	S-F	7018		4											
										5											
										5											
	1.5									9											
					End of WPD04 at 1.50m, Silty Clay																
	2.0																				

Photos to be inserted

Continent Geotech Services

TEST PIT LOG

TEST PIT No.	WPD05
SHEET:	1 of 1

CLIENT:	*Graham Foley & Associates*	DATE COMMENCED	14-03-17
PROJECT:	Pavement Investigations Wanganui Road & Ford Road	DATE COMPLETED	14-03-17
LOCATION	Shepparton	LOGGED BY	*JW*
JOB NUMBER:	6035	CHECKED BY	*SK*

Trench Length	0.4m	Easting		Chainage	-
Trench Width	0.3m	Northing		Lane	West Bound

Method	Depth or RL	Depth of Unit	Graphic Log	Classification Symbol	Material Description	Moisture Condition	Consistency / Strength	Sample ID	Sample Type	DCP	Field CBR	PP (kPa)	SV (kPa)	MC (%)	LL(%)	PI	LS	Swell	CBR	Field Records / Comments	Water
Jack Hammer		0.030			ASPHALT, 30mm																
Jack Hammer		0.22			Non Descriptive CRUSHED ROCK: Sandy GRAVEL,Light Brown, Coarse to fine grained, angular; sand: fine to coarse grained (40mm, Type A)	D-M		7019													
Hand Auger					SAND: red brown, fine grained, low plastic	D	Firm	7020	Disturbed	10											
Hand Auger									Disturbed	7											
Hand Auger	0.5								Disturbed	6											
Hand Auger									Disturbed	10											
Hand Auger									Disturbed	10											
Hand Auger									Disturbed	10											
Hand Auger									Disturbed	10											
Hand Auger	1.0								Disturbed	8											
Hand Auger					1.1m grades to clayey sand, red brown				Disturbed	11											
Hand Auger									Disturbed	12											
Hand Auger									Disturbed	10											
Hand Auger									Disturbed	13											
Hand Auger	1.5	1.5							Disturbed	15											
					End of WPD05 at 1.50m, Silty Clay																
	2.0																				

Photos to be inserted

Continent Geotech Services

TEST PIT LOG

TEST PIT No.	WPD06
SHEET:	1 of 1

CLIENT:	*Graham Foley & Associates*	DATE COMMENCED	14-03-17
PROJECT:	**Pavement Investigations Wanganui Road & Ford Road**	DATE COMPLETED	14-03-17
LOCATION	**Shepparton**	LOGGED BY	*JW*
JOB NUMBER:	**6035**	CHECKED BY	*SK*

Trench Length	0.4m	Easting		Chainage	-
Trench Width	0.3m	Northing		Lane	East Bound

Method	Depth or RL	Depth of Unit	Graphic Log	Classification Symbol	Material Description	Moisture Condition	Consistency / Strength	Sample ID	Sample Type	DCP	Field CBR	PP (kPa)	SV (kPa)	MC (%)	LL(%)	PI	LS	Swell	CBR		Field Records / Comments	Water
Jack Hammer		0.025			ASPHALT, 25mm																	
Jack Hammer		0.22			Non Descriptive CRUSHED ROCK: Sandy GRAVEL, Light Brown, Coarse to fine grained, angular; sand: fine to coarse grained (40mm, Type A)	D		7025														
Hand Auger	0.5 1.0 1.5	1.5			SAND: red brown, fine grained, low plastic	D	Firm	7026	Disturbed	11 22 9 12 17 21 25 18 16 16 10 11 15												
	2.0				**End of WPD06 at 1.50m, Silty Clay**																	

Photos to be inserted

Continent Geotech Services

TEST PIT LOG

TEST PIT No.	WPD07
SHEET:	1 of 1

CLIENT:	*Graham Foley & Associates*	DATE COMMENCED	14-03-17
PROJECT:	Pavement Investigations Wanganui Road & Ford Road	DATE COMPLETED	14-03-17
LOCATION	Shepparton	LOGGED BY	*JW*
JOB NUMBER:	6035	CHECKED BY	*SK*

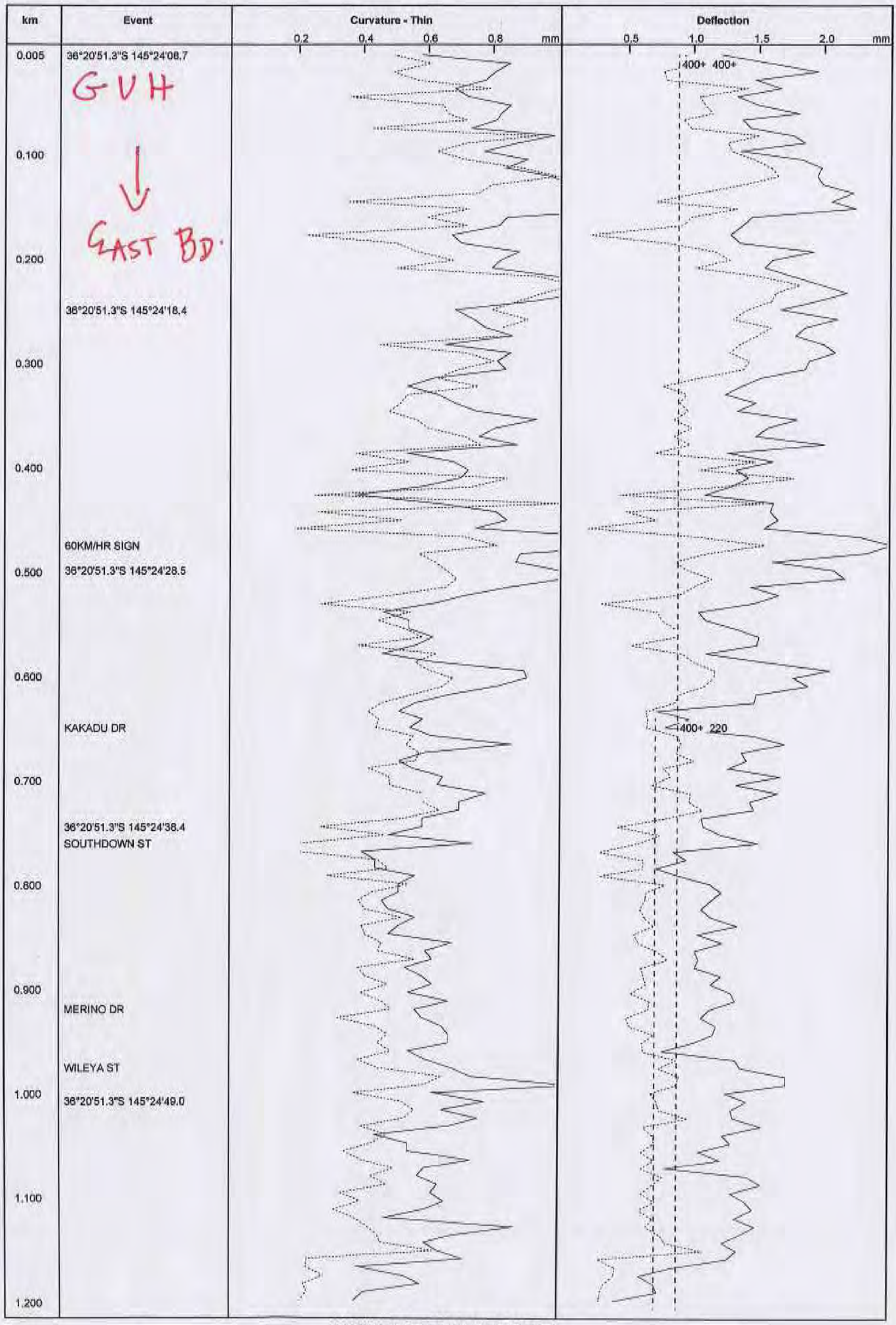
Trench Length	0.4m	Easting		Chainage	-
Trench Width	0.3m	Northing		Lane	West Bound

Method	Depth or RL	Depth of Unit	Graphic Log	Classification Symbol	Material Description	Moisture Condition	Consistency / Strength	Sample ID	Sample Type	DCP	Field CBR	PP (kPa)	SV (kPa)	MC (%)	LL(%)	PI	LS	Swell	CBR	Field Records / Comments	Water
Jack Hammer		0.025			ASPHALT, 25mm																
		0.22			Non Descriptive CRUSHED ROCK: Sandy GRAVEL,Light Brown, Coarse to fine grained, angular; sand: fine to coarse grained (40mm, Type A)	D		7025													
Hand Auger					SAND: red brown, fine grained, low plastic	D	Firm	7026	Disturbed	10											
										16											
	0.5									11											
										10											
										10											
										14											
										13											
	1.0									14											
										15											
										16											
										16											
										11											
	1.5	1.5								11											
					End of WPD06 at 1.50m, Silty Clay																
	2.0																				

Photos to be inserted

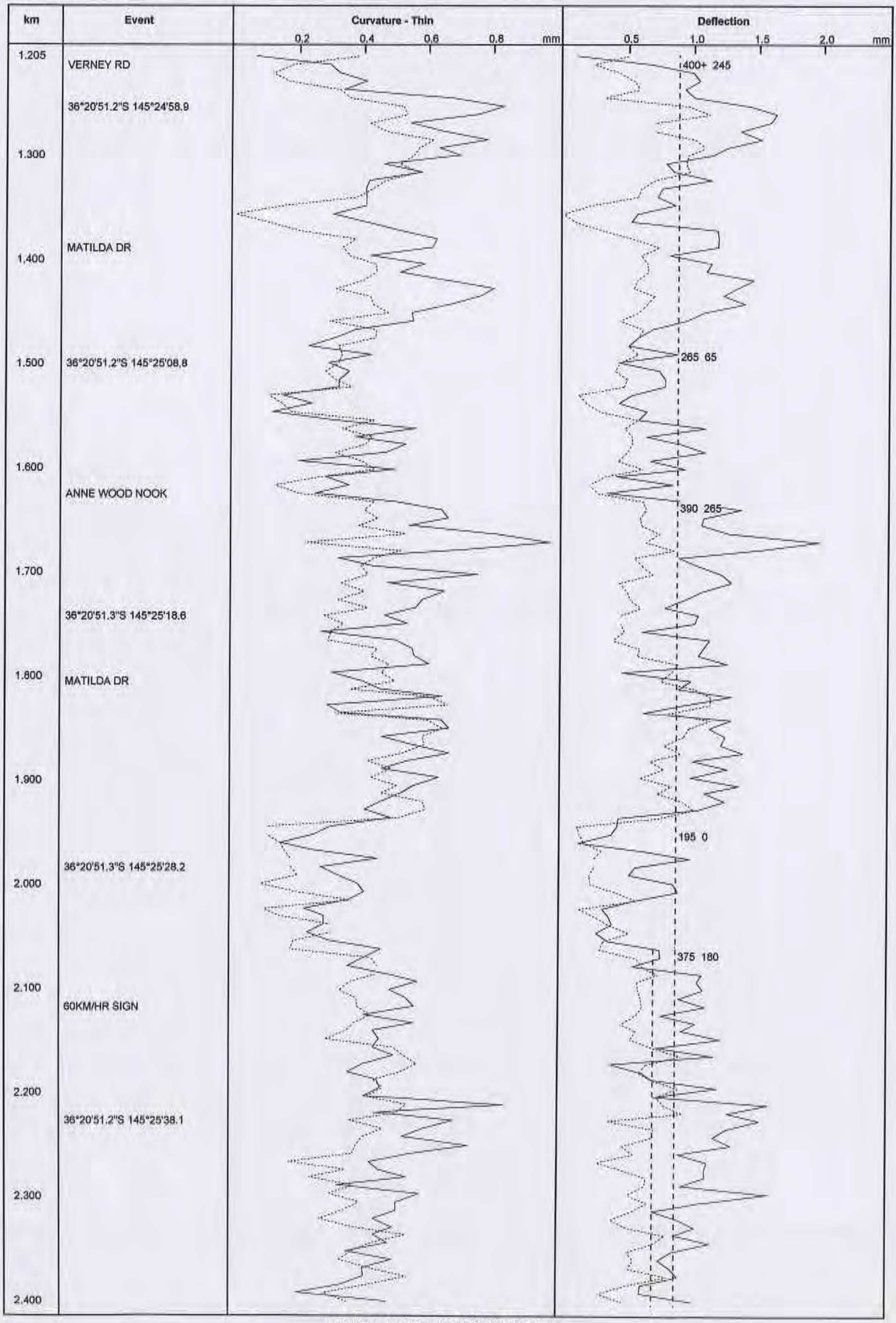
FORD RD.

Road Name	FORD RD	Run	170095		Sheet 1/3
Test Lane	EB 1	Date Tested	23/02/2017		Test Speed 4.1 km/h
Region/LGA	GI	LH wheelpath	———	2.8M NTH OF CL	
		RH wheelpath	·········	1.0M NTH OF CL	



GEOPAVE - VicRoads 14:50 03/03/17 (printed)

Road Name	**FORD RD**	Run	**170095**	Sheet 2/3
Test Lane	EB 1	Date Tested	23/02/2017	Test Speed 4.1 km/h
Region/LGA	GI	LH wheelpath	——— 2.8M NTH OF CL	
		RH wheelpath	········· 1.0M NTH OF CL	

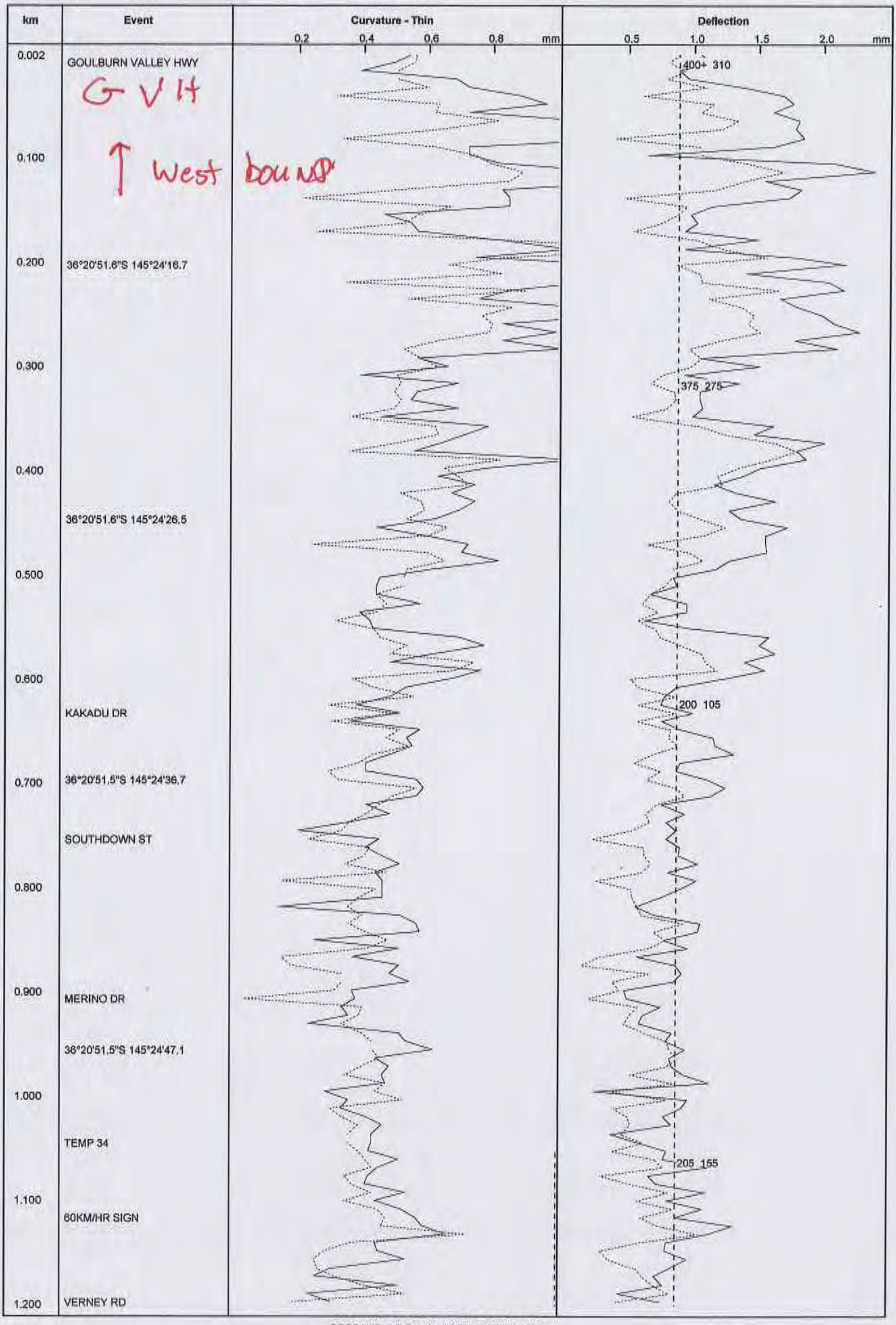


Road Name	FORD RD	Run	170095	Sheet 3/3
Test Lane	EB 1	Date Tested	23/02/2017	Test Speed 4.1 km/h
Region/LGA	GI	LH wheelpath	——— 2.8M NTH OF CL	
		RH wheelpath	.... 1.0M NTH OF CL	

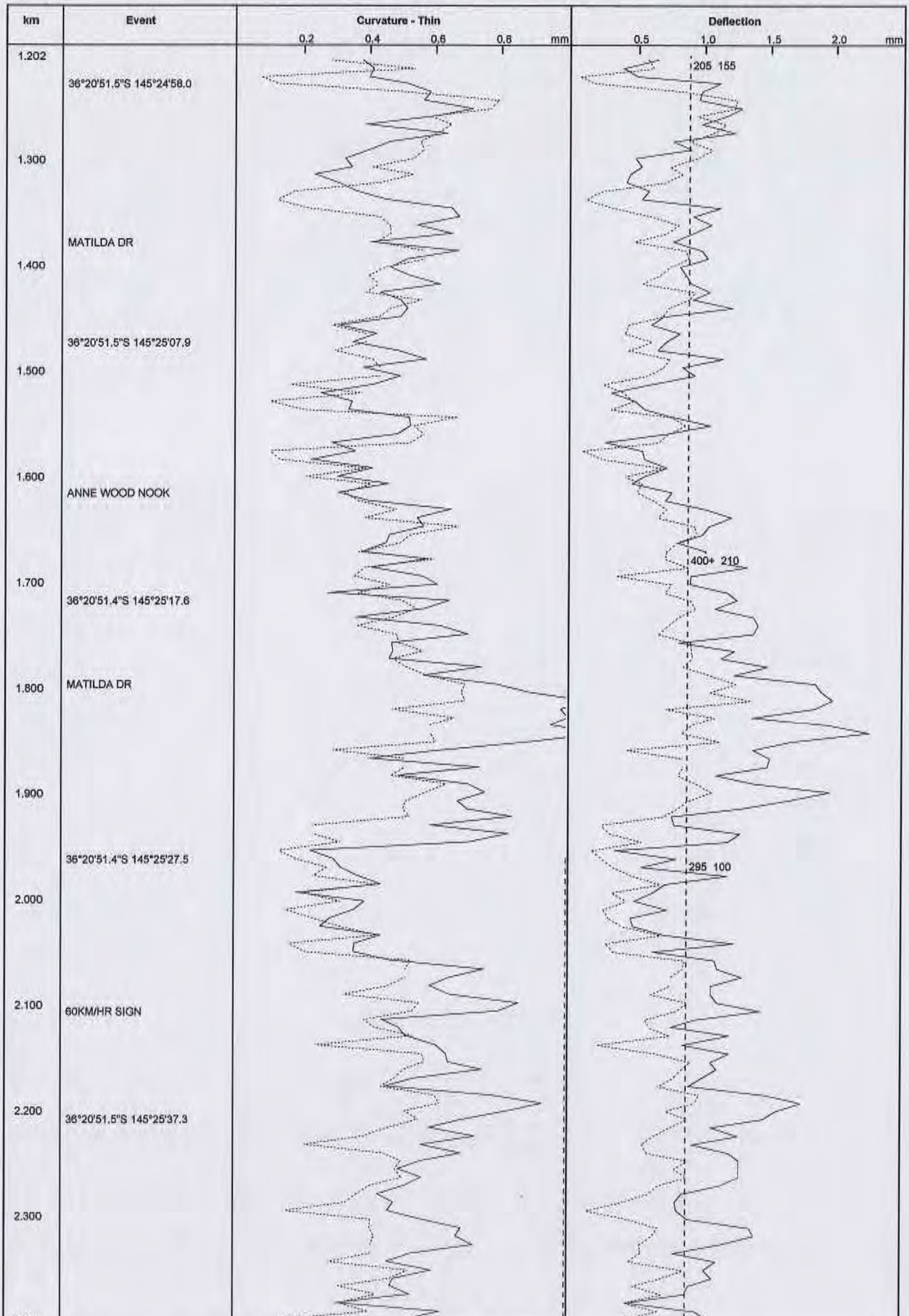
km	Event
2.405	
	36°20'51.3"S 145°25'47.7
2.500	
2.600	
	GRAHAMVALE RD
	RAIL XING
2.700	END
	36°20'51.3"S 145°25'57.6
	100KM/HR SIGN
2.800	
2.900	
	MASALKI ENT
3.000	
3.100	
3.200	
3.300	
3.400	
3.500	
3.600	

FORD RD.

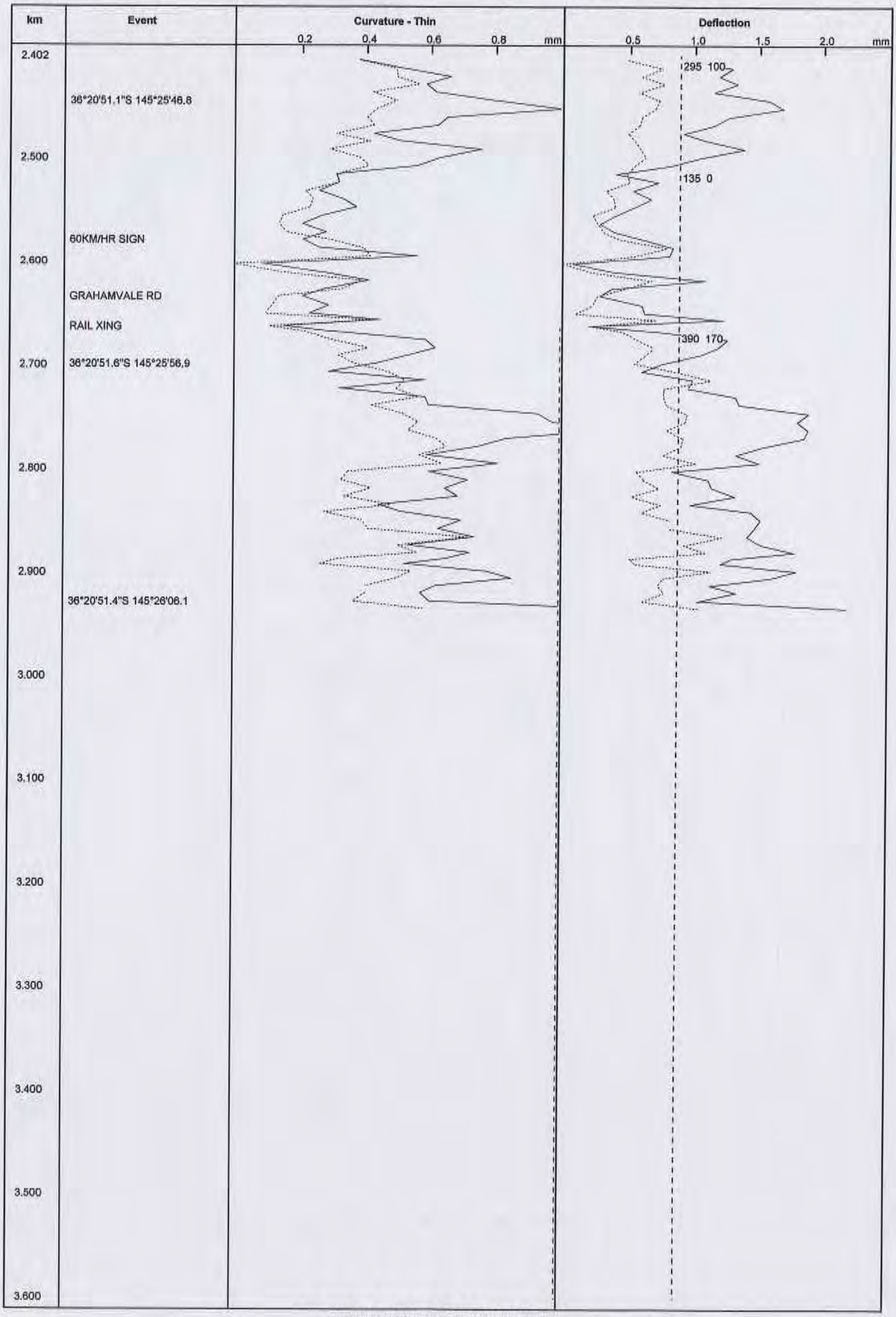
Road Name	FORD RD	Run	170096	Sheet 1/3
Test Lane	WB 1	Date Tested	23/02/2017	Test Speed 4.1 km/h
Region/LGA	GI	LH wheelpath	——— 2.8M STH OF CL	
		RH wheelpath	········ 1.0M STH OF CL	



Road Name	FORD RD	Run	170096	Sheet 2/3
Test Lane	WB 1	Date Tested	23/02/2017	Test Speed 4.1 km/h
Region/LGA	GI	LH wheelpath	——— 2.8M STH OF CL	
		RH wheelpath	------- 1.0M STH OF CL	



Road Name	**FORD RD**	Run	**170096**	Sheet 3/3
Test Lane	WB 1	Date Tested	23/02/2017	Test Speed 4.1 km/h
Region/LGA	GI	LH wheelpath	——— 2.8M STH OF CL	
		RH wheelpath	·········· 1.0M STH OF CL	

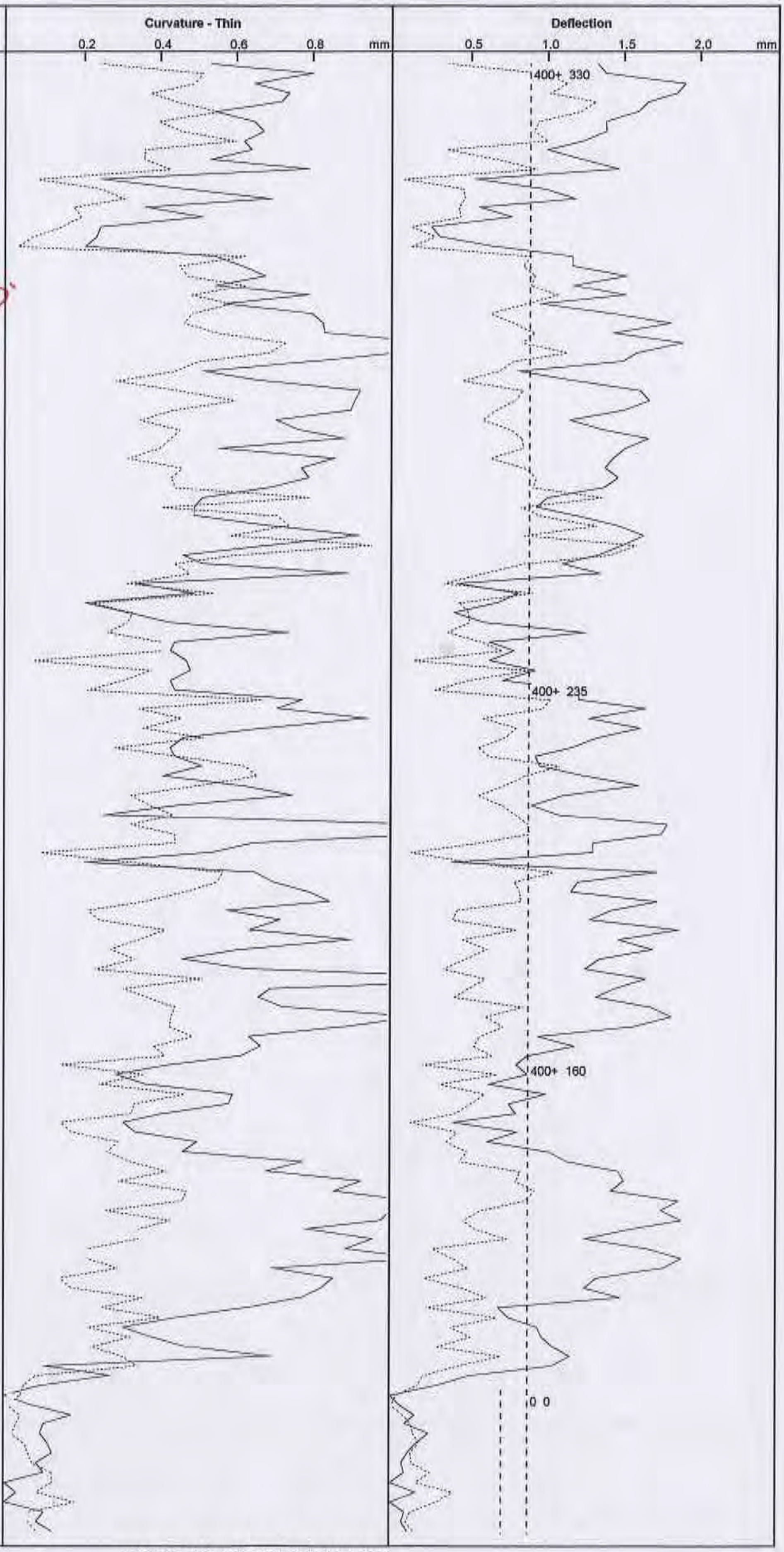


WANGANUI RD

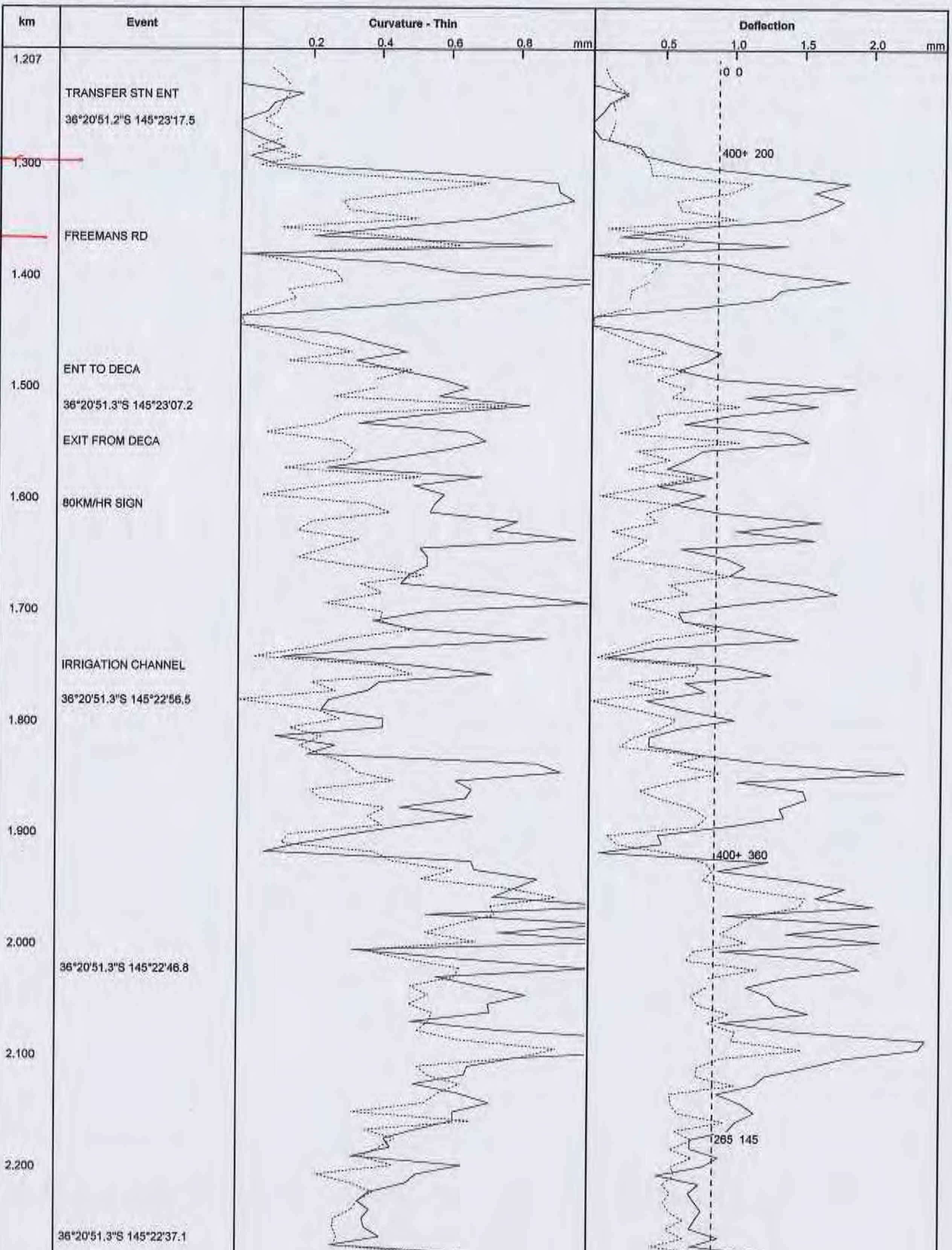
Road Name	**WANGANUI RD**	Run	**170098**	Sheet 1/3
Test Lane	EB 1	Date Tested	23/02/2017	Test Speed 4.1 km/h
Region/LGA	GI	LH wheelpath	——— 2.8M NTH OF CL	
		RH wheelpath	.... 1.0M NTH OF CL	

East-bound

km	Event
0.007	GOULBURN VALLEY HWY GVH 36°20'50.7"S 145°24'05.5
0.100	↑
0.200	EAST BOUND
0.300	36°20'51.4"S 145°23'56.2
0.400	
0.500	36°20'51.3"S 145°23'46.6 80KM POST
0.600	
0.700	36°20'51.4"S 145°23'36.9
0.800	
0.900	
1.000	36°20'51.3"S 145°23'27.3
1.100	
1.200	

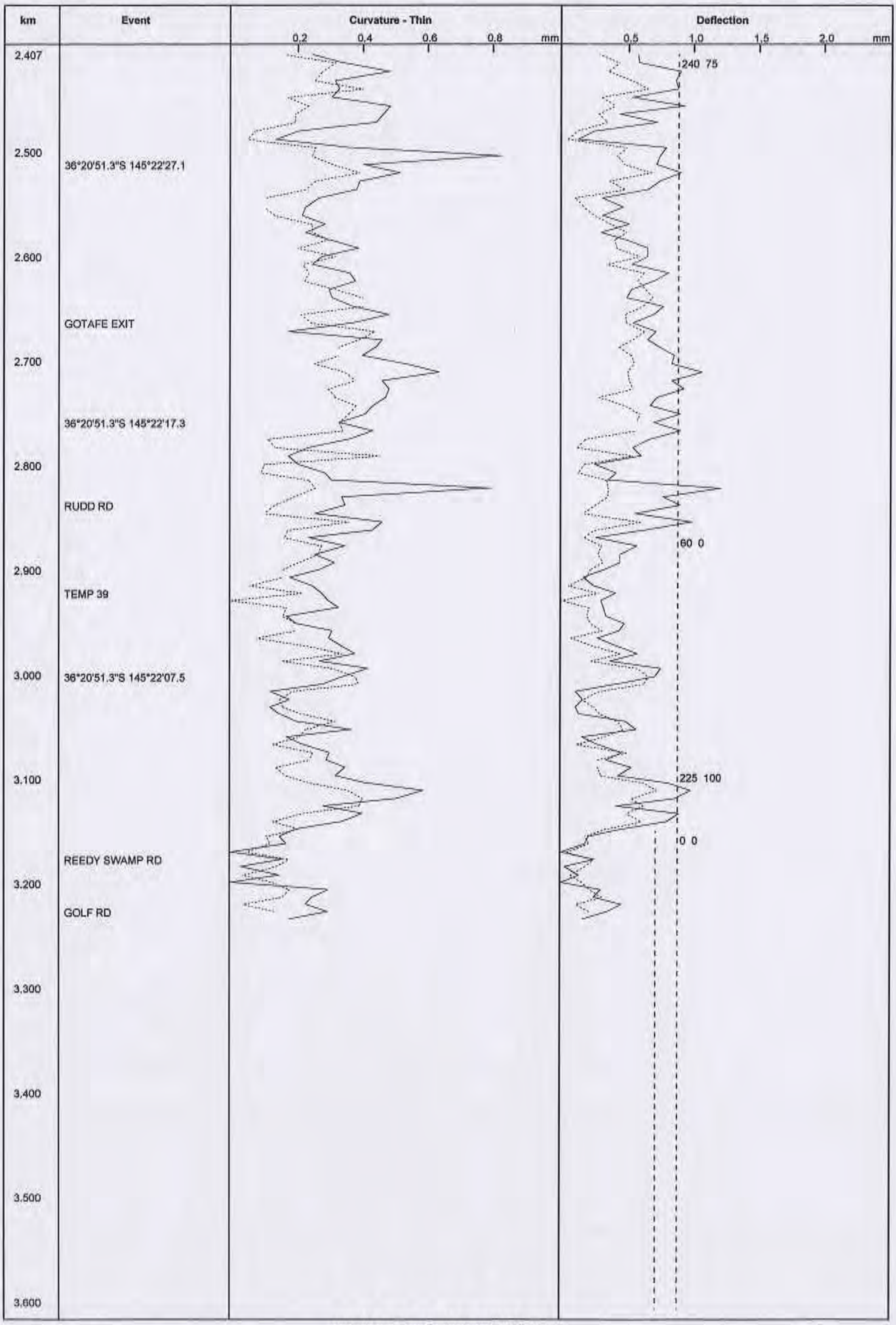


Road Name	**WANGANUI RD**	Run	**170098**	Sheet 2/3
Test Lane	EB 1	Date Tested	23/02/2017	Test Speed 4.1 km/h
Region/LGA	GI	LH wheelpath	——— 2.8M NTH OF CL	
		RH wheelpath	········ 1.0M NTH OF CL	



GEOPAVE - VicRoads 15:00 03/03/17 (printed)

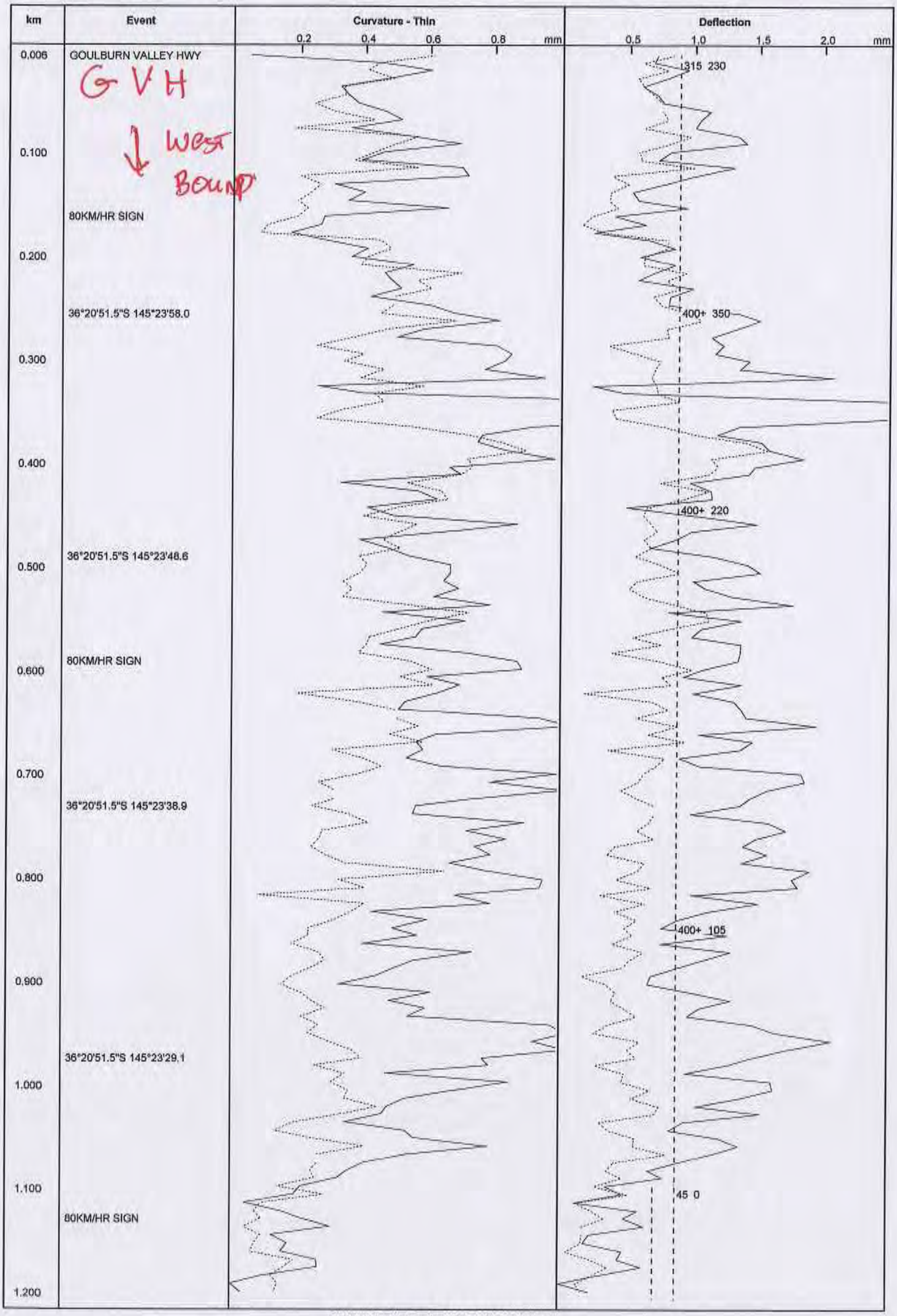
Road Name	**WANGANUI RD**	Run	**170098**	Sheet 3/3
Test Lane	EB 1	Date Tested	23/02/2017	Test Speed 4.1 km/h
Region/LGA	GI	LH wheelpath	2.8M NTH OF CL	
		RH wheelpath	1.0M NTH OF CL	



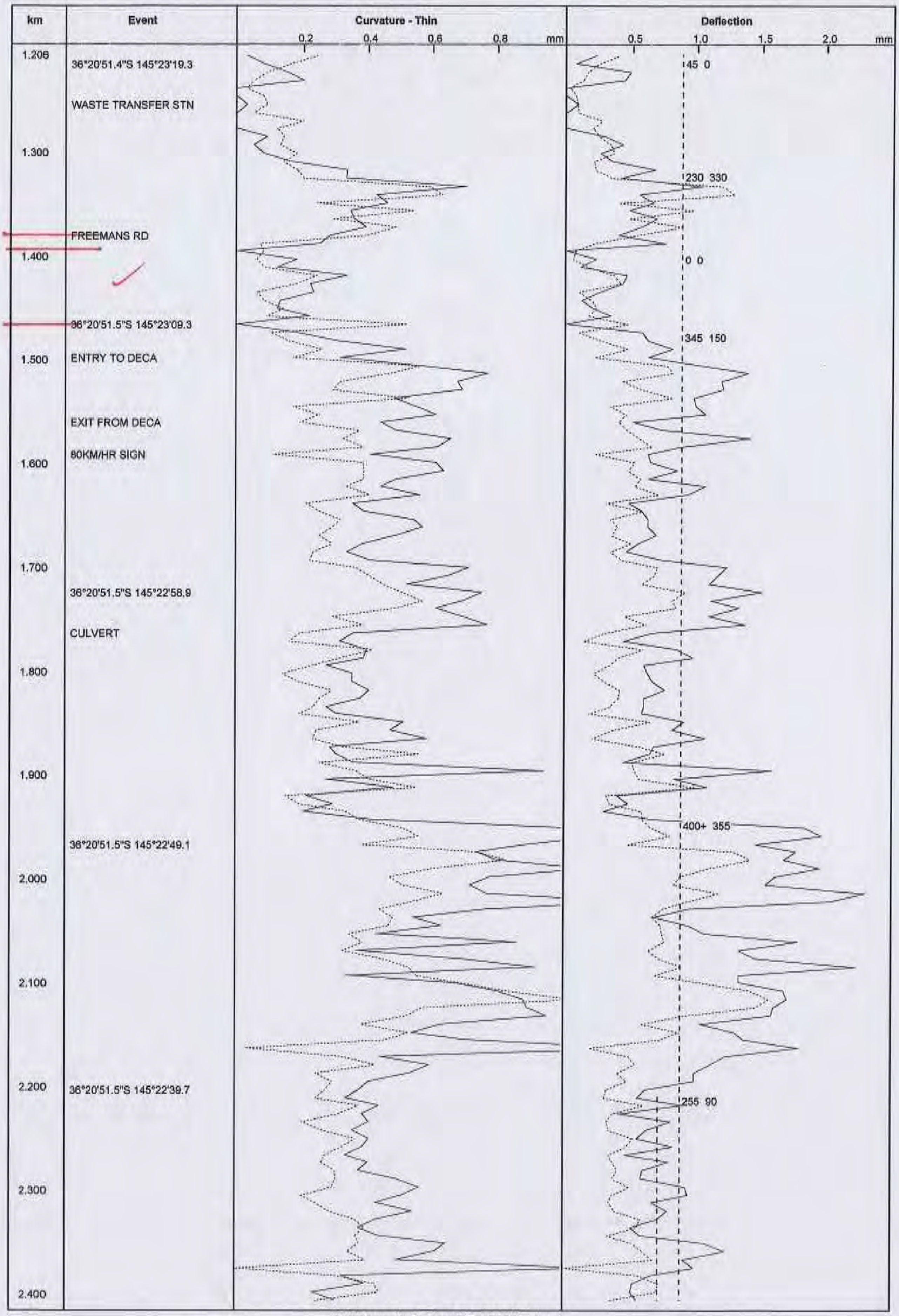
GEOPAVE - VicRoads 15:00 03/03/17 (printed)

WANGANUI RD -West bound

Road Name	WANGANUI RD	Run	170097	Sheet 1/3
Test Lane	WB 1	Date Tested	23/02/2017	Test Speed 4.1 km/h
Region/LGA	GI	LH wheelpath	——— 2.8M STH OF CL	
		RH wheelpath	········ 1.0M STH OF CL	

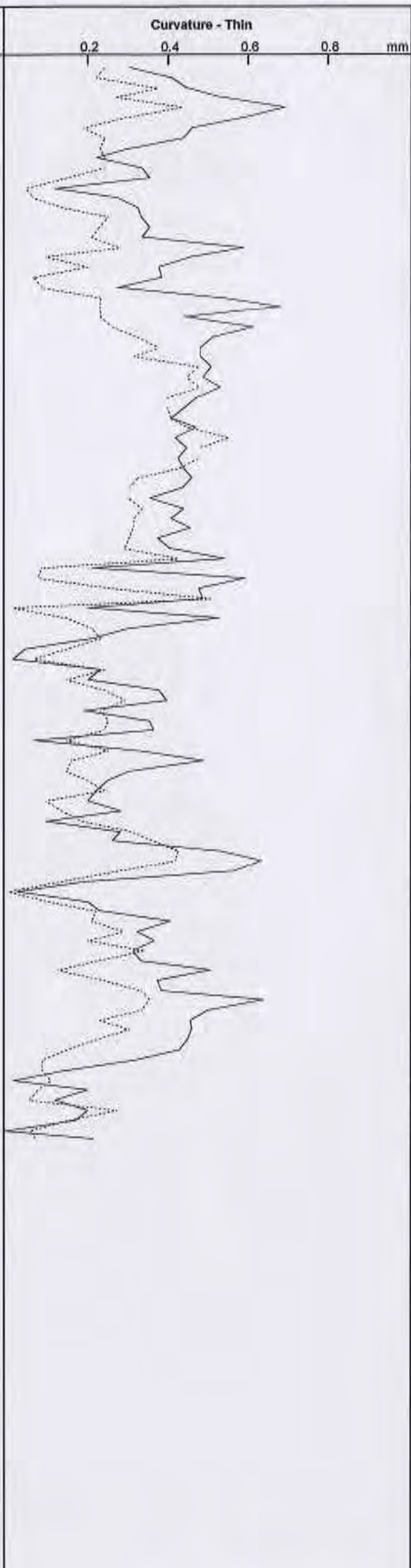


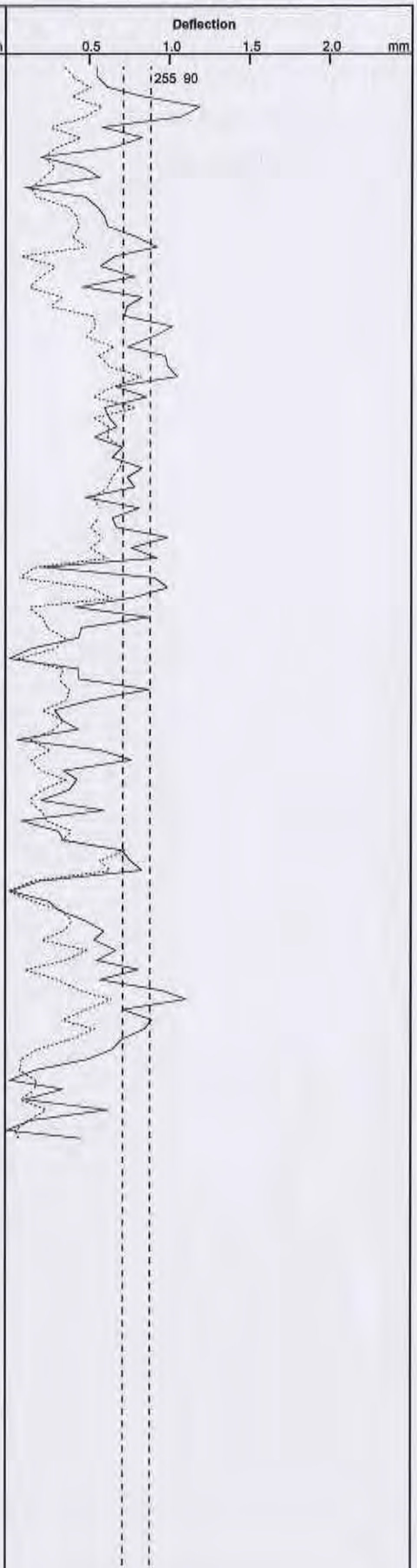
Road Name	**WANGANUI RD**	Run	**170097**	Sheet 2/3
Test Lane	WB 1	Date Tested	23/02/2017	Test Speed 4.1 km/h
Region/LGA	GI	LH wheelpath	——— 2.8M STH OF CL	
		RH wheelpath	.... 1.0M STH OF CL	



Road Name	**WANGANUI RD**	Run	**170097**	Sheet 3/3
Test Lane	WB 1	Date Tested	23/02/2017	Test Speed 4.1 km/h
Region/LGA	GI	LH wheelpath	——— 2.8M STH OF CL	
		RH wheelpath	.... 1.0M STH OF CL	

km	Event
2.406	KITTLES RD
	36°20'51.5"S 145°22'29.9
2.500	
2.600	
	GOTAFE ENT
2.700	
2.800	
	RUDD RD
2.900	
	36°20'51.5"S 145°22'10.4
	GOTAFE EXIT
3.000	
3.100	
	36°20'51.4"S 145°22'00.8
	REEDY SWAMP RD
3.200	
	GOLF DR
3.300	
3.400	
3.500	
3.600	





FORD RD

EAST-BOUND RD
Asphalt Overlay

INPUT DATA

RUN NUMBER :170095
RUN DATE :23/02/2017
ROAD NUMBER :1000
DESCENDING? T/F :F
START CHAINAGE : 0
FINISH CHAINAGE : 2950
ROAD NAME :FORD RD
LOCATION :GOULBURN VALLEY HWYEB 1
MUNICIPALITY :NORTH EASTERN
LW DESCRIPTION :2.8M NTH OF CL
LW LOCATION :EB 1
RW DESCRIPTION :1.0M NTH OF CL
RW LOCATION :
OFFSET : 200
VSCALE : 0
COMMENT :
F.FACT : 1.65
W.M.A.P.T. : 24.00
RSHEET? T/F :F
SECTION SET :B

DEFLECTION ANALYSIS REPORT

RUN NO. :170095 ROAD NUMBER :1000 PAGE 1 OF 1

JOB :FORD RD, GOULBURN VALLEY HWYEB 1, NORTH EASTERN
DESCENDING? T/F :F START CHAINAGE :0 FINISH CHAINAGE :2950
TEST DATE :23/02/2017
WHEEL PATH LOCATION :EB 1
CARRIAGEWAY LEFT RIGHT
:2.8M NTH OF CL 1.0M NTH OF CL
RESHEET? T/F :F SECTION SET :B OVERLAY OPTION :THIN
F FACTOR :1.65 WMAPT :24.0 LOAD CONVERSION FACTOR :0.90
COMMENT :

SECTION (M)		DTL	ASPH (MM)	ASPH TEMP	ADJUSTMENT FACTORS TEMP		SEAS	STAND		SPEED		MILL		BIND	DESN DEFL	ADJUSTED CHAR DEFL (MM)		CHAR CURV (MM)		REQUIRED OVERLAY FOR DEFLECTION (MM)		FATIGUE (MM)		LANE AREA	DEFLECTION MEAN (MM)		STD DEV (MM)		CURVATURE MEAN (MM)		STD DEV (MM)		NO OF BOWLS (USED/READ)		AV SPEED
FROM	TO				DEFL	CURV		DEFL	CURV	DEFL	CURV	DEFL	CURV			LWP	RWP	LWP	RWP	LWP	RWP	LWP	RWP	%	LWP	RWP	LWP	RWP	LWP	RWP	LWP	RWP	LWP	RWP	KM/H
GVH 5	445	2.8E+007	50	35.0	0.93	0.88	1.30	1.20	0.87	0.96	0.88	1.00	1.00	0.98	0.84	3.13	2.51	0.80	0.66	150+	150+	150+	150+	15	1.67	1.16	0.30	0.34	0.81	0.66	0.17	0.20	56/56	56/56	4.1
445	635	2.8E+007	50	35.0	0.93	0.88	1.30	1.20	0.87	0.96	0.87	1.00	1.00	0.98	0.84	3.44	1.99	0.76	0.55	150+	125	150+	150+	6	1.65	0.90	0.44	0.29	0.76	0.55	0.22	0.14	24/24	24/24	4.1
635	955	2.8E+007	50	35.0	0.93	0.88	1.30	1.20	0.87	0.96	0.87	1.00	1.00	0.98	0.84	2.31	1.43	0.59	0.46	145	80	150+	150+	11	1.21	0.70	0.23	0.17	0.59	0.46	0.10	0.10	40/40	40/40	4.1
955	1215	2.8E+007	50	35.0	0.93	0.88	1.30	1.20	0.87	0.96	0.87	1.00	1.00	0.98	0.84	2.63	1.45	0.60	0.41	150+	80	150+	150+	9	1.18	0.66	0.38	0.21	0.60	0.41	0.17	0.12	33/33	33/33	4.1
1215	1470	2.2E+007	30	35.0	0.95	0.93	1.30	1.20	0.92	0.96	0.88	1.00	1.00	0.98	0.85	2.34	1.60	0.62	0.43	145	95	150+	150+	9	1.10	0.64	0.29	0.27	0.55	0.38	0.15	0.15	32/32	32/32	4.1
1470	1625	2.2E+007	30	35.0	0.95	0.93	1.30	1.20	0.92	0.96	0.88	1.00	1.00	0.98	0.85	1.59	1.01	0.37	0.35	95	25	150+	150+	5	0.70	0.44	0.22	0.15	0.34	0.31	0.12	0.11	20/20	20/20	4.1
1625	1940	2.2E+007	30	35.0	0.95	0.93	1.30	1.20	0.92	0.96	0.88	1.00	1.00	0.98	0.85	2.35	1.62	0.60	0.50	145	95	150+	150+	11	1.09	0.73	0.30	0.22	0.54	0.45	0.15	0.11	41/41	41/41	4.1
1940	2075	2.2E+007	30	35.0	0.95	0.93	1.30	1.20	0.92	0.96	0.87	1.00	1.00	0.98	0.85	1.42	0.83	0.36	0.23	75	0	150+	0	5	0.55	0.32	0.24	0.15	0.32	0.20	0.09	0.10	17/17	17/17	4.1
2075	2200	2.2E+007	30	35.0	0.95	0.93	1.30	1.20	0.92	0.96	0.88	1.00	1.00	0.98	0.85	2.00	1.29	0.53	0.48	125	65	150+	150+	4	0.93	0.67	0.26	0.12	0.47	0.43	0.07	0.08	16/16	16/16	4.1
2200	2510	2.2E+007	30	35.0	0.95	0.93	1.30	1.20	0.92	0.96	0.87	1.00	1.00	0.98	0.85	2.17	1.29	0.54	0.44	135	60	150+	150+	11	1.04	0.60	0.26	0.16	0.48	0.39	0.12	0.09	39/39	39/39	4.1
2510	2645	2.2E+007	30	35.0	0.95	0.93	1.30	1.20	0.92	0.96	0.87	1.00	1.00	0.98	0.85	1.93	1.28	0.34	0.29	120	60	150+	150+	5	0.66	0.44	0.39	0.26	0.30	0.26	0.18	0.13	17/17	17/17	4.2
2645	2942	2.2E+007	30	35.0	0.95	0.93	1.30	1.20	0.92	0.96	0.86	1.00	1.00	0.98	0.85	3.18	1.74	0.84	0.46	150+	105	150+	150+	10	1.43	0.77	0.43	0.24	0.75	0.41	0.30	0.13	38/38	38/38	4.0

NOTE : TEMP & MILL FACTORS ARE NOT APPLICABLE TO RESHEET
: THE DEFLECTION AND CURVATURE MEAN/SD VALUES HAVE BEEN ADJUSTED FOR SPEED & LOAD CONVERSION FACTORS
: CHAR. DEFLECTION = (MEAN + F*SD)*TEMP FACTOR*SEAS FACTOR*STAND FACTOR*MILL FACTOR
: CHAR. CURVATURE = MEAN *TEMP FACTOR*SEAS FACTOR*STAND FACTOR*MILL FACTOR

*** INDICATES THE NO. OF BOWLS IS GREATER THAN 999

Grahamvale Rd.

INPUT DATA

RUN NUMBER :170096
RUN DATE :23/02/2017
ROAD NUMBER :1000
DESCENDING? T/F :T
START CHAINAGE : 2940
FINISH CHAINAGE : 2
ROAD NAME :FORD RD
LOCATION :GOULBURN VALLEY HWYEB 1
MUNICIPALITY :NORTH EASTERN
LW DESCRIPTION :2.8M STH OF CL
LW LOCATION :WB 1
RW DESCRIPTION :1.0M STH OF CL
RW LOCATION :
OFFSET : 200
VSCALE : 0
COMMENT :
F.FACT : 1.65
W.M.A.P.T. : 26.00
RSHEET? T/F :F
SECTION SET :B

FORD RD
WEST-BOUND LANE
Asphalt overlay

DEFLECTION ANALYSIS REPORT

RUN NO. :170096 ROAD NUMBER :1000 PAGE 1 OF 1

JOB :FORD RD, GOULBURN VALLEY HWYEB 1, NORTH EASTERN
DESCENDING? T/F :T START CHAINAGE :2940 FINISH CHAINAGE :2
TEST DATE :23/02/2017
WHEEL PATH LOCATION :WB 1
CARRIAGEWAY LEFT RIGHT
:2.8M STH OF CL 1.0M STH OF CL
RESHEET? T/F :F SECTION SET :B OVERLAY OPTION :THIN
F FACTOR :1.65 WMAPT :26.0 LOAD CONVERSION FACTOR :0.90
COMMENT :

SECTION (M) FROM	TO	DTL	ASPH (MM)	ASPH TEMP	TEMP DEFL	TEMP CURV	SEAS	STAND DEFL	STAND CURV	SPEED DEFL	SPEED CURV	MILL DEFL	MILL CURV	BIND	DESN DEFL
GVH 2	295	2.8E+007	50	35.0	0.94	0.90	1.30	1.20	0.87	0.96	0.87	1.00	1.00	1.02	0.84
295	345	2.8E+007	50	35.0	0.94	0.90	1.30	1.20	0.87	0.96	0.87	1.00	1.00	1.02	0.84
345	615	2.8E+007	50	35.0	0.94	0.90	1.30	1.20	0.87	0.96	0.87	1.00	1.00	1.02	0.84
615	1190	2.8E+007	50	35.0	0.94	0.90	1.30	1.20	0.87	0.96	0.87	1.00	1.00	1.02	0.84
1190	1620	2.3E+007	30	35.0	0.96	0.94	1.30	1.20	0.92	0.96	0.87	1.00	1.00	1.02	0.85
1620	1755	2.3E+007	30	35.0	0.96	0.94	1.30	1.20	0.92	0.96	0.87	1.00	1.00	1.02	0.85
1755	1925	2.3E+007	30	35.0	0.96	0.94	1.30	1.20	0.92	0.96	0.87	1.00	1.00	1.02	0.85
1925	2030	2.3E+007	30	35.0	0.96	0.94	1.30	1.20	0.92	0.96	0.87	1.00	1.00	1.02	0.85
2030	2510	2.3E+007	30	35.0	0.96	0.94	1.30	1.20	0.92	0.96	0.87	1.00	1.00	1.02	0.85
2510	2645	2.3E+007	30	35.0	0.96	0.94	1.30	1.20	0.92	0.96	0.87	1.00	1.00	1.02	0.85
2645	2935	2.3E+007	30	35.0	0.96	0.94	1.30	1.20	0.92	0.96	0.89	1.00	1.00	1.02	0.85

SECTION (M) FROM	TO	ADJUSTED CHAR DEFL (MM) LWP	CHAR DEFL RWP	CHAR CURV (MM) LWP	CHAR CURV RWP	REQUIRED OVERLAY FOR DEFLECTION (MM) LWP	DEFLECTION RWP	FATIGUE (MM) LWP	FATIGUE RWP	LANE AREA %	DEFLECTION MEAN (MM) LWP	MEAN RWP	STD DEV (MM) LWP	STD DEV RWP	CURVATURE MEAN (MM) LWP	MEAN RWP	STD DEV (MM) LWP	STD DEV RWP	NO OF BOWLS (USED/READ) LWP	RWP	AV SPEED KM/H
GVH 2	295	3.45	2.37	0.87	0.66	150+	150+	150+	150+	10	1.59	1.10	0.46	0.32	0.85	0.65	0.23	0.22	37/37	37/37	4.1
295	345	2.24	1.45	0.60	0.54	145	85	150+	150+	2	1.53	0.99	0.00	0.00	0.59	0.53	0.12	0.05	6/6	6/6	4.2
345	615	2.82	2.23	0.64	0.55	150+	145	150+	150+	9	1.35	0.99	0.35	0.32	0.63	0.54	0.15	0.13	33/33	33/33	4.2
615	1190	1.79	1.42	0.46	0.40	115	80	150+	150+	20	0.88	0.65	0.21	0.20	0.45	0.39	0.10	0.10	72/72	72/72	4.2
1190	1620	1.80	1.67	0.51	0.47	115	105	150+	150+	15	0.78	0.65	0.26	0.28	0.45	0.41	0.12	0.17	55/55	55/55	4.1
1620	1755	2.17	1.52	0.59	0.52	140	90	150+	150+	5	1.11	0.77	0.21	0.15	0.52	0.47	0.12	0.09	17/17	17/17	4.2
1755	1925	3.24	1.89	0.84	0.63	150+	120	150+	150+	6	1.52	0.94	0.39	0.20	0.74	0.56	0.21	0.09	22/22	22/22	4.2
1925	2030	1.89	0.91	0.46	0.29	120	15	150+	150+	4	0.75	0.37	0.31	0.15	0.41	0.25	0.19	0.08	13/13	13/13	4.2
2030	2510	2.31	1.43	0.67	0.48	150	80	150+	150+	16	1.13	0.66	0.26	0.18	0.60	0.43	0.14	0.11	61/61	61/61	4.2
2510	2645	1.42	1.05	0.33	0.26	80	35	150+	150+	5	0.54	0.39	0.25	0.19	0.29	0.23	0.10	0.12	17/17	17/17	4.2
2645	2935	2.96	1.73	0.71	0.49	150+	110	150+	150+	10	1.30	0.76	0.41	0.24	0.63	0.44	0.22	0.14	39/39	39/39	3.8

Grahamvale Rd

NOTE : TEMP & MILL FACTORS ARE NOT APPLICABLE TO RESHEET
: THE DEFLECTION AND CURVATURE MEAN/SD VALUES HAVE BEEN ADJUSTED FOR SPEED & LOAD CONVERSION FACTORS
: CHAR. DEFLECTION = (MEAN + F*SD)*TEMP FACTOR*SEAS FACTOR*STAND FACTOR*MILL FACTOR
: CHAR. CURVATURE = MEAN *TEMP FACTOR*SEAS FACTOR*STAND FACTOR*MILL FACTOR

*** INDICATES THE NO. OF BOWLS IS GREATER THAN 999

INPUT DATA --

RUN NUMBER :170098
RUN DATE :23/02/2017
ROAD NUMBER :1000
DESCENDING? T/F :T
START CHAINAGE : 3240
FINISH CHAINAGE : 1
ROAD NAME :WANGANUI RD
LOCATION :GOLF DR
MUNICIPALITY :NORTH EASTERN
LW DESCRIPTION :2.8M NTH OF CL
LW LOCATION :EB 1
RW DESCRIPTION :1.0M NTH OF CL
RW LOCATION :
OFFSET : 200
VSCALE : 0
COMMENT :
F.FACT : 1.65
W.M.A.P.T. : 26.00
RSHEET? T/F :F
SECTION SET :B

WANGANUI RD
EASTBOUND LANE
Asphalt Overlay

DEFLECTION ANALYSIS REPORT

RUN NO. :170098 ROAD NUMBER :1000 PAGE 1 OF 1

JOB :WANGANUI RD, GOLF DR, NORTH EASTERN
DESCENDING? T/F :T START CHAINAGE :3240 FINISH CHAINAGE :1
TEST DATE :23/02/2017
WHEEL PATH LOCATION :EB 1
CARRIAGEWAY LEFT RIGHT
:2.8M NTH OF CL 1.0M NTH OF CL
RESHEET? T/F :F SECTION SET :B OVERLAY OPTION :THIN
F FACTOR :1.65 WMAPT :26.0 LOAD CONVERSION FACTOR :0.90
COMMENT :

Transfer Station Zone

Asphalt

SECTION (M) FROM	TO	DTL	ASPH (MM)	ASPH TEMP	TEMP DEFL	TEMP CURV	SEAS	STAND DEFL	STAND CURV	SPEED DEFL	SPEED CURV	MILL DEFL	MILL CURV	BIND	DESN DEFL
GVH 7	820	4.8E+007	50	39.0	0.93	0.87	1.30	1.20	0.87	0.96	0.87	1.00	1.00	1.02	0.82
820	1085	4.8E+007	30	39.0	0.95	0.93	1.30	1.20	0.92	0.96	0.87	1.00	1.00	1.02	0.82
1085	1280	4.8E+007	100	39.0	0.88	0.75	1.30	1.20	0.78	0.96	0.87	1.00	1.00	1.02	0.82
1280	1905	4.8E+007	30	39.0	0.95	0.93	1.30	1.20	0.92	0.96	0.87	1.00	1.00	1.02	0.82
1905	2165	4.8E+007	30	39.0	0.95	0.93	1.30	1.20	0.92	0.96	0.87	1.00	1.00	1.02	0.82
2165	2390	4.8E+007	30	39.0	0.95	0.93	1.30	1.20	0.92	0.96	0.87	1.00	1.00	1.02	0.82
2390	3234	4.8E+007	30	39.0	0.95	0.93	1.30	1.20	0.92	0.96	0.88	1.00	1.00	1.02	0.82

FROM	TO	ADJUSTED CHAR DEFL (MM) LWP	CHAR DEFL RWP	CHAR CURV (MM) LWP	CHAR CURV RWP	REQUIRED OVERLAY FOR DEFLECTION (MM) LWP	DEFLECTION RWP	FATIGUE (MM) LWP	FATIGUE RWP	LANE AREA %	DEFLECTION MEAN (MM) LWP	MEAN RWP	STD DEV (MM) LWP	STD DEV RWP	CURVATURE MEAN (MM) LWP	MEAN RWP	STD DEV (MM) LWP	STD DEV RWP	NO OF BOWLS (USED/READ) LWP	NO OF BOWLS RWP	AV SPEED KM/H
GVH 7	820	2.74	1.75	0.64	0.42	150+	115	150+	150+	25	1.26	0.73	0.39	0.29	0.64	0.42	0.22	0.16	104/104	104/104	4.1
820	1085	2.78	1.26	0.70	0.33	150+	70	150+	150+	8	1.17	0.50	0.43	0.21	0.63	0.30	0.27	0.10	33/33	33/33	4.2
1085	1280	0.32	0.34	0.05	0.06	0	0	0	0	6	0.09	0.14	0.09	0.07	0.07	0.06	0.06	0.04	25/25	24/25	4.2
1280	1905	2.68	1.39	0.58	0.31	150+	80	150+	150+	19	0.99	0.49	0.50	0.28	0.52	0.28	0.26	0.16	78/78	78/78	4.2
1905	2165	3.35	2.07	0.81	0.65	150+	140	150+	150+	8	1.41	0.92	0.52	0.29	0.73	0.58	0.27	0.16	32/32	32/32	4.2
2165	2390	2.24	1.24	0.55	0.39	150	65	150+	150+	7	0.93	0.58	0.36	0.15	0.49	0.35	0.19	0.10	28/28	28/28	4.2
2390	3234	1.45	0.98	0.36	0.25	90	30	150+	150+	26	0.54	0.37	0.27	0.18	0.32	0.23	0.14	0.10	111/111	111/111	4.0

GOLF RD

NOTE : TEMP & MILL FACTORS ARE NOT APPLICABLE TO RESHEET
: THE DEFLECTION AND CURVATURE MEAN/SD VALUES HAVE BEEN ADJUSTED FOR SPEED & LOAD CONVERSION FACTORS
: CHAR. DEFLECTION = (MEAN + F*SD)*TEMP FACTOR*SEAS FACTOR*STAND FACTOR*MILL FACTOR
: CHAR. CURVATURE = MEAN *TEMP FACTOR*SEAS FACTOR*STAND FACTOR*MILL FACTOR

*** INDICATES THE NO. OF BOWLS IS GREATER THAN 999

WANGANUI RD
WEST-BOUND LANE
Asphalt Overlay

INPUT DATA --
RUN NUMBER :170097
RUN DATE :23/02/2017
ROAD NUMBER :1000
DESCENDING? T/F :F
START CHAINAGE : 0
FINISH CHAINAGE : 3240
ROAD NAME :WANGANUI RD
LOCATION :GOULBURN VALLEY HWY
MUNICIPALITY :NORTH EASTERN
LW DESCRIPTION :2.8M STH OF CL
LW LOCATION :WB 1
RW DESCRIPTION :1.0M STH OF CL
RW LOCATION :
OFFSET : 200
VSCALE : 0
COMMENT :
F.FACT : 1.65
W.M.A.P.T. : 26.00
RSHEET? T/F :F
SECTION SET :B

DEFLECTION ANALYSIS REPORT

RUN NO. :170097 ROAD NUMBER :1000 PAGE 1 OF 1

JOB :WANGANUI RD, GOULBURN VALLEY HWY, NORTH EASTERN
DESCENDING? T/F :F START CHAINAGE :0 FINISH CHAINAGE :3240
TEST DATE :23/02/2017
WHEEL PATH LOCATION :WB 1
CARRIAGEWAY LEFT RIGHT
:2.8M STH OF CL 1.0M STH OF CL
RESHEET? T/F :F SECTION SET :B OVERLAY OPTION :THIN
F FACTOR :1.65 WMAPT :26.0 LOAD CONVERSION FACTOR :0.90
COMMENT :

Transfer Station Zone

Asphalt

SECTION (M) FROM	SECTION (M) TO	DTL	ASPH (MM)	ASPH TEMP	TEMP DEFL	TEMP CURV	SEAS	STAND DEFL	STAND CURV	SPEED DEFL	SPEED CURV	MILL DEFL	MILL CURV	BIND	DESN DEFL	ADJUSTED CHAR DEFL (MM) LWP	ADJUSTED CHAR DEFL (MM) RWP	ADJUSTED CHAR CURV (MM) LWP	ADJUSTED CHAR CURV (MM) RWP	REQUIRED OVERLAY FOR DEFLECTION (MM) LWP	REQUIRED OVERLAY FOR DEFLECTION (MM) RWP	REQUIRED OVERLAY FOR FATIGUE (MM) LWP	REQUIRED OVERLAY FOR FATIGUE (MM) RWP	LANE AREA %	DEFLECTION MEAN (MM) LWP	DEFLECTION MEAN (MM) RWP	DEFLECTION STD DEV (MM) LWP	DEFLECTION STD DEV (MM) RWP	CURVATURE MEAN (MM) LWP	CURVATURE MEAN (MM) RWP	CURVATURE STD DEV (MM) LWP	CURVATURE STD DEV (MM) RWP	NO OF BOWLS (USED/READ) LWP	NO OF BOWLS (USED/READ) RWP	AV SPEED KM/H
GVH 6	245	4.8E+007	50	39.0	0.93	0.87	1.30	1.20	0.87	0.96	0.88	1.00	1.00	1.02	0.82	1.81	1.46	0.43	0.38	120	90	150+	150+	7	0.82	0.65	0.26	0.22	0.43	0.38	0.15	0.16	31/31	31/31	4.0
245	435	4.8E+007	50	39.0	0.93	0.87	1.30	1.20	0.87	0.96	0.88	1.00	1.00	1.02	0.82	3.66	1.97	0.80	0.53	150+	135	150+	150+	6	1.46	0.87	0.65	0.30	0.81	0.54	0.37	0.18	25/25	25/25	4.1
435	840	4.8E+007	50	39.0	0.93	0.87	1.30	1.20	0.87	0.96	0.88	1.00	1.00	1.02	0.82	2.70	1.42	0.68	0.42	150+	85	150+	150+	13	1.31	0.67	0.34	0.19	0.69	0.42	0.17	0.13	52/52	52/52	4.1
840	1090	4.8E+007	30	39.0	0.95	0.93	1.30	1.20	0.92	0.96	0.88	1.00	1.00	1.02	0.82	2.60	1.10	0.67	0.31	150+	50	150+	150+	8	1.18	0.50	0.35	0.15	0.60	0.28	0.20	0.07	33/33	33/33	4.1
1090	1320	4.8E+007	30	39.0	0.95	0.93	1.30	1.20	0.92	0.96	0.88	1.00	1.00	1.02	0.82	0.99	0.61	0.13	0.14	30	0	40	0	1	0.30	0.22	0.22	0.12	0.12	0.13	0.10	0.06	29/29	29/29	4.1
1320	1395	4.8E+007	30	39.0	0.95	0.93	1.30	1.20	0.92	0.96	0.88	1.00	1.00	1.02	0.82	1.51	1.99	0.40	0.40	95	135	150+	150+	2	0.57	0.65	0.28	0.42	0.36	0.36	0.18	0.21	10/10	10/10	4.0
1395	1470	4.8E+007	30	39.0	0.95	0.93	1.30	1.20	0.92	0.96	0.87	1.00	1.00	1.02	0.82	0.73	0.70	0.18	0.17	0	0	0	0	2	0.22	0.23	0.17	0.15	0.16	0.16	0.11	0.14	10/10	10/10	4.1
1470	1635	4.8E+007	30	39.0	0.95	0.93	1.30	1.20	0.92	0.96	0.88	1.00	1.00	1.02	0.82	2.00	1.23	0.59	0.35	135	65	150+	150+	5	0.91	0.51	0.27	0.20	0.53	0.32	0.14	0.13	21/21	21/21	4.1
1635	1765	4.8E+007	30	39.0	0.95	0.93	1.30	1.20	0.92	0.96	0.88	1.00	1.00	1.02	0.82	2.20	1.30	0.61	0.38	150	75	150+	150+	4	0.91	0.55	0.35	0.20	0.55	0.34	0.15	0.11	17/17	17/17	4.0
1765	1935	4.8E+007	30	39.0	0.95	0.93	1.30	1.20	0.92	0.96	0.88	1.00	1.00	1.02	0.82	1.79	1.17	0.43	0.33	120	55	150+	150+	5	0.73	0.45	0.29	0.20	0.38	0.30	0.16	0.12	22/22	22/22	4.1
1935	2195	4.8E+007	30	39.0	0.95	0.93	1.30	1.20	0.92	0.96	0.88	1.00	1.00	1.02	0.82	3.26	2.03	0.81	0.55	150+	140	150+	150+	9	1.44	0.84	0.46	0.33	0.73	0.50	0.26	0.19	34/34	34/34	4.1
2195	3239	4.8E+007	30	39.0	0.95	0.93	1.30	1.20	0.92	0.96	0.88	1.00	1.00	1.02	0.82	1.59	1.05	0.43	0.29	105	40	150+	150+	32	0.63	0.40	0.27	0.19	0.38	0.26	0.16	0.12	135/135	135/135	4.0

GOLF RD

NOTE : TEMP & MILL FACTORS ARE NOT APPLICABLE TO RESHEET
: THE DEFLECTION AND CURVATURE MEAN/SD VALUES HAVE BEEN ADJUSTED FOR SPEED & LOAD CONVERSION FACTORS
: CHAR. DEFLECTION = (MEAN + F*SD)*TEMP FACTOR*SEAS FACTOR*STAND FACTOR*MILL FACTOR
: CHAR. CURVATURE = MEAN *TEMP FACTOR*SEAS FACTOR*STAND FACTOR*MILL FACTOR

*** INDICATES THE NO. OF BOWLS IS GREATER THAN 999

Ford Rd
Granular Resheet
East-Bound Lane

INPUT DATA --

RUN NUMBER :170095
RUN DATE :23/02/2017
ROAD NUMBER :1000
DESCENDING? T/F :F
START CHAINAGE : 0
FINISH CHAINAGE : 2950
ROAD NAME :FORD RD
LOCATION :GOULBURN VALLEY HWYEB 1
MUNICIPALITY :NORTH EASTERN
LW DESCRIPTION :2.8M NTH OF CL
LW LOCATION :EB 1
RW DESCRIPTION :1.0M NTH OF CL
RW LOCATION :
OFFSET : 200
VSCALE : 0
COMMENT :
F.FACT : 1.65
W.M.A.P.T. : 24.00
RSHEET? T/F :T
SECTION SET :B

DEFLECTION ANALYSIS REPORT

RUN NO. :170095 ROAD NUMBER :1000 PAGE 1 OF 1

JOB :FORD RD, GOULBURN VALLEY HWYEB 1, NORTH EASTERN
DESCENDING? T/F :F START CHAINAGE :0 FINISH CHAINAGE :2950
TEST DATE :23/02/2017
WHEEL PATH LOCATION :EB 1
CARRIAGEWAY LEFT RIGHT
:2.8M NTH OF CL 1.0M NTH OF CL
RESHEET? T/F :T SECTION SET :B OVERLAY OPTION :THIN
F FACTOR :1.65 WMAPT :24.0 LOAD CONVERSION FACTOR :0.90

SECTION (M) FROM	TO	DTL	ADJUSTMENT FACTORS SEAS	STAND DEFL	STAND CURV	SPEED DEFL	SPEED CURV	DESN DEFL	ADJUSTED CHAR DEFL (MM) LWP	RWP	GRANULAR RESHEET (MM) LWP	RWP	LANE AREA %	DEFLECTION MEAN (MM) LWP	RWP	STD DEV (MM) LWP	RWP	NO OF BOWLS (USED/READ) LWP	RWP	AV SPEED KM/H
GVH 5	445	2.8E+007	1.30	1.20	0.87	0.96	0.88	0.84	3.37	2.70	400+	400+	15	1.67	1.16	0.30	0.34	56/56	56/56	4.1
445	635	2.8E+007	1.30	1.20	0.87	0.96	0.87	0.84	3.70	2.14	400+	380	6	1.65	0.90	0.44	0.29	24/24	24/24	4.1
635	955	2.8E+007	1.30	1.20	0.87	0.96	0.87	0.84	2.49	1.54	400+	245	11	1.21	0.70	0.23	0.17	40/40	40/40	4.1
955	1215	2.8E+007	1.30	1.20	0.87	0.96	0.87	0.84	2.83	1.56	400+	250	9	1.18	0.66	0.38	0.21	33/33	33/33	4.1
1215	1470	2.2E+007	1.30	1.20	0.92	0.96	0.88	0.85	2.46	1.69	400+	275	9	1.10	0.64	0.29	0.27	32/32	32/32	4.1
1470	1625	2.2E+007	1.30	1.20	0.92	0.96	0.88	0.85	1.67	1.06	275	90	5	0.70	0.44	0.22	0.15	20/20	20/20	4.1
1625	1940	2.2E+007	1.30	1.20	0.92	0.96	0.88	0.85	2.47	1.70	400+	280	11	1.09	0.73	0.30	0.22	41/41	41/41	4.1
1940	2075	2.2E+007	1.30	1.20	0.92	0.96	0.87	0.85	1.49	0.87	225	10	5	0.55	0.32	0.24	0.15	17/17	17/17	4.1
2075	2200	2.2E+007	1.30	1.20	0.92	0.96	0.88	0.85	2.11	1.36	365	190	4	0.93	0.67	0.26	0.12	16/16	16/16	4.1
2200	2510	2.2E+007	1.30	1.20	0.92	0.96	0.87	0.85	2.28	1.35	400	190	11	1.04	0.60	0.26	0.16	39/39	39/39	4.1
2510	2645	2.2E+007	1.30	1.20	0.92	0.96	0.87	0.85	2.03	1.35	350	185	5	0.66	0.44	0.39	0.26	17/17	17/17	4.2
2645	2942	2.2E+007	1.30	1.20	0.92	0.96	0.88	0.85	3.34	1.83	400+	310	10	1.43	0.77	0.43	0.24	38/38	38/38	4.0

Grahamvale Rd.

NOTE : TEMP & MILL FACTORS ARE NOT APPLICABLE TO RESHEET
: THE DEFLECTION AND CURVATURE MEAN/SD VALUES HAVE BEEN ADJUSTED FOR SPEED & LOAD CONVERSION FACTORS
: CHAR. DEFLECTION = (MEAN + F*SD)*TEMP FACTOR*SEAS FACTOR*STAND FACTOR*MILL FACTOR
: CHAR. CURVATURE = MEAN *TEMP FACTOR*SEAS FACTOR*STAND FACTOR*MILL FACTOR

*** INDICATES THE NO. OF BOWLS IS GREATER THAN 999

FORD RD

WEST - BOUND LANE

GRANULAR RESHEET

INPUT DATA --

RUN NUMBER	:170096
RUN DATE	:23/02/2017
ROAD NUMBER	:1000
DESCENDING? T/F	:T
START CHAINAGE	: 2940
FINISH CHAINAGE	: 2
ROAD NAME	:FORD RD
LOCATION	:GOULBURN VALLEY HWYEB 1
MUNICIPALITY	:NORTH EASTERN
LW DESCRIPTION	:2.8M STH OF CL
LW LOCATION	:WB 1
RW DESCRIPTION	:1.0M STH OF CL
RW LOCATION	:
OFFSET	: 200
VSCALE	: 0
COMMENT	:
F.FACT	: 1.65
W.M.A.P.T.	: 26.00
RSHEET? T/F	:T
SECTION SET	:B

DEFLECTION ANALYSIS REPORT

RUN NO.	:170096	ROAD NUMBER	:1000	PAGE 1 OF 1	
JOB	:FORD RD, GOULBURN VALLEY HWYEB 1, NORTH EASTERN				
DESCENDING? T/F	:T	START CHAINAGE	:2940	FINISH CHAINAGE	:2
TEST DATE	:23/02/2017				
WHEEL PATH LOCATION	:WB 1				
CARRIAGEWAY	LEFT		RIGHT		
	:2.8M STH OF CL		1.0M STH OF CL		
RESHEET? T/F	:T	SECTION SET	:B	OVERLAY OPTION	:THIN
F FACTOR	:1.65	WMAPT	:26.0	LOAD CONVERSION FACTOR	:0.90
COMMENT	:				

SECTION (M)		DTL	ADJUSTMENT FACTORS						ADJUSTED CHAR DEFL (MM)		GRANULAR RESHEET (MM)		LANE AREA	DEFLECTION				NO OF BOWLS (USED/READ)		AV SPEED
			SEAS	STAND DEFL	STAND CURV	SPEED DEFL	SPEED CURV	DESN DEFL						MEAN (MM)		STD DEV (MM)				
FROM	TO								LWP	RWP	LWP	RWP	%	LWP	RWP	LWP	RWP	LWP	RWP	KM/H
GVH 2	295	2.8E+007	1.30	1.20	0.87	0.96	0.87	0.84	3.67	2.53	400+	400+	10	1.59	1.10	0.46	0.32	37/37	37/37	4.1
295	345	2.8E+007	1.30	1.20	0.87	0.96	0.87	0.84	2.38	1.54	400+	245	2	1.53	0.99	0.00	0.00	6/6	6/6	4.2
345	615	2.8E+007	1.30	1.20	0.87	0.96	0.87	0.84	3.00	2.37	400+	400+	9	1.35	0.99	0.35	0.32	33/33	33/33	4.2
615	1190	2.8E+007	1.30	1.20	0.87	0.96	0.87	0.84	1.91	1.51	330	240	20	0.88	0.65	0.21	0.20	72/72	72/72	4.2
1190	1620	2.3E+007	1.30	1.20	0.92	0.96	0.87	0.85	1.88	1.75	320	290	15	0.78	0.65	0.26	0.28	55/55	55/55	4.1
1620	1755	2.3E+007	1.30	1.20	0.92	0.96	0.87	0.85	2.27	1.58	400	250	5	1.11	0.77	0.21	0.15	17/17	17/17	4.2
1755	1925	2.3E+007	1.30	1.20	0.92	0.96	0.87	0.85	3.38	1.97	400+	340	6	1.52	0.94	0.39	0.20	22/22	22/22	4.2
1925	2030	2.3E+007	1.30	1.20	0.92	0.96	0.87	0.85	1.97	0.95	340	45	4	0.75	0.37	0.31	0.15	13/13	13/13	4.2
2030	2510	2.3E+007	1.30	1.20	0.92	0.96	0.87	0.85	2.41	1.50	400+	230	16	1.13	0.66	0.26	0.18	61/61	61/61	4.2
2510	2645	2.3E+007	1.30	1.20	0.92	0.96	0.87	0.85	1.48	1.10	225	105	5	0.54	0.39	0.25	0.19	17/17	17/17	4.2
2645	2935	2.3E+007	1.30	1.20	0.92	0.96	0.89	0.85	3.09	1.81	400+	305	10	1.30	0.76	0.41	0.24	39/39	39/39	3.8

Granamvale Rd

NOTE : TEMP & MILL FACTORS ARE NOT APPLICABLE TO RESHEET
: THE DEFLECTION AND CURVATURE MEAN/SD VALUES HAVE BEEN ADJUSTED FOR SPEED & LOAD CONVERSION FACTORS
: CHAR. DEFLECTION = (MEAN + F*SD)*TEMP FACTOR*SEAS FACTOR*STAND FACTOR*MILL FACTOR
: CHAR. CURVATURE = MEAN *TEMP FACTOR*SEAS FACTOR*STAND FACTOR*MILL FACTOR

*** INDICATES THE NO. OF BOWLS IS GREATER THAN 999

INPUT DATA

```
RUN NUMBER        :170098
RUN DATE          :23/02/2017
ROAD NUMBER       :1000
DESCENDING? T/F   :T
START CHAINAGE    :   3240
FINISH CHAINAGE   :      1
ROAD NAME         :WANGANUI RD
LOCATION          :GOLF DR
MUNICIPALITY      :NORTH EASTERN
LW DESCRIPTION    :2.8M NTH OF CL
LW LOCATION       :EB 1
RW DESCRIPTION    :1.0M NTH OF CL
RW LOCATION       :
OFFSET            :    200
VSCALE            :      0
COMMENT           :
F.FACT            :   1.65
W.M.A.P.T.        :  26.00
RSHEET? T/F       :T
SECTION SET       :A
```

WANGANUI RD
EAST-BOUND LANE
GRANULAR RESHEET

DEFLECTION ANALYSIS REPORT

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RUN NO.              :170098        ROAD NUMBER      :1000          PAGE 1 OF 1

JOB                  :WANGANUI RD, GOLF DR, NORTH EASTERN
DESCENDING? T/F      :T             START CHAINAGE   :3240          FINISH CHAINAGE          :1
TEST DATE            :23/02/2017
WHEEL PATH LOCATION  :EB 1
CARRIAGEWAY           LEFT                            RIGHT
                     :2.8M NTH OF CL                  1.0M NTH OF CL
RESHEET? T/F         :T             SECTION SET      :B             OVERLAY OPTION           :THIN
F FACTOR             :1.65          WMAPT            :26.0          LOAD CONVERSION FACTOR   :0.90
COMMENT              :
```

TRANSFER STATION ZONE

SECTION (M) FROM	SECTION (M) TO	DTL	ADJUSTMENT FACTORS SEAS	STAND DEFL	STAND CURV	SPEED DEFL	SPEED CURV	DESN DEFL	ADJUSTED CHAR DEFL (MM) LWP	RWP	GRANULAR RESHEET (MM) LWP	RWP	LANE AREA %	DEFLECTION MEAN (MM) LWP	RWP	STD DEV (MM) LWP	RWP	NO OF BOWLS (USED/READ) LWP	RWP	AV SPEED KM/H
GVH 7	820	4.8E+007	1.30	1.20	0.87	0.96	0.87	0.82	2.96	1.89	400+	340	25	1.26	0.73	0.39	0.29	104/104	104/104	4.1
820	1085	4.8E+007	1.30	1.20	0.92	0.96	0.87	0.82	2.93	1.33	400+	195	8	1.17	0.50	0.43	0.21	33/33	33/33	4.2
1085	1280	4.8E+007	1.30	1.20	0.78	0.96	0.87	0.82	0.36	0.39	0	0	6	0.09	0.14	0.09	0.07	25/25	24/25	4.2
1280	1905	4.8E+007	1.30	1.20	0.92	0.96	0.87	0.82	2.82	1.47	400+	235	19	0.99	0.49	0.50	0.28	78/78	78/78	4.2
1905	2165	4.8E+007	1.30	1.20	0.92	0.96	0.87	0.82	3.53	2.18	400+	395	8	1.41	0.92	0.52	0.29	32/32	32/32	4.2
2165	2390	4.8E+007	1.30	1.20	0.92	0.96	0.87	0.82	2.36	1.30	400+	190	7	0.93	0.58	0.36	0.15	28/28	28/28	4.2
2390	3234	4.8E+007	1.30	1.20	0.92	0.96	0.88	0.82	1.53	1.04	255	95	26	0.54	0.37	0.27	0.18	111/111	111/111	4.0

← GOLF RD

NOTE : TEMP & MILL FACTORS ARE NOT APPLICABLE TO RESHEET
: THE DEFLECTION AND CURVATURE MEAN/SD VALUES HAVE BEEN ADJUSTED FOR SPEED & LOAD CONVERSION FACTORS
: CHAR. DEFLECTION = (MEAN + F*SD)*TEMP FACTOR*SEAS FACTOR*STAND FACTOR*MILL FACTOR
: CHAR. CURVATURE = MEAN *TEMP FACTOR*SEAS FACTOR*STAND FACTOR*MILL FACTOR

*** INDICATES THE NO. OF BOWLS IS GREATER THAN 999

INPUT DATA --

RUN NUMBER :170097
RUN DATE :23/02/2017
ROAD NUMBER :1000
DESCENDING? T/F :F
START CHAINAGE : 0
FINISH CHAINAGE : 3240
ROAD NAME :WANGANUI RD
LOCATION :GOULBURN VALLEY HWY
MUNICIPALITY :NORTH EASTERN
LW DESCRIPTION :2.8M STH OF CL
LW LOCATION :WB 1
RW DESCRIPTION :1.0M STH OF CL
RW LOCATION :
OFFSET : 200
VSCALE : 0
COMMENT :
F.FACT : 1.65
W.M.A.P.T. : 26.00
RSHEET? T/F :T
SECTION SET :B

WANGANUI RD
WEST BOUND LANE
GRANULAR RESHEET

DEFLECTION ANALYSIS REPORT

RUN NO. :170097 ROAD NUMBER :1000 PAGE 1 OF 1

JOB :WANGANUI RD, GOULBURN VALLEY HWY, NORTH EASTERN
DESCENDING? T/F :F START CHAINAGE :0 FINISH CHAINAGE :3240
TEST DATE :23/02/2017
WHEEL PATH LOCATION :WB 1
CARRIAGEWAY LEFT :2.8M STH OF CL RIGHT 1.0M STH OF CL
RESHEET? T/F :T SECTION SET :B OVERLAY OPTION :THIN
F FACTOR :1.65 WMAPT :26.0 LOAD CONVERSION FACTOR :0.90
COMMENT :

TRANSFER STATION ZONE

SECTION (M) FROM	TO	DTL	ADJUSTMENT FACTORS SEAS	STAND DEFL	STAND CURV	SPEED DEFL	SPEED CURV	DESN DEFL	ADJUSTED CHAR DEFL (MM) LWP	RWP	GRANULAR RESHEET (MM) LWP	RWP	LANE AREA %	DEFLECTION MEAN (MM) LWP	RWP	STD DEV (MM) LWP	RWP	NO OF BOWLS (USED/READ) LWP	RWP	AV SPEED KM/H
GVH 6	245	4.8E+007	1.30	1.20	0.87	0.96	0.88	0.82	1.95	1.58	350	265	7	0.82	0.65	0.26	0.22	31/31	31/31	4.0
245	435	4.8E+007	1.30	1.20	0.87	0.96	0.88	0.82	3.95	2.13	400+	385	6	1.46	0.87	0.65	0.30	25/25	25/25	4.1
435	840	4.8E+007	1.30	1.20	0.87	0.96	0.88	0.82	2.91	1.54	400+	255	13	1.31	0.67	0.34	0.19	52/52	52/52	4.1
840	1090	4.8E+007	1.30	1.20	0.92	0.96	0.88	0.82	2.74	1.16	400+	140	8	1.18	0.50	0.35	0.15	33/33	33/33	4.1
1090	1320	4.8E+007	1.30	1.20	0.92	0.96	0.88	0.82	1.04	0.65	100	0	7	0.30	0.22	0.22	0.12	29/29	29/29	4.1
1320	1395	4.8E+007	1.30	1.20	0.92	0.96	0.88	0.82	1.59	2.10	270	380	2	0.57	0.65	0.28	0.42	10/10	10/10	4.0
1395	1470	4.8E+007	1.30	1.20	0.92	0.96	0.87	0.82	0.77	0.74	0	0	2	0.22	0.23	0.17	0.15	10/10	10/10	4.1
1470	1635	4.8E+007	1.30	1.20	0.92	0.96	0.88	0.82	2.11	1.29	380	185	5	0.91	0.51	0.27	0.20	21/21	21/21	4.1
1635	1765	4.8E+007	1.30	1.20	0.92	0.96	0.88	0.82	2.33	1.37	400+	210	4	0.91	0.55	0.35	0.20	17/17	17/17	4.0
1765	1935	4.8E+007	1.30	1.20	0.92	0.96	0.88	0.82	1.89	1.23	335	165	5	0.73	0.45	0.29	0.20	22/22	22/22	4.1
1935	2195	4.8E+007	1.30	1.20	0.92	0.96	0.88	0.82	3.44	2.15	400+	390	8	1.44	0.84	0.46	0.33	34/34	34/34	4.1
2195	3239	4.8E+007	1.30	1.20	0.92	0.96	0.88	0.82	1.68	1.11	290	125	32	0.63	0.40	0.27	0.19	135/135	135/135	4.0

GOLF RD

NOTE : TEMP & MILL FACTORS ARE NOT APPLICABLE TO RESHEET
: THE DEFLECTION AND CURVATURE MEAN/SD VALUES HAVE BEEN ADJUSTED FOR SPEED & LOAD CONVERSION FACTORS
: CHAR. DEFLECTION = (MEAN + F*SD)*TEMP FACTOR*SEAS FACTOR*STAND FACTOR*MILL FACTOR
: CHAR. CURVATURE = MEAN *TEMP FACTOR*SEAS FACTOR*STAND FACTOR*MILL FACTOR

*** INDICATES THE NO. OF BOWLS IS GREATER THAN 999

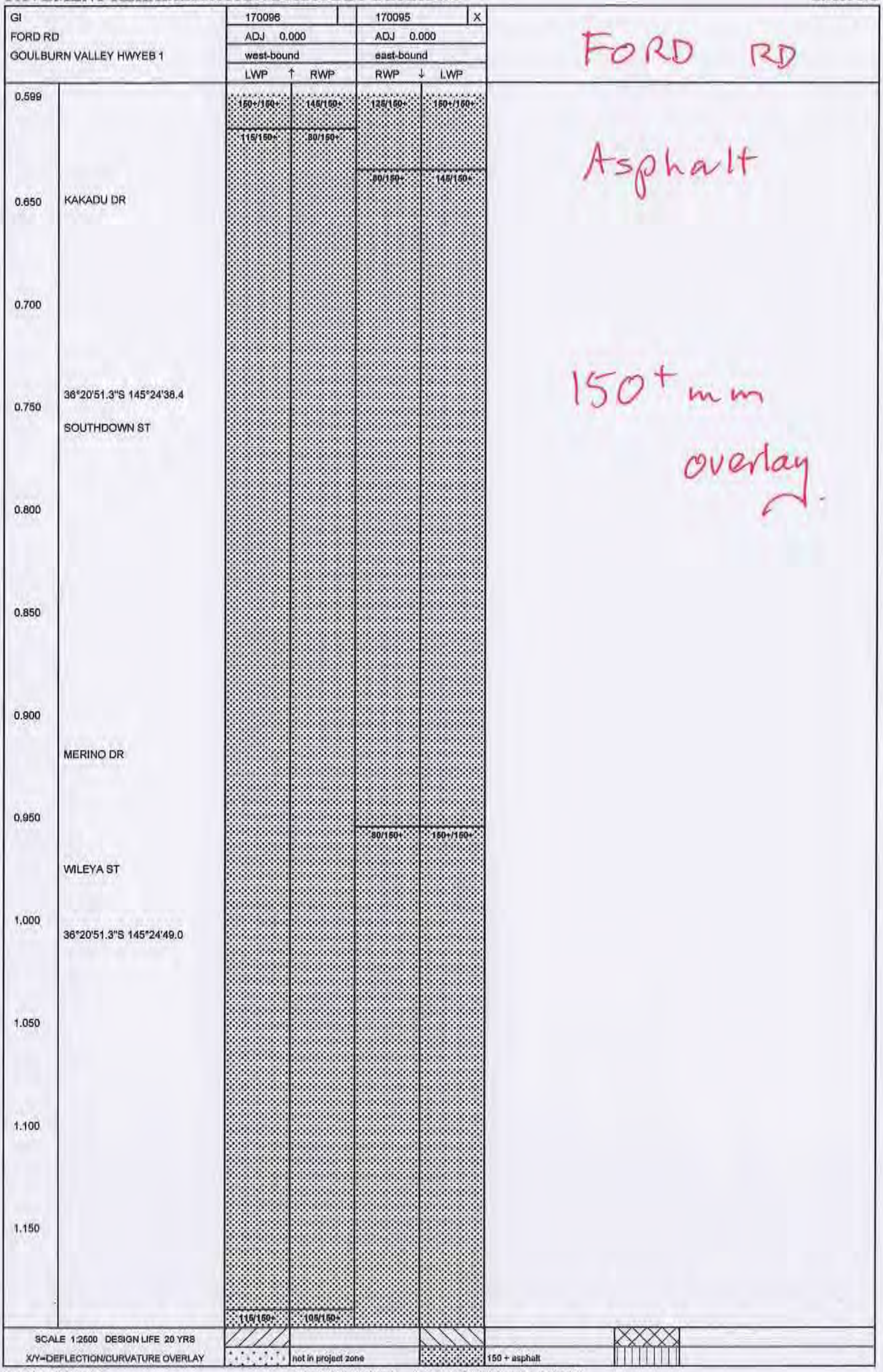
ASPHALT OVERLAY REQUIREMENTS AND PAVEMENT REHABILITATION STRATEGY DIAGRAM

GI FORD RD GOULBURN VALLEY HWYEB 1		170096 ADJ 0.000 west-bound LWP ↑	RWP	170095 ADJ 0.000 east-bound RWP ↓	LWP X	FORD RD
0.005	36°20'51.3"S 145°24'08.7 GOULBURN VALLEY HWY	150+/150+	150+/150+	150+/150+	150+/150+	ASPHALT
0.050						
0.100						
0.150						150+ mm Overlay
0.200						
0.250	36°20'51.3"S 145°24'18.4					
0.300		148/150+	88/150+			
0.350		150+/150+	148/150+			
0.400						
0.450				125/150+	150+/150+	
	60KM/HR SIGN					
0.500	36°20'51.3"S 145°24'28.5					
0.550						

SCALE 1:2500 DESIGN LIFE 20 YRS
X/Y=DEFLECTION/CURVATURE OVERLAY

not in project zone
150 + asphalt

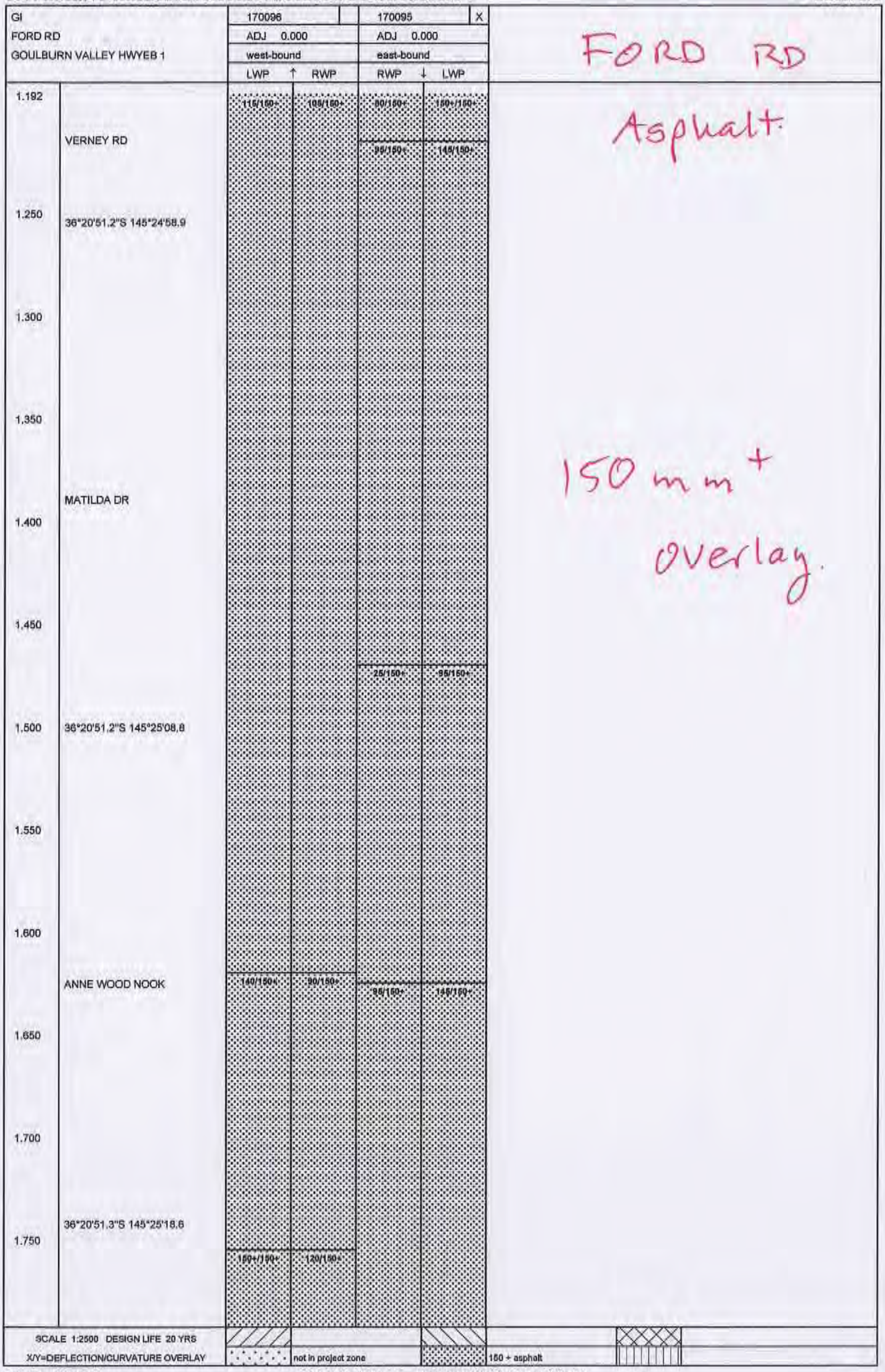
ASPHALT OVERLAY REQUIREMENTS AND PAVEMENT REHABILITATION STRATEGY DIAGRAM



Ford Rd_AC rehab/B

GEOPAVE - VicRoads Analysed 30/05/17, Printed 30/05/17

ASPHALT OVERLAY REQUIREMENTS AND PAVEMENT REHABILITATION STRATEGY DIAGRAM



Ford Rd_AC rehab/B

GEOPAVE - VicRoads Analysed 30/05/17, Printed 30/05/17

ASPHALT OVERLAY REQUIREMENTS AND PAVEMENT REHABILITATION STRATEGY DIAGRAM

Sheet 4/5

GI
FORD RD
GOULBURN VALLEY HWYEB 1

FORD RD

Asphalt :

150+ mm Overlay

Chainage	Feature	170096 ADJ 0.000 west-bound LWP ↑	RWP	170095 ADJ 0.000 east-bound RWP ↓	LWP (X)
1.786		150+/150+	120/150+	95/150+	145/150+
1.800	MATILDA DR				
1.850					
1.900		120/150+	15/150+		
1.950				0/0	75/150+
	36°20'51.3"S 145°25'28.2				
2.000		150/150+	80/150+		
2.050				65/150+	125/150+
2.100	60KM/HR SIGN				
2.150					
2.200				80/150+	135/150+
	36°20'51.2"S 145°25'38.1				
2.250					
2.300					
2.350					

SCALE 1:2500 DESIGN LIFE 20 YRS
X/Y=DEFLECTION/CURVATURE OVERLAY

not in project zone

150 + asphalt

ASPHALT OVERLAY REQUIREMENTS AND PAVEMENT REHABILITATION STRATEGY DIAGRAM

GI FORD RD GOULBURN VALLEY HWYEB 1		170096 ADJ 0.000 west-bound		170095 X ADJ 0.000 east-bound	
		LWP ↑	RWP	RWP ↓	LWP
2.380		150/150+	80/150+	80/150+	135/150+
2.400					
2.450	36°20'51.3"S 145°25'47.7				
2.500		80/150+	35/150+	60/150+	120/150+
2.550					
2.600					
	GRAHAMVALE RD	150+/150+	110/150+	105/150+	150+/150+
2.650	RAIL XING				
2.700	36°20'51.3"S 145°25'57.6				
2.750	100KM/HR SIGN				
2.800					
2.850					
2.900					
	MASALKI ENT	END	2.93	END	2.94
2.950					

FORD RD.

Asphalt

150 + mm overlay.

↓ END

NOT IN PROJECT

SCALE 1:2500 DESIGN LIFE 20 YRS

X/Y=DEFLECTION/CURVATURE OVERLAY

not in project zone

150 + asphalt

GRANULAR RESHEET REQUIREMENTS AND PAVEMENT REHABILITATION STRATEGY DIAGRAM

Sheet 1/5

GI
FORD RD
GOULBURN VALLEY HWYEB 1

		170096		170095 X	
		ADJ 0.000		ADJ 0.000	
		west-bound		east-bound	
		LWP ↑	RWP	RWP ↓	LWP
0.005	36°20'51.3"S 145°24'08.7 GOULBURN VALLEY HWY	400+	400+	400+	400+
0.050					
0.100					
0.150					
0.200					
0.250	36°20'51.3"S 145°24'18.4				
0.300		400+	385		
0.350					
0.400				370	400+
0.450					
	60KM/HR SIGN				
0.500	36°20'51.3"S 145°24'28.5				
0.550					

FORD RD

Granular

400^{+} mm

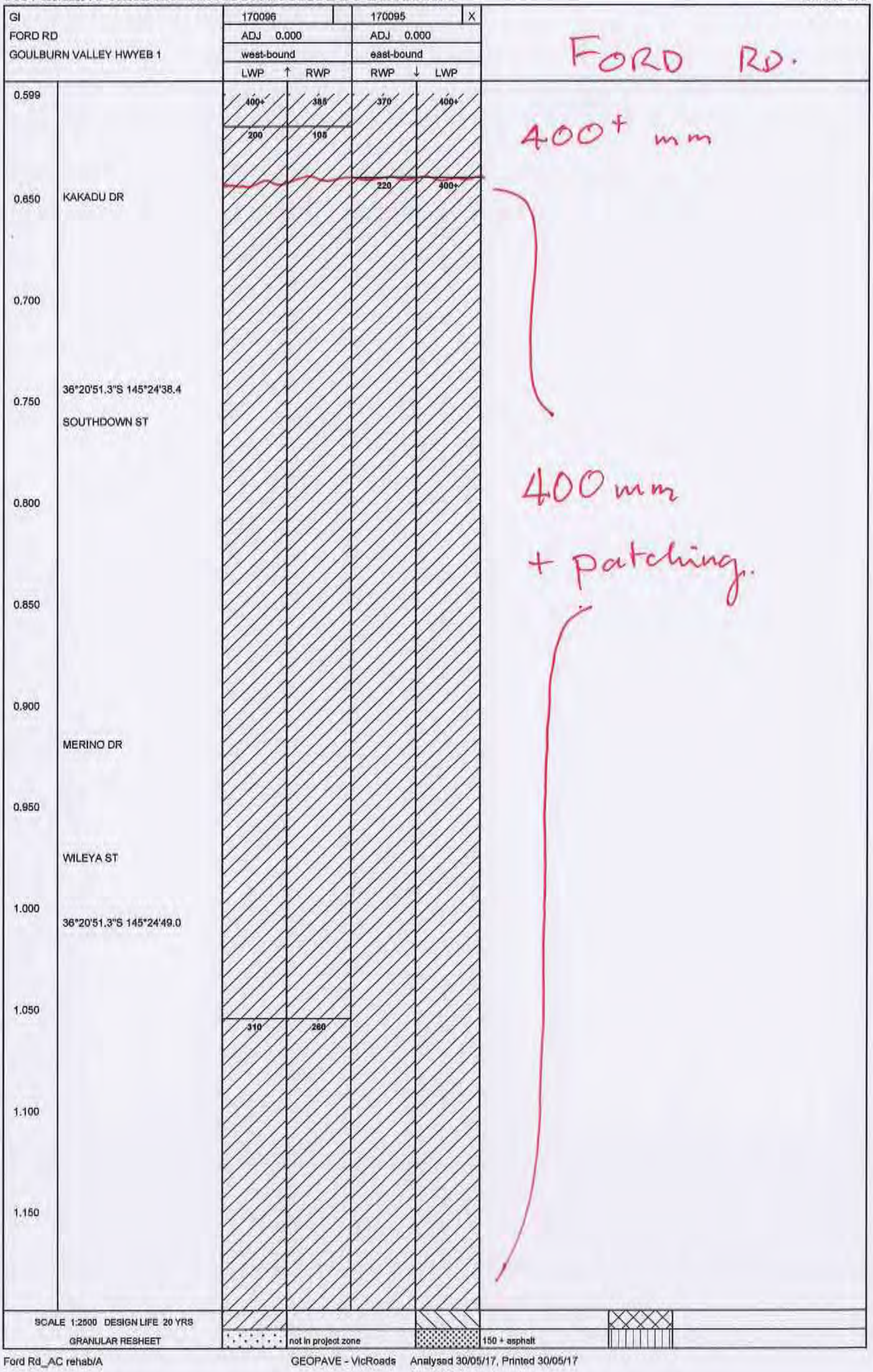
SCALE 1:2500 DESIGN LIFE 20 YRS
GRANULAR RESHEET

not in project zone

150 + asphalt

Ford Rd_AC rehab/A GEOPAVE - VicRoads Analysed 30/05/17, Printed 30/05/17

GRANULAR RESHEET REQUIREMENTS AND PAVEMENT REHABILITATION STRATEGY DIAGRAM



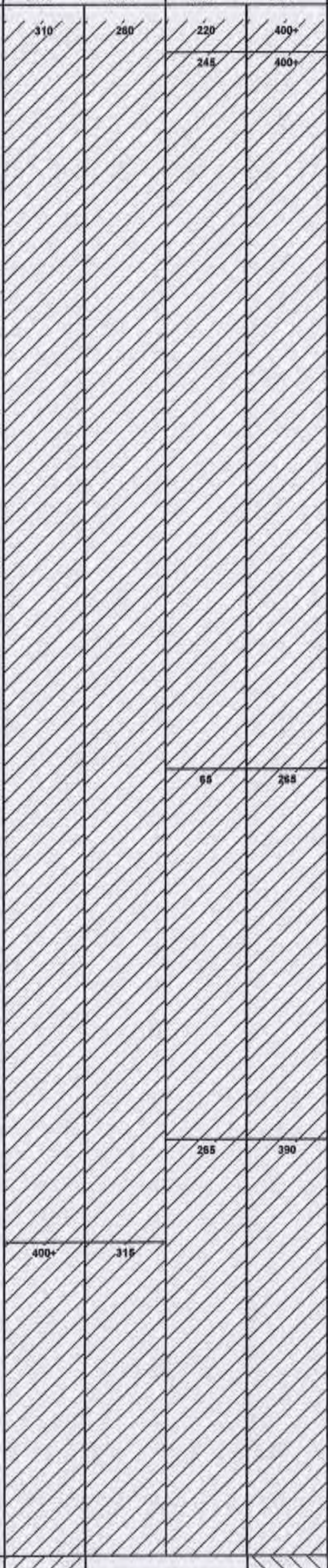
GRANULAR RESHEET REQUIREMENTS AND PAVEMENT REHABILITATION STRATEGY DIAGRAM

GI
FORD RD
GOULBURN VALLEY HWYEB 1

170096		170095	X
ADJ 0.000		ADJ 0.000	
west-bound		east-bound	
LWP ↑	RWP	RWP ↓	LWP

FORD RD

1.192	
	VERNEY RD
1.250	36°20'51.2"S 145°24'58.9
1.300	
1.350	
	MATILDA DR
1.400	
1.450	
1.500	36°20'51.2"S 145°25'08.8
1.550	
1.600	
	ANNE WOOD NOOK
1.650	
1.700	
	36°20'51.3"S 145°25'18.6
1.750	



400 mm
+ Patching
Granular.

SCALE 1:2500 DESIGN LIFE 20 YRS
GRANULAR RESHEET

not in project zone

150 + asphalt

GRANULAR RESHEET REQUIREMENTS AND PAVEMENT REHABILITATION STRATEGY DIAGRAM

GI FORD RD GOULBURN VALLEY HWYEB 1		170096 ADJ 0.000 west-bound LWP ↑	RWP	170095 ADJ 0.000 east-bound RWP ↓	LWP X
1.786		400+	315	265	390
1.800	MATILDA DR				
1.850					
1.900					
1.950				0	195
		400	205		
	36°20'51.3"S 145°25'28.2				
2.000					
2.050				180	375
2.100					
	60KM/HR SIGN				
2.150					
2.200					
	36°20'51.2"S 145°25'38.1				
2.250					
2.300					
2.350					

SCALE 1:2500 DESIGN LIFE 20 YRS

GRANULAR RESHEET | not in project zone | 150 + asphalt

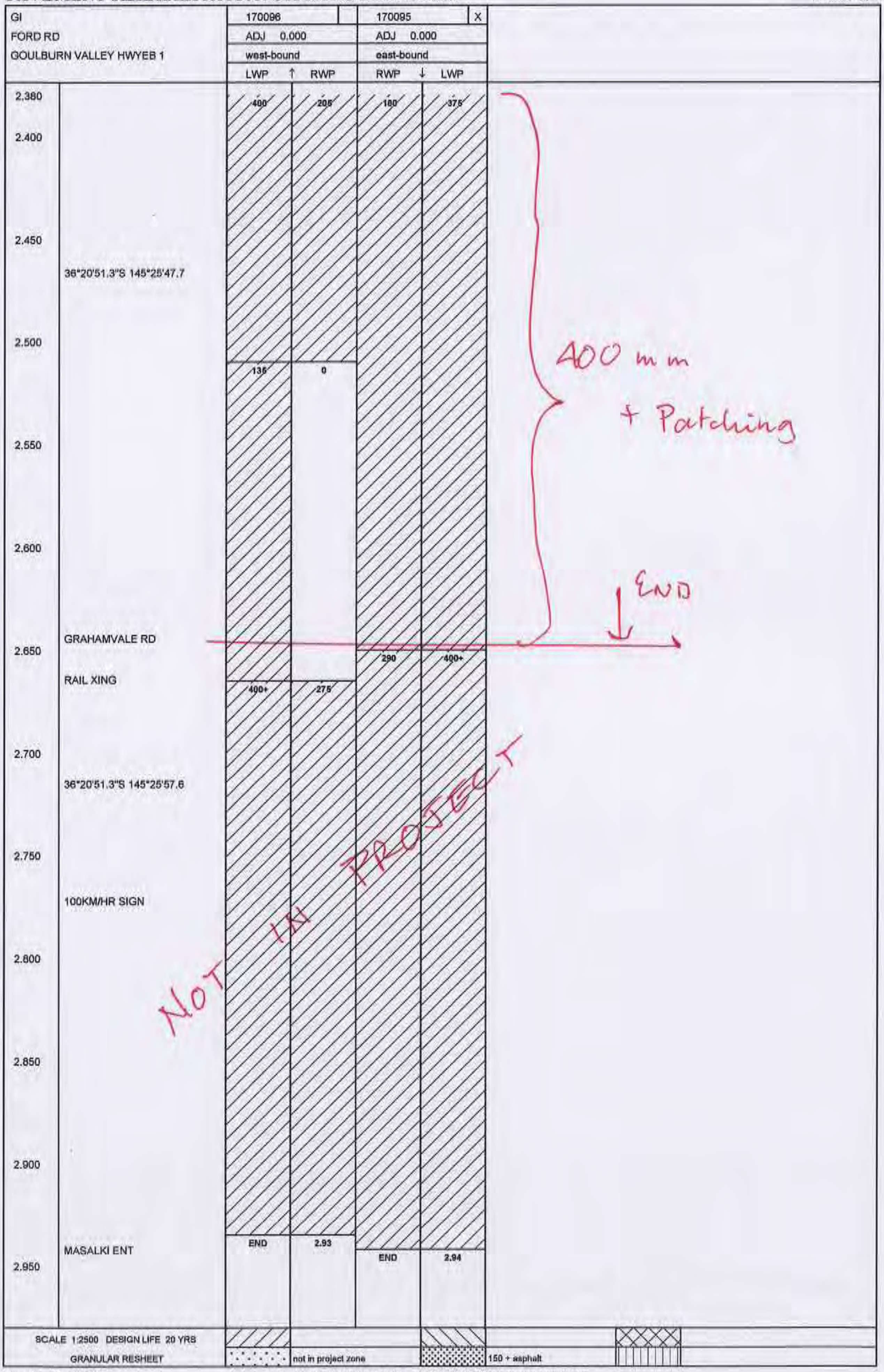
FORD RD

Granular

400 mm
+ Patching.

GRANULAR RESHEET REQUIREMENTS AND PAVEMENT REHABILITATION STRATEGY DIAGRAM

Sheet 5/5



Ford Rd_AC rehab/A GEOPAVE - VicRoads Analysed 30/05/17, Printed 30/05/17

ASPHALT OVERLAY REQUIREMENTS AND PAVEMENT REHABILITATION STRATEGY DIAGRAM

GI WANGANUI RD GOULBURN VALLEY HWY		170098		170097	X
		ADJ 0.000		ADJ 0.000	
				westbound	
		LWP ↑	RWP	RWP ↓	LWP
0.006	GOULBURN VALLEY HWY 36°20'50.2"S 145°24'07.5	150+/150+	115/150+	?/?	?/?
0.050					
0.100					
0.150	80KM/HR SIGN				
0.200					
0.250	36°20'51.5"S 145°23'58.0			135/150+	150+/150+
0.300					
0.350					
0.400				96/150+	150+/150+
0.450					
0.500	36°20'51.5"S 145°23'48.6				
0.550					
	80KM/HR SIGN				

WANGANUI RD

Asphalt

150+ mm

overlay

SCALE 1:2500 DESIGN LIFE 20 YRS

X/Y=DEFLECTION/CURVATURE OVERLAY

150 + asphalt

ASPHALT OVERLAY REQUIREMENTS AND PAVEMENT REHABILITATION STRATEGY DIAGRAM

GI / WANGANUI RD / GOULBURN VALLEY HWY		170098 / ADJ 0.000		170097 / ADJ 0.000 / westbound		WANGANUI RD
		LWP ↑	RWP	RWP ↓	LWP	X
0.600		150+/150+	115/150+	88/150+	150+/150+	
0.650						
0.700						
	36°20'51.5"S 145°23'38.9 TEMP 39					
0.750						150+ mm
0.800						
		150+/150+	70/150+			
0.850				50/150+	150+/150+	
0.900						
0.950						
	36°20'51.5"S 145°23'29.1					
1.000						
1.050						
		0/0	0/0	0/0	30/40	
1.100						
	80KM/HR SIGN					NIL o/lay
1.150						

SCALE 1:2500 DESIGN LIFE 20 YRS

X/Y=DEFLECTION/CURVATURE OVERLAY

150 + asphalt

ASPHALT OVERLAY REQUIREMENTS AND PAVEMENT REHABILITATION STRATEGY DIAGRAM

GI
WANGANUI RD
GOULBURN VALLEY HWY

		170098		170097	X
		ADJ 0.000		ADJ 0.000	
				westbound	
		LWP ↑	RWP	RWP ↓	LWP
1,194		0/0	0/0	0/0	30/40
	36°20'51.4"S 145°23'19.3				
1.250	WASTE TRANSFER STN				
		150+/150+	80/150+		
1.300					
				135/150+	95/150+
1.350					
	FREEMANS RD				
1.400				0/0	0/0
1.450					
	36°20'51.5"S 145°23'09.3			65/150+	130/150+
1.500	ENTRY TO DECA				
1.550	EXIT FROM DECA				
	80KM/HR SIGN				
1.600					
				75/150+	150/150+
1.650					
1.700					
	36°20'51.5"S 145°22'58.9				
1.750	CULVERT				
				55/150+	120/150+

WANGANUI RD

Nil overlay.

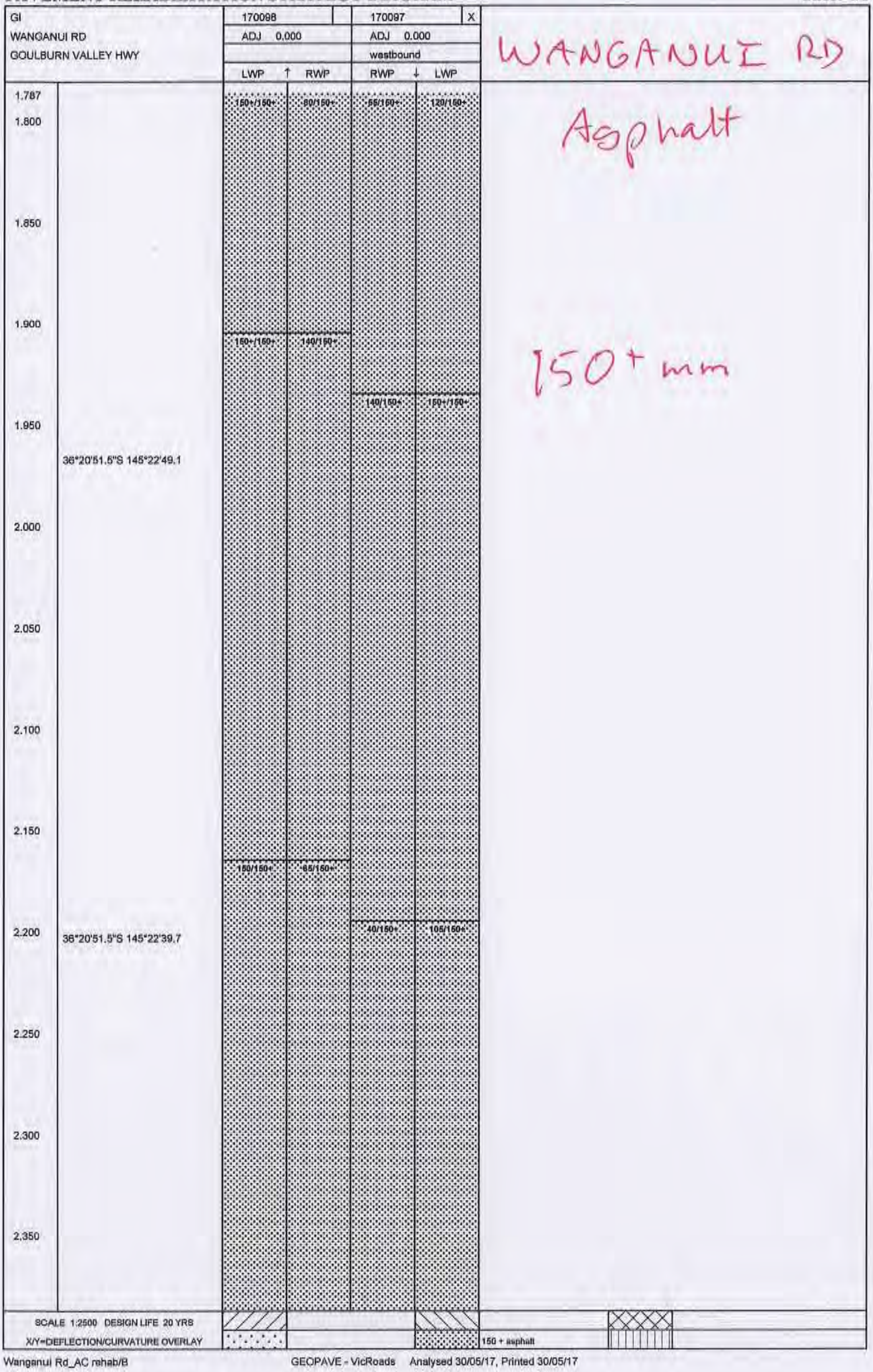
150+ mm overlay

SCALE 1:2500 DESIGN LIFE 20 YRS
X/Y=DEFLECTION/CURVATURE OVERLAY

150 + asphalt

ASPHALT OVERLAY REQUIREMENTS AND PAVEMENT REHABILITATION STRATEGY DIAGRAM

Sheet 4/6



Wanganui Rd_AC rehab/B GEOPAVE - VicRoads Analysed 30/05/17, Printed 30/05/17

ASPHALT OVERLAY REQUIREMENTS AND PAVEMENT REHABILITATION STRATEGY DIAGRAM

GI	170098	170097 X	
WANGANUI RD	ADJ 0.000	ADJ 0.000	WANGANUI RD
GOULBURN VALLEY HWY		westbound	
	LWP ↑ RWP	RWP ↓ LWP	

Chainage	Feature	LWP (170098)	RWP (170098)	Notes
2.381		150/150+	65/150+	Asphalt
		90/150+	30/150+	
2.400				
	KITTLES RD			
	36°20'51.5"S 145°22'29.9			
2.450				
2.500				150+mm overlay
2.550				
2.600				
2.650				
	GOTAFE ENT 36°20'51.5"S 145°22'20.3			
2.700				
2.750				
2.800				
2.850	RUDD RD			
2.900				
	36°20'51.5"S 145°22'10.4			
2.950	GOTAFE EXIT			

SCALE 1:2500 DESIGN LIFE 20 YRS

X/Y=DEFLECTION/CURVATURE OVERLAY

150 + asphalt

ASPHALT OVERLAY REQUIREMENTS AND PAVEMENT REHABILITATION STRATEGY DIAGRAM

Sheet 6/6

GI WANGANUI RD GOULBURN VALLEY HWY	170098 ADJ 0.000 LWP ↑ RWP	170097 X ADJ 0.000 westbound RWP ↓ LWP

WANGANUI RD

Asphalt

150mm + overlay.

Chainage	Features	170098 LWP	170098 RWP	170097 RWP	170097 LWP
2.975					
3.000					
3.050					
3.100					
3.150	36°20'51.4"S 145°22'00.8 REEDY SWAMP RD				
3.200	GOLF DR	END	3.23	END	3.24
3.250					
3.300					
3.350					
3.400					
3.450					
3.500					
3.550					

SCALE 1:2500 DESIGN LIFE 20 YRS

X/Y=DEFLECTION/CURVATURE OVERLAY

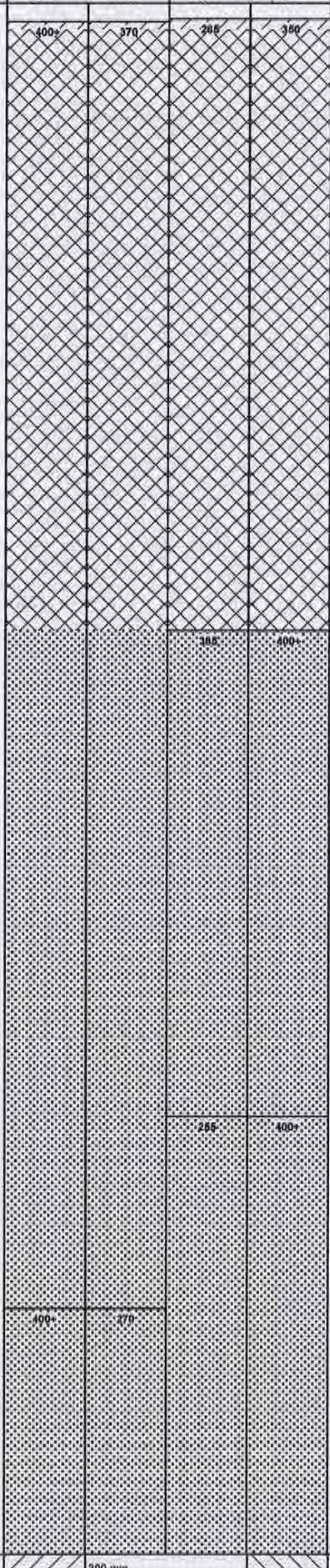
150 + asphalt

Wanganui Rd_AC rehab/B   GEOPAVE - VicRoads   Analysed 30/05/17, Printed 30/05/17

GRANULAR RESHEET REQUIREMENTS AND PAVEMENT REHABILITATION STRATEGY DIAGRAM

GI WANGANUI RD GOULBURN VALLEY HWY	170098 ADJ 0.000 east-bound LWP ↑ RWP	170097 X ADJ 0.000 west-bound RWP ↓ LWP	WANGANUI RD.

Chainage	Feature
0.006	GOULBURN VALLEY HWY 36°20'50.2"S 145°24'07.5
0.050	
0.100	
0.150	80KM/HR SIGN
0.200	
0.250	36°20'51.5"S 145°23'58.0
0.300	
0.350	
0.400	
0.450	
0.500	36°20'51.5"S 145°23'48.6
0.550	
	80KM/HR SIGN



GRANULAR

400 mm

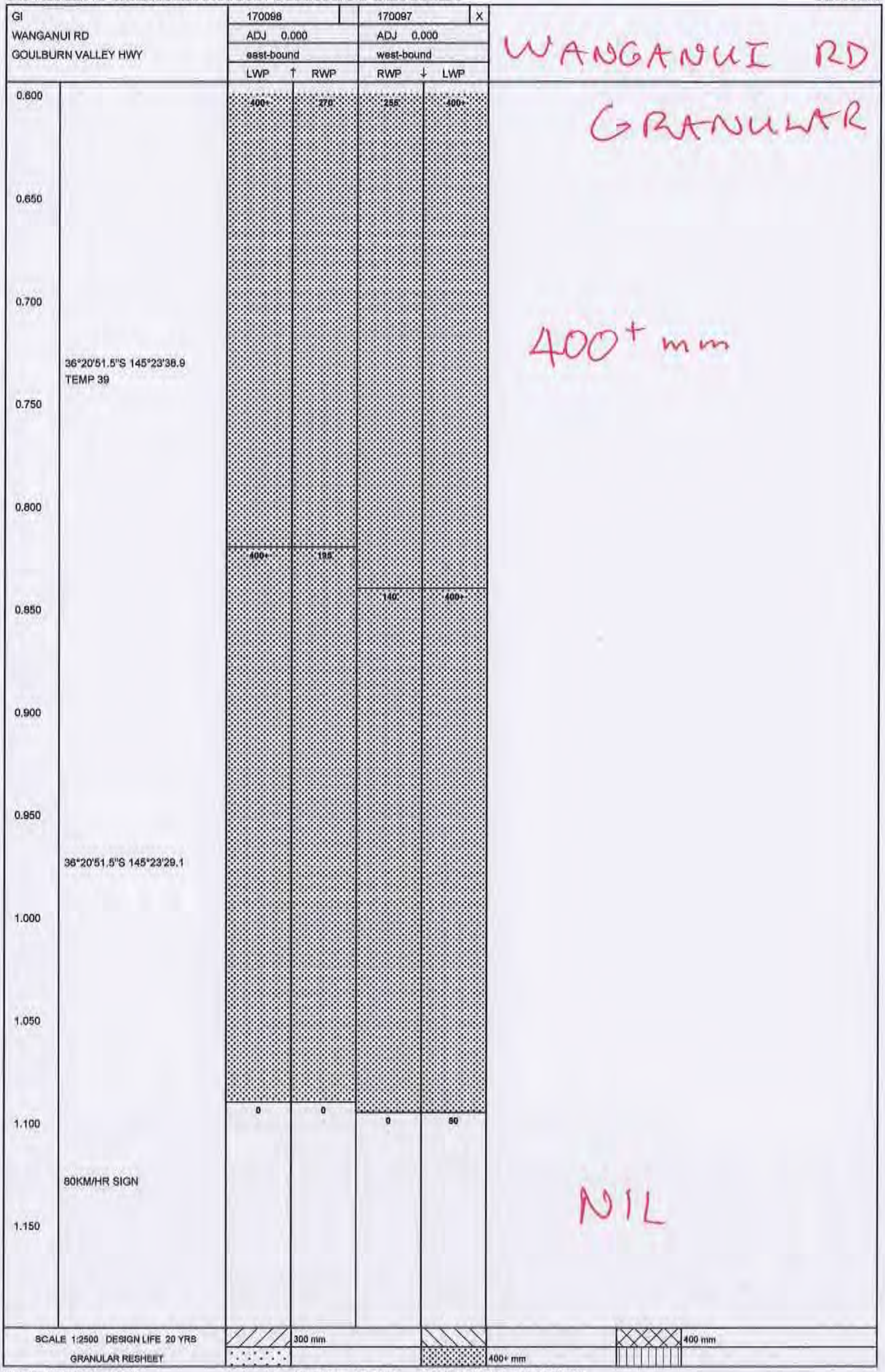
400+ mm

SCALE 1:2500 DESIGN LIFE 20 YRS	300 mm		400 mm
GRANULAR RESHEET		400+ mm	

Wanganui Rd_Gran rehab/A

GEOPAVE - VicRoads Analysed 30/05/17, Printed 30/05/17

GRANULAR RESHEET REQUIREMENTS AND PAVEMENT REHABILITATION STRATEGY DIAGRAM



GRANULAR RESHEET REQUIREMENTS AND PAVEMENT REHABILITATION STRATEGY DIAGRAM

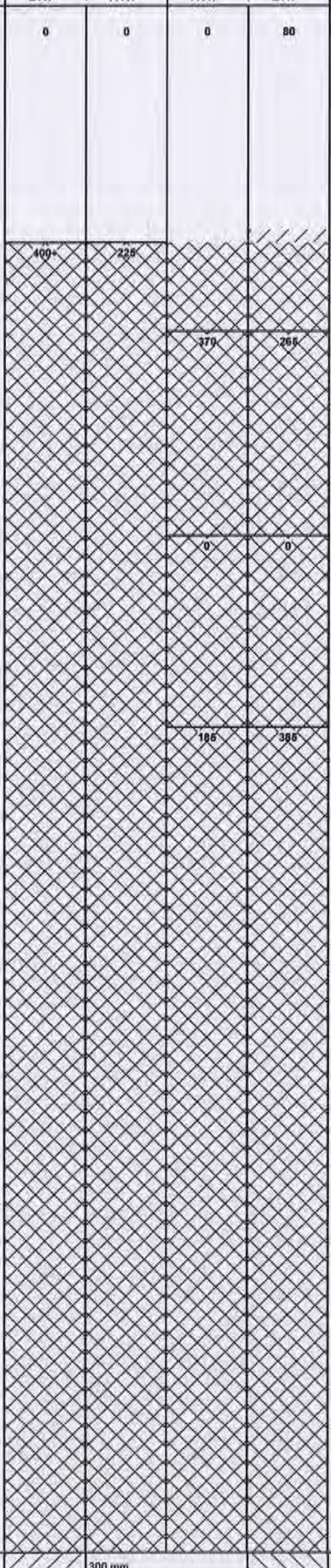
GI WANGANUI RD GOULBURN VALLEY HWY	170098 ADJ 0.000 east-bound LWP ↑ RWP	170097 X ADJ 0.000 west-bound RWP ↓ LWP

WANGANUI RD

GRANULAR

NIL

Chainage	Feature
1.194	
	36°20'51.4"S 145°23'19.3
1.250	WASTE TRANSFER STN
1.300	
1.350	
	FREEMANS RD
1.400	
1.450	
	36°20'51.5"S 145°23'09.3
1.500	ENTRY TO DECA
1.550	
	EXIT FROM DECA
	80KM/HR SIGN
1.600	
1.650	
1.700	
	36°20'51.5"S 145°22'58.9
1.750	
	CULVERT



400 mm

resheet

SCALE 1:2500 DESIGN LIFE 20 YRS

GRANULAR RESHEET

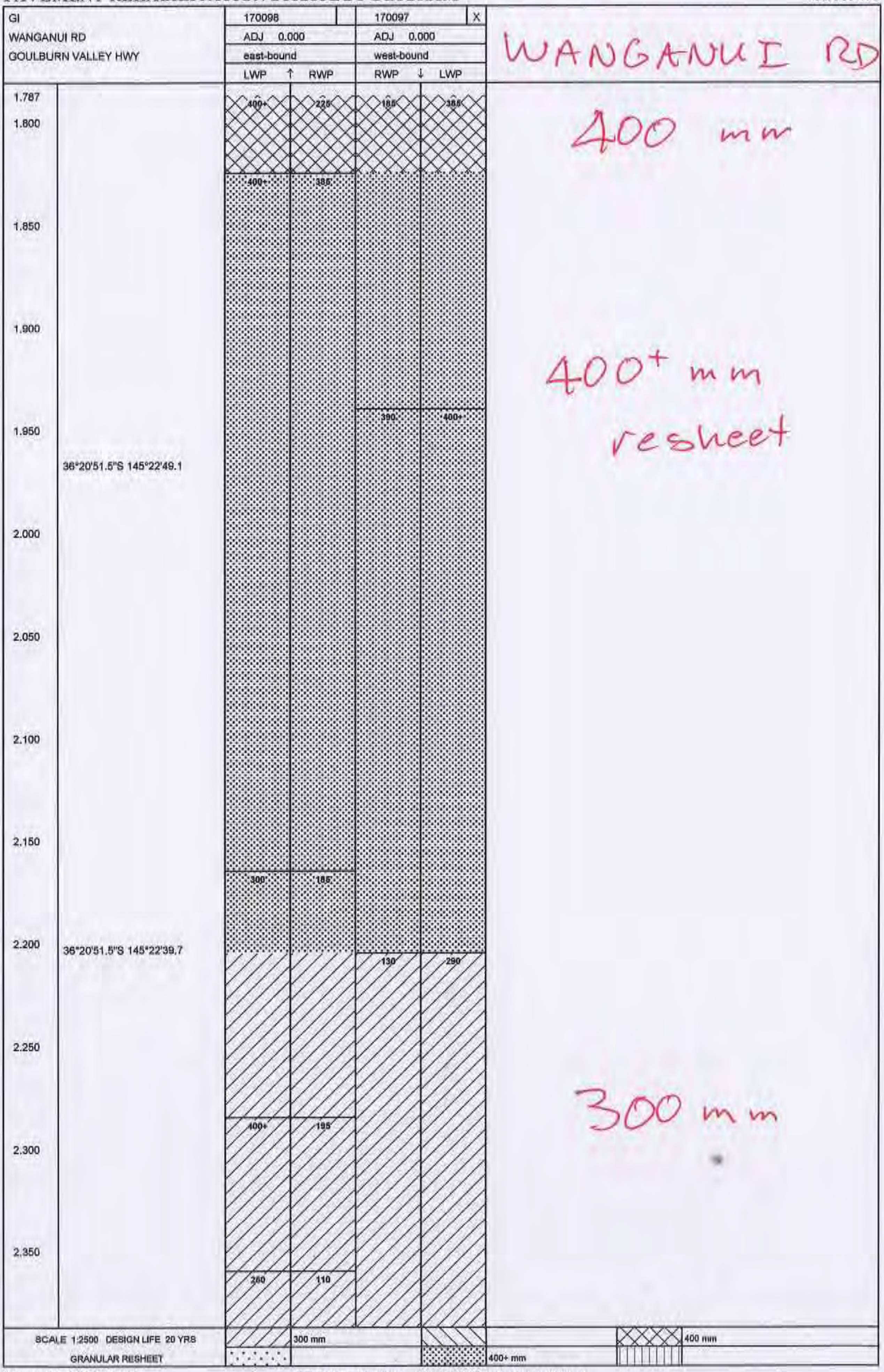
300 mm

400+ mm

400 mm

GRANULAR RESHEET REQUIREMENTS AND PAVEMENT REHABILITATION STRATEGY DIAGRAM

Sheet 4/6



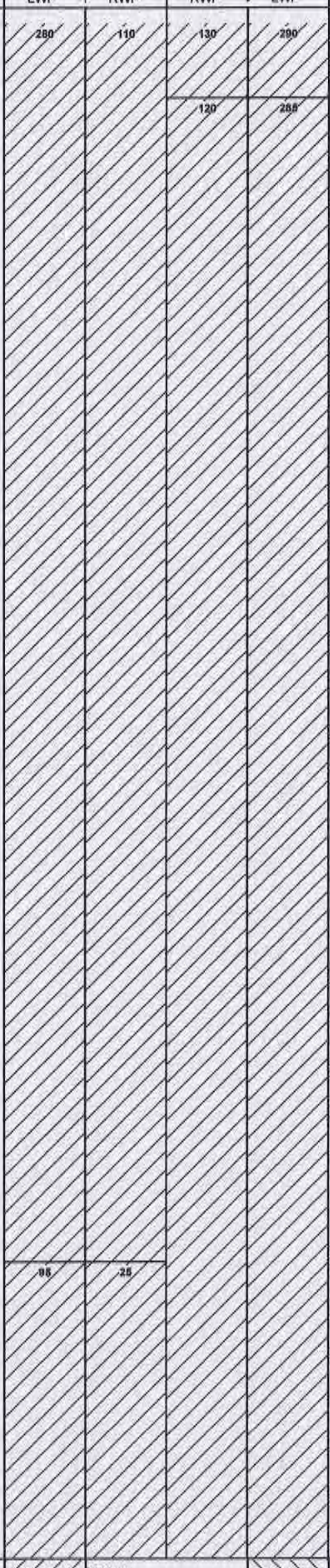
Wanganui Rd_Gran rehab/A GEOPAVE - VicRoads Analysed 30/05/17, Printed 30/05/17

GRANULAR RESHEET REQUIREMENTS AND PAVEMENT REHABILITATION STRATEGY DIAGRAM

Sheet 5/6

GI	170098	170097 X
WANGANUI RD	ADJ 0.000	ADJ 0.000
GOULBURN VALLEY HWY	east-bound	west-bound
	LWP ↑ RWP	RWP ↓ LWP

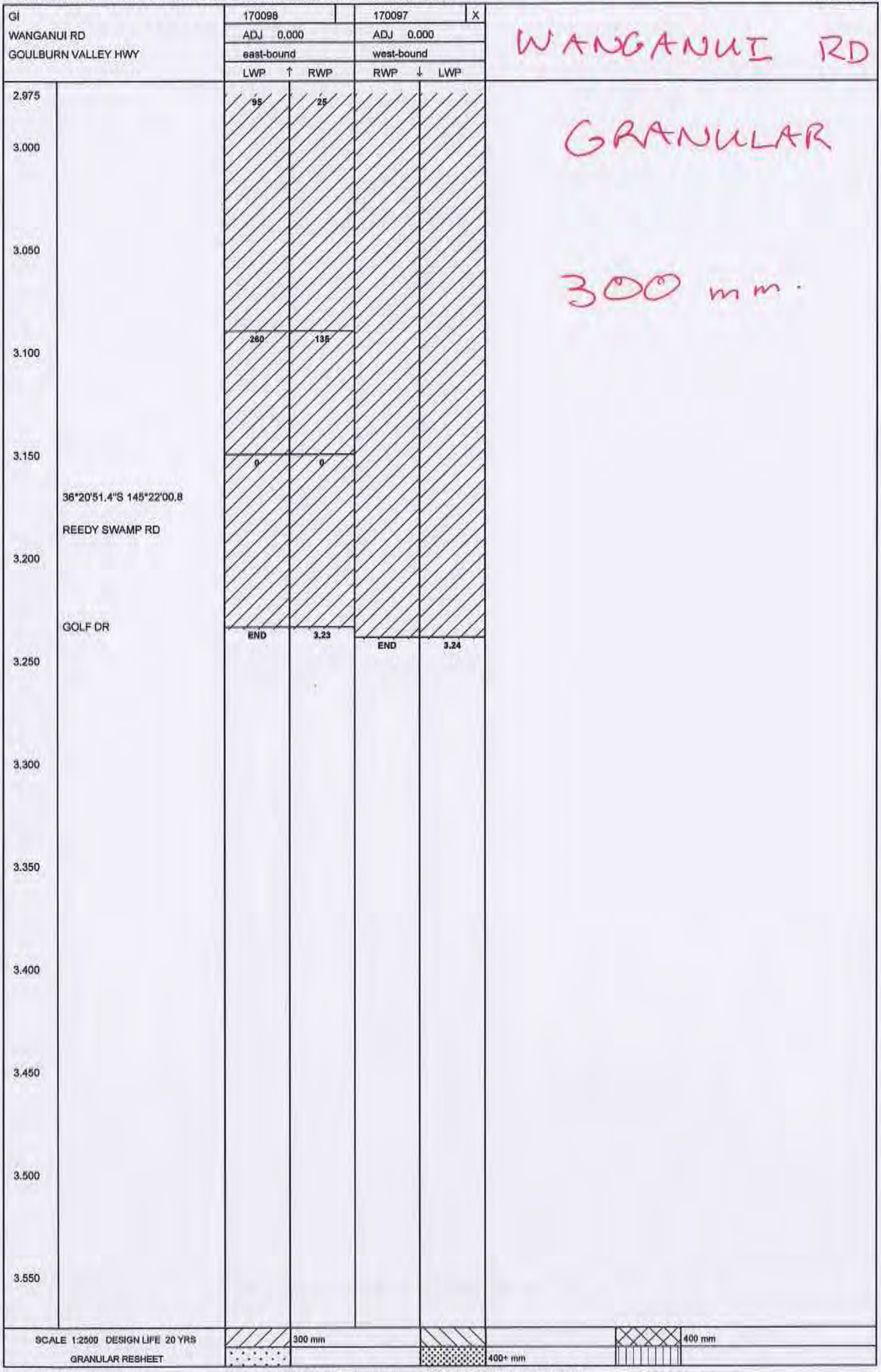
WANGANUI RD
Granular.



2.381
2.400
KITTLES RD
36°20'51.5"S 145°22'29.9
2.450
2.500
2.550
2.600
300 mm resheet
2.650
GOTAFE ENT
36°20'51.5"S 145°22'20.3
2.700
2.750
2.800
2.850
RUDD RD
2.900
36°20'51.5"S 145°22'10.4
2.950
GOTAFE EXIT

SCALE 1:2500 DESIGN LIFE 20 YRS
GRANULAR RESHEET
300 mm
400+ mm
400 mm

GRANULAR RESHEET REQUIREMENTS AND PAVEMENT REHABILITATION STRATEGY DIAGRAM



WANGANUI RD

GRANULAR

300 mm.

Appendix F

Costings

vicroads

Project Name	East-West Link Shepparton
Location	Wanganui Road - Golf Drive to Goulburn Valley Highway
Prepared by	Ajanthan Pillai
Business Area	Technical department
Estimate Date	18/01/2018

P90 Project Costs	$44,241,000	
State Program On Costs (4%)	$1,856,920	
On Costs - Unsuccessful Proposals (0.7%)	$324,961	
Final TEI	**$46,423,000**	**Effective Estimate Risk = 20%**

Endorsement of Risk Based Estimate			
Position	**Name (print)**	**Signature**	**Date**
Development Project Manager	Alex Blacket		
Development Team Leader	**Your Team Leader Name**		
Delivery Project Manager			
Delivery Team Leader			

Attachments:

Project Details

Estimate

Summary

Estimate Confidence

Est_Profile

Project:	East-West Link Shepparton
Location:	Wanganui Road - Golf Drive to Goulburn Valley Highway
Estimate Prepared By:	Ajanthan Pillai
Business Area:	Technical department
Estimate Date:	18/01/18
Estimate Approved By:	Craig Gist
Business Area:	Technical department
Date:	22/01/18

Item	Base	P50*	P90*
A Project & Program Management	$4,892,350	$5,780,000	$6,348,000
B Design and Investigation	$725,000	$770,000	$805,000
C Land Acquisition			
D Preconstruction & Construction	$30,459,000	$35,065,000	$36,257,000
SUB-TOTAL (Inherent Risks)	**Base Cost Estimate = $36,076,350**	$41,615,000	$43,410,000
E Contingent Risks		$767,000	$831,000
TOTAL (No Escalation)		$42,382,000	$44,241,000
Escalation		$0	$0
TOTAL (Including Escalation)		**Project Cost Estimate = $42,382,000**	**Total Estimated Investment (TEI) = $44,241,000**
Base Risk Allocation			**Base Risk Allocation = $6,305,650**
Contingency			**Contingency = $1,859,000**

	Base	P50*	P90*
A - PROJECT & PROGRAM MANAGEMENT			
A2 - Project Management - Development	$ 1,677,450	$ 1,981,800	$ 2,176,552
A3 - Project Management - Construction	$ 3,214,900	$ 3,798,200	$ 4,171,448
SUB-TOTAL	**$ 4,892,350**	**$ 5,780,000**	**$ 6,348,000**
B - DESIGN AND INVESTIGATION			
B1 - Planning Activities	$ 100,000	$ 106,207	$ 111,034
A1 - Project Management - Planning	$ 80,000	$ 84,966	$ 88,828
B2 - Ground Surveys	$ 120,000	$ 127,448	$ 133,241
B3 - Environmental Studies	$ 70,000	$ 74,345	$ 77,724
B5 - Detailed Design	$ 355,000	$ 377,034	$ 394,172
SUB-TOTAL	**$ 725,000**	**$ 770,000**	**$ 805,000**
D - PRECONSTRUCTION & CONSTRUCTION WORKS			
D1 - Contractor Management	$ 1,130,000	$ 1,300,878	$ 1,345,100
D5 - Site Preparation	$ 35,000	$ 40,293	$ 41,662
D6 - Utility Service Relocations	$ 4,205,000	$ 4,840,879	$ 5,005,440
D7 - Traffic Management	$ 930,000	$ 1,070,634	$ 1,107,029
D10 - Environmental Offsets	$ 43,500	$ 50,078	$ 51,780
D11 - Earthworks	$ 4,306,700	$ 4,957,958	$ 5,126,499
D24 - Landscaping	$ 5,244,000	$ 6,036,996	$ 6,242,218
D12 - Drainage	$ 5,300,000	$ 6,101,464	$ 6,308,878
D13 - Pavements	$ 6,214,500	$ 7,154,255	$ 7,397,456
D14 - Structures	$ 1,931,350	$ 2,223,408	$ 2,298,991
D17 - Traffic Signals & Lighting	$ 888,000	$ 1,022,283	$ 1,057,035
D23 - Signage, Linemarking, Road Furniture	$ 172,950	$ 199,103	$ 205,872
D25 - Maintenance	$ 58,000	$ 66,771	$ 69,041
SUB-TOTAL	**$ 30,459,000**	**$ 35,065,000**	**$ 36,257,000**
E - CONTINGENT RISKS			
E1 - Project Risks	$ 665,000	$ 767,000	$ 831,000
SUB-TOTAL	**$ 665,000**	**$ 767,000**	**$ 831,000**

***Note: The P50 and P90 values in the tables above are proportioned to ensure they add to the total cost P90 values. True P90 values are detailed in the Est_Confidence sheet.**

Project Cost Estimate Input

Project:	East-West Link Shepparton
Location:	Wanganui Road - Golf Drive to Goulburn Valley Highway
Estimate Prepared By:	Ajanthan Pillai
Business Area:	Technical department
Estimate Date:	18/01/2018
Estimate Approved By:	Craig Gist
Business Area:	Technical department
Date:	22/01/2018

No of Iterations	10000
Correlate between Cost Items?	No
Items to use in Time sheet:	Level 2 cost items
Check Federal Cost Items?	No

ITEM	Description	Level 1 Category	Level 2 Category	UNIT	Prob of Occurrence	QUANTITY				RATE				BASE ESTIMATE COST	COMMENTS
						Risk Profile - Quantity	Likely Quantity	Lowest Quantity	Highest Quantity	Risk Profile -Rate	Likely Rate	Lowest Rate	Highest Rate		
A	**PROJECT & PROGRAM MANAGEMENT**														
A1	**PROJECT PLANNING**														
A1.1	Project Planning/ Business Case	A - PROJECT & PROGRAM MANAGEMENT	A1 - Project Management - Planning												
A2	**PROJECT DEVELOPMENT**														
A2.1	VicRoads/ Council - Project Scoping, Scheduling & Reporting	A - PROJECT & PROGRAM MANAGEMENT	A2 - Project Management - Development	%	100%	Constant Value	1	1	1	-20% , +30%	5.00	4.00	6.50	1,597,450	
A2.2	Traffic Investigations	A - PROJECT & PROGRAM MANAGEMENT	A2 - Project Management - Development	Item	100%	Constant Value				User defined					
A2.3	Consultancy/ Concept Design	A - PROJECT & PROGRAM MANAGEMENT	A2 - Project Management - Development	Item	100%	Constant Value	1	1	1	Constant Value	80,000.00	80,000.00	80,000.00	80,000	
A3	**PROJECT MANAGEMENT CONSTRUCTION**														
A3.1	Contract administration / management	A - PROJECT & PROGRAM MANAGEMENT	A3 - Project Management - Construction	%	100%	Constant Value	1	1	1	-20% , +30%	10.00	8.00	13.00	3,194,900	
A3.2	Network Operations Advice	A - PROJECT & PROGRAM MANAGEMENT	A3 - Project Management - Construction	Item	100%	Constant Value	1	1	1	Constant Value	5,000.00	5,000.00	5,000.00	5,000	
A3.3	TMP Review	A - PROJECT & PROGRAM MANAGEMENT	A3 - Project Management - Construction	Item	100%	Constant Value	1	1	1	-10% , +30%	15,000.00	13,500.00	19,500.00	15,000	
A4	**STAKEHOLDER MANAGEMENT**														
A5	**PROGRAM ADMINISTRATION**														
A5.1	Overhead costs - unsuccessful jobs	A - PROJECT & PROGRAM MANAGEMENT	A5 - Program Administration												
A5.2	On costs - Road Safety Department (3%) [DO NOT INCLUDE HERE - Refer Cover Sheet]	A - PROJECT & PROGRAM MANAGEMENT	A5 - Program Administration												This item does not calculated accurately on this sheet. Therefore this item is included to the Final Summary Sheet
A5.3	On costs - State (4%) [DO NOT INCLUDE HERE - Refer Cover Sheet]	A - PROJECT & PROGRAM MANAGEMENT	A5 - Program Administration												This item does not calculated accurately on this sheet. Therefore this item is included to the Final Summary Sheet
B	**DESIGN AND INVESTIGATION**														
B1	**PLANNING ACTIVITIES**														
B1.2	Landscape designs	B - DESIGN AND INVESTIGATION	B1 - Planning Activities	Item	100%	Constant Value	1	1	1	-10% , +30%	100,000.00	90,000.00	130,000.00	100,000	
B1.3	Functional Design	B - DESIGN AND INVESTIGATION	A1 - Project Management - Planning	Item	100%	Constant Value	1	1	1	-10% , +30%	80,000.00	72,000.00	104,000.00	80,000	
B2	**GROUND SURVEYS**														
B2.1	Feature surveys	B - DESIGN AND INVESTIGATION	B2 - Ground Surveys	Item	100%	Constant Value	1	1	1	-10% , +30%	50,000.00	45,000.00	65,000.00	50,000	
B2.2	Service Proofing (detail)	B - DESIGN AND INVESTIGATION	B2 - Ground Surveys	Item	100%	Constant Value	1	1	1	-10% , +30%	70,000.00	63,000.00	91,000.00	70,000	
B3	**ENVIRONMENTAL STUDIES**														
B3.1	Detailed Cultural Heritage Studies	B - DESIGN AND INVESTIGATION	B3 - Environmental Studies	item	100%	Constant Value	1	1	1	-10% , +30%	35,000.00	31,500.00	45,500.00	35,000	
B3.2	Detailed Flora and Fauna Studies	B - DESIGN AND INVESTIGATION	B3 - Environmental Studies	item	100%	Constant Value	1	1	1	-10% , +30%	35,000.00	31,500.00	45,500.00	35,000	
B4	**REFERENCE DESIGN**		B4 - Reference Design												
B4.1	Reference Design	B - DESIGN AND INVESTIGATION													
B4.2	Reference Design 2	B - DESIGN AND INVESTIGATION													
B5	**DETAILED DESIGN**														
B5.1	Detailed road design (including final plans)	B - DESIGN AND INVESTIGATION	B5 - Detailed Design	Item	100%	Constant Value	1	1	1	-10% , +30%	300,000.00	270,000.00	390,000.00	300,000	
B5.2	Road Safety Audit	B - DESIGN AND INVESTIGATION	B5 - Detailed Design	Item	100%	Constant Value	1	1	1	-10% , +30%	55,000.00	49,500.00	71,500.00	55,000	
C	**LAND ACQUISITION**														
C1	**PROPERTY MANAGEMENT**	C - LAND ACQUISITION	C1 - Property Management	item	100%	Constant Value				User defined					
C1.1	Property Services	C - LAND ACQUISITION	C1 - Property Management												
C1.2	Title survey	C - LAND ACQUISITION	C1 - Property Management												
C1.3	Developing Plan of Subdivision	C - LAND ACQUISITION	C2 - Land Compensation												
C2	**LAND COMPENSATION**	C - LAND ACQUISITION	C2 - Land Compensation												
C2.1	Compensation Payments	C - LAND ACQUISITION	C2 - Land Compensation												
C2.2	Stamp Duties	C - LAND ACQUISITION	C2 - Land Compensation												
D	**PRECONSTRUCTION AND CONSTRUCTION WORKS**	D - PRECONSTRUCTION & CONSTRUCTION WORKS													
D1	**CONTRACTOR MANAGEMENT**	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D1 - Contractor Management												
D1.1	Site Establishment	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D1 - Contractor Management	Item	100%	Constant Value				-10% , +30%	100,000.00	90,000.00	130,000.00		
D1.2	Site Management & Supervision	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D1 - Contractor Management	week	100%	-5% , +30%	180	171	234	-10% , +30%	6,000.00	5,400.00	7,800.00	1,080,000	
D1.3	Service Relocation Management, programming, co-ordination of all service asset works including associated documentation	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D1 - Contractor Management	Item	100%	Constant Value	1	1	1	-10% , +30%	10,000.00	9,000.00	13,000.00	10,000	
D1.4	As Constructed Plans	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D1 - Contractor Management	Item	100%	Constant Value	1	1	1	-10% , +30%	20,000.00	18,000.00	26,000.00	20,000	
D1.5	Environment Management Plan	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D1 - Contractor Management	Item	100%	Constant Value	1	1	1	-10% , +30%	20,000.00	18,000.00	26,000.00	20,000	
D2	**CONTRACTOR'S OFFSITE OVERHEAD & MARGIN**	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D2 - Contractor's Offsite Overhead & Margin												
D3	**SPECIAL CONTRACTING COSTS**	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D3 - Special Contracting Costs												
D4	**DETAILED DESIGN**	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D4 - Detailed Design												
D5	**SITE PREPARATION**	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D5 - Site Preparation												
D5.1	Survey Set outs	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D5 - Site Preparation	item	100%	Constant Value	1	1	1	-10% , +30%	35,000.00	31,500.00	45,500.00	35,000	

Project Cost Estimate Input

Project:	East-West Link Shepparton
Location:	Wanganui Road - Golf Drive to Goulburn Valley Highway
Estimate Prepared By:	Ajanthan Pillai
Business Area:	Technical department
Estimate Date:	18/01/2018
Estimate Approved By:	Craig Gist
Business Area:	Technical department
Date:	22/01/2018

No of Iterations	10000
Correlate between Cost Items?	No
Items to use in Time sheet:	Level 2 cost items
Check Federal Cost Items?	No

ITEM	Description	Level 1 Category	Level 2 Category	UNIT	Prob of Occurrence	QUANTITY				RATE				BASE ESTIMATE COST	COMMENTS
						Risk Profile - Quantity	Likely Quantity	Lowest Quantity	Highest Quantity	Risk Profile -Rate	Likely Rate	Lowest Rate	Highest Rate		
D6	**UTILITY SERVICE RELOCATIONS**	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D6 - Utility Service Relocations												
D6.1	Power	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D6 - Utility Service Relocations	Item	100%	Constant Value	33	33	33	-5% , +40%	60,000.00	57,000.00	84,000.00	1,980,000	Operation and Maintenance contracts etc.
D6.2	Telecommunications (Telstra / Optus)	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D6 - Utility Service Relocations	Item	100%	Constant Value	1	1	1	-5% , +40%	700,000.00	665,000.00	980,000.00	700,000	
D6.3	Gas	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D6 - Utility Service Relocations	Item	100%	Constant Value	1	1	1	-5% , +40%	25,000.00	23,750.00	35,000.00	25,000	
D6.4	Water	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D6 - Utility Service Relocations	Item	100%	Constant Value	1	1	1	-5% , +40%	1,000,000.00	950,000.00	1,400,000.00	1,000,000	
D6.5	Sewerage	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D6 - Utility Service Relocations	Item	100%	Constant Value	1	1	1	-5% , +40%	500,000.00	475,000.00	700,000.00	500,000	
D7	**TRAFFIC MANAGEMENT**	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D7 - Traffic Management												
D7.1	Provision for Traffic Control	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D7 - Traffic Management	week	100%	-5% , +30%	180	171	234	-10% , +30%	5,000.00	4,500.00	6,500.00	900,000	
D7.2	Electronic Variable Message Sign	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D7 - Traffic Management	Item	100%	-5% , +30%	25	23.75	32.5	-10% , +30%	1,200.00	1,080.00	1,560.00	30,000	
D8	**RAIL MANAGEMENT**	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D8 - Rail Management												
D9	**ENVIRONMENTAL MANAGEMENT**	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D9 - Environmental Management												
D10	**ENVIRONMENTAL OFFSETS**	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D10 - Environmental Offsets												
D10.1	Planting trees	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D10 - Environmental Offsets	Item	100%	-5% , +30%	30	28.5	39	-10% , +30%	450.00	405.00	585.00	13,500	
D10.2	Habitats welfare	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D10 - Environmental Offsets	Item	100%	Constant Value	1	1	1	-10% , +30%	30,000.00	27,000.00	39,000.00	30,000	
D11	**EARTHWORKS**	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D11 - Earthworks												
D11.1	Lump Sum Allowance for Formation Construction	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D11 - Earthworks	Item	100%	**Constant Value**	**1**	**1**	**1**	**-10% , +30%**	250,000.00	**225,000.00**	**325,000.00**	250,000	
D11.2	Clearing & Grubbing	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D11 - Earthworks	m^2	100%	-5% , +30%	**105000**	**99750**	**136500**	-10% , +30%	3.00	**2.70**	**3.90**	315,000	
D11.3	Removal of Trees (significant), Includes grub up & cart away	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D11 - Earthworks	item	100%	-5% , +30%	**30**	**28.5**	**39**	-10% , +30%	1,000.00	**900.00**	**1,300.00**	30,000	
D11.4	Stripping & Stockpiling of Topsoil	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D11 - Earthworks	m^2	100%	-5% , +30%	**64800**	**61560**	**84240**	-10% , +30%	7.00	**6.30**	**9.10**	453,600	
D11.7	Earthworks - Cut to Fill	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D11 - Earthworks	m^3 solid	100%	-5% , +30%	**10000**	**9500**	**13000**	-10% , +30%	30.00	**27.00**	**39.00**	300,000	
D11.8	Earthworks - Cut to Waste (place "on-site")	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D11 - Earthworks	m^3 solid	100%	-5% , +30%	**20000**	**19000**	**26000**	-10% , +30%	25.00	**22.50**	**32.50**	500,000	
D11.9	Earthworks - Cut to waste (place "off site")	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D11 - Earthworks	m^3 solid	100%	-5% , +30%	**21000**	**19950**	**27300**	-5% , +50%	40.00	**38.00**	**60.00**	840,000	
D11.10	Earthworks - Import to Fill (type B material)	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D11 - Earthworks	m^3 solid	100%	-5% , +30%	**21500**	**20425**	**27950**	-5% , +50%	45.00	**42.75**	**67.50**	967,500	
D11.11	Construct Table Drains & Verges	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D11 - Earthworks	m	100%	-5% , +30%	**1200**	**1140**	**1560**	-10% , +30%	28.00	**25.20**	**36.40**	33,600	
D11.14	Topsoiling (include fertilising & seeding)	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D11 - Earthworks	m^2	100%	-5% , +30%	**30850**	**29307.5**	**40105**	-10% , +30%	20.00	**18.00**	**26.00**	617,000	
D11.15	Landscaping - Supply, Plant & Maintain	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D24 - Landscaping	m2	100%	**-5% , +30%**	**41200**	**39140**	**53560**	**-10% , +30%**	120.00	**108.00**	**156.00**	4,944,000	
D12	**DRAINAGE WORKS**	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D12 - Drainage												
D12.1	Lump Sum Allowance for drainage works	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D12 - Drainage	Item	100%	**User defined**				**User defined**	10,000.00	**7,000.00**	**13,000.00**		
D12.2	Supply & Install 450x300 RC Box Culvert	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D12 - Drainage	m	100%	-5% , +30%	**1200**	**1140**	**1560**	-10% , +30%	450.00	**405.00**	**585.00**	540,000	
D12.3	Supply & Install 2000x1500 RC Box Culvert	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D12 - Drainage	m	100%	-5% , +30%	**800**	**760**	**1040**	-10% , +30%	3,800.00	**3,420.00**	**4,940.00**	3,040,000	
D12.14	Supply & Install Class 2 375mm dia RCP	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D12 - Drainage	m	100%	-5% , +30%		**0**	**0**	User defined	250.00	**237.00**	**375.00**		
D12.15	Supply & Install Class 3 375mm dia RCP	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D12 - Drainage	m	100%	-5% , +30%	**5000**	**4750**	**6500**	-10% , +30%	200.00	**180.00**	**260.00**	1,000,000	
D12.24	Supply & Install Subsurface Drains (Fabric around trench) Type 2	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D12 - Drainage	m	100%	-5% , +30%	**6000**	**5700**	**7800**	-10% , +30%	55.00	**49.50**	**71.50**	330,000	
D12.25	Supply & Install Subsurface Drains (100mm sockfitted) Type 3	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D12 - Drainage	m	100%	-5% , +30%				-5% , +50%	50.00	**47.50**	**75.00**		
D12.26	Supply & Install Subsurface Drain Risers	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D12 - Drainage	No.	100%	-5% , +30%	**50**	**47.5**	**65**	-10% , +30%	600.00	**540.00**	**780.00**	30,000	
D12.27	Supply & Install Subsurface Drain Pit	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D12 - Drainage	No.	100%	-5% , +30%	**50**	**47.5**	**65**	-10% , +30%	800.00	**720.00**	**1,040.00**	40,000	
D12.28	Supply & Install Subsurface Drain Outlets	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D12 - Drainage	No.	100%	-5% , +30%				-5% , +50%	500.00	**475.00**	**750.00**		
D12.29	Supply & Install Junction Pits	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D12 - Drainage	No.	100%	-5% , +30%	**50**	**47.5**	**65**	-10% , +30%	2,000.00	**1,800.00**	**2,600.00**	100,000	
D12.30	Supply & Install SEP's (1.5m x 600 x 450)	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D12 - Drainage	No.	100%	-5% , +30%	**100**	**95**	**130**	-10% , +30%	2,200.00	**1,980.00**	**2,860.00**	220,000	
D12.38	Supply & Install Erosion Matting	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D12 - Drainage	m^2	100%	-5% , +30%				-5% , +50%	17.00	**16.15**	**25.50**		
D13	**PAVEMENT CONSTRUCTION**	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D13 - Pavements												
D13.1	Lump Sum Item for Pavement construction	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D13 - Pavements	Item	100%	**User defined**				**User defined**					
D13.3	Construct deep strength pavement, including wearing course (530mm depth)	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D13 - Pavements	m^2	100%	-5% , +30%	**38700**	**36765**	**50310**	-10% , +30%	160.00	**144.00**	**208.00**	6,192,000	
D13.5	Construct granular pavement, including double application seal (700mm depth)	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D13 - Pavements	m^2	100%	-5% , +30%				-5% , +50%	130.00	**123.50**	**195.00**		

Project Cost Estimate Input

Project:	East-West Link Shepparton
Location:	Wanganui Road - Golf Drive to Goulburn Valley Highway
Estimate Prepared By:	Ajanthan Pillai
Business Area:	Technical department
Estimate Date:	18/01/2018
Estimate Approved By:	Craig Gist
Business Area:	Technical department
Date:	22/01/2018

No of Iterations	10000
Correlate between Cost Items?	No
Items to use in Time sheet:	Level 2 cost items
Check Federal Cost Items?	No

ITEM	Description	Level 1 Category	Level 2 Category	UNIT	Prob of Occurrence	QUANTITY				RATE				BASE ESTIMATE COST	COMMENTS
						Risk Profile - Quantity	Likely Quantity	Lowest Quantity	Highest Quantity	Risk Profile -Rate	Likely Rate	Lowest Rate	Highest Rate		
	Individual Pavement Components														
D13.6	Rip, Mix & Compact Existing Pavement to 250mm	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D13 - Pavements	m^2	100%	-5% , +30%				-5% , +50%	6.00	**5.70**	**9.00**		
D13.7	Profiling	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D13 - Pavements	day	100%	-5% , +30%				User defined					
D13.8	Cold Planning	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D13 - Pavements	m^2	100%	-5% , +30%				-5% , +50%	30.00	**28.50**	**45.00**		
	Pavement Surfacing														
D13.29	Lump Sum Allowance	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D13 - Pavements	Item	100%	**User defined**				**User defined**					
D13.35	Asphalt - Supply & Place Wearing Course - Standard (V/H/HG)	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D13 - Pavements	Tonne	100%	-5% , +30%	**50**	**47.5**	**65**	-10% , +30%	450.00	**405.00**	**585.00**	22,500	
D14	**STRUCTURES & CONCRETE WORKS**	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D14 - Structures												
D14.1	Lump Sum Allowance for structural works - Bridge works	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D14 - Structures	Item	100%	Constant Value				-5% , +50%	**0.00**				
D14.15	Supply & Cast Kerb & Channel (SM2 & SM3)	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D14 - Structures	m	100%	-5% , +30%	**12190**	**11580.5**	**15847**	-10% , +20%	85.00	**76.50**	**102.00**	1,036,150	
D14.18	Concrete paving (200mm depth) with bedding	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D14 - Structures	m^2	100%	-5% , +30%				-10% , +30%	110.00	**99.00**	**143.00**		
D14.20	Construct Bicycle/Pedestrian Path	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D14 - Structures	m^2	100%	-5% , +30%	**13720**	**13034**	**17836**	-10% , +30%	60.00	**54.00**	**78.00**	823,200	
D14.21	Median Paving/Patterned Concrete	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D14 - Structures	m^2	100%	**-5% , +30%**	**400**	**380**	**520**	**-10% , +30%**	**80.00**	**72.00**	**104.00**	32,000	
D14.22	Relocate Bus Shelter	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D14 - Structures	No	100%	Constant Value	**2**	**2**	**2**	-10% , +30%	5,000.00	**4,500.00**	**6,500.00**	10,000	
D14.23	Bus Bays (reinforced concrete)	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D14 - Structures	No.	100%	Constant Value	**2**	**2**	**2**	-10% , +30%	15,000.00	**13,500.00**	**19,500.00**	30,000	
D14.24	3 m hgt Noise Fence	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D14 - Structures	lin m	100%	-5% , +30%				-5% , +50%	1,000.00	**950.00**	**1,500.00**		
D15	**BUILDING CONSTRUCTION WORKS**	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D15 - Buildings												
D16	**NOISE ATTENUATION WORKS**	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D16 - Noise Attenuation												
D16.1	Noise Attenuation Works	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D16 - Noise Attenuation												
D17	**TRAFFIC SIGNALS & LIGHTING**	D - PRECONSTRUCTION & CONSTRUCTION WORKS													
	Signal Installation														
	Street Lighting														
D17.70	Retirement of Existing Poles	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D17 - Traffic Signals & Lighting	No.	100%	Constant Value	**4**	**4**	**4**	-10% , +30%	2,000.00	**1,800.00**	**2,600.00**	8,000	
D17.71	New Lighting Pole (all inclusive)	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D17 - Traffic Signals & Lighting	No.	100%	-10% , +30%	**110**	**99**	**143**	-10% , +30%	8,000.00	**7,200.00**	**10,400.00**	880,000	
D18	**INTELLIGENT TRANSPORT SYSTEMS**	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D18 - Intelligent Transport Systems												
D18.1	Intelligent Transport System	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D18 - Intelligent Transport Systems	Item	100%	**Constant Value**				**-20% , +30%**		**0.00**	**0.00**		
D19	**RAIL TRACK WORKS**	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D19 - Rail Track												
D20	**RAIL POWER WORKS**	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D20 - Rail Power												
D21	**RAIL SIGNALLING WORKS**	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D21 - Rail Signalling												
D22	**RAIL COMMUNICATIONS WORKS**	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D22 - Rail Communications												
D23	**SIGNAGE, LINEMARKING, ROAD FURNITURE**	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D23 - Signage, Linemarking, Road Furniture												
D23.1	Lump Sum Allowance for Signs and Linemarking	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D23 - Signage, Linemarking, Road Furniture	Item	100%	**User defined**				**User defined**					
D23.2	Guideposts - Supply & Install	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D23 - Signage, Linemarking, Road Furniture	No.	100%	-5% , +30%				-5% , +50%	60.00	**57.00**	**90.00**		
D23.3	RRPM's - Supply & Install	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D23 - Signage, Linemarking, Road Furniture	each	100%	-5% , +30%				-5% , +50%	15.00	**14.25**	**22.50**		
	Guard fence & Wire Rope Safety Barrier														
D23.5	Guard fence - Supply & Erect (Armco) (>1km length)	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D23 - Signage, Linemarking, Road Furniture	m	100%	-5% , +30%				User defined	140.00	**130.00**	**180.00**		2014 reviewed Rates
D23.8	Breakaway Cable Terminal (BCTA/BCTB) (>10 terminals)	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D23 - Signage, Linemarking, Road Furniture	No.	100%	-5% , +30%				-5% , +50%	1,900.00	**1,805.00**	**2,850.00**		
D23.9	GREAT Guard Fence Terminal - Supply & Install	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D23 - Signage, Linemarking, Road Furniture	No.	100%	User defined				User defined	4,300.00	**3,000.00**	**6,000.00**		2014 reviewed Rates
D23.14	Wire Rope Safety Barrier - End Terminals (<10 terminals)	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D23 - Signage, Linemarking, Road Furniture	No.	100%	-5% , +30%				-5% , +50%	4,000.00	**3,800.00**	**6,000.00**		
D23.16	Install stac cushions	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D23 - Signage, Linemarking, Road Furniture	m	100%	-5% , +30%				-5% , +50%	45.00	**42.75**	**67.50**		
	Signage														
D23.17	Manufacture & Erect New Signing	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D23 - Signage, Linemarking, Road Furniture	Each	100%	-5% , +30%	**100**	**95**	**130**	-10% , +30%	450.00	**405.00**	**585.00**	45,000	

Project Cost Estimate Input

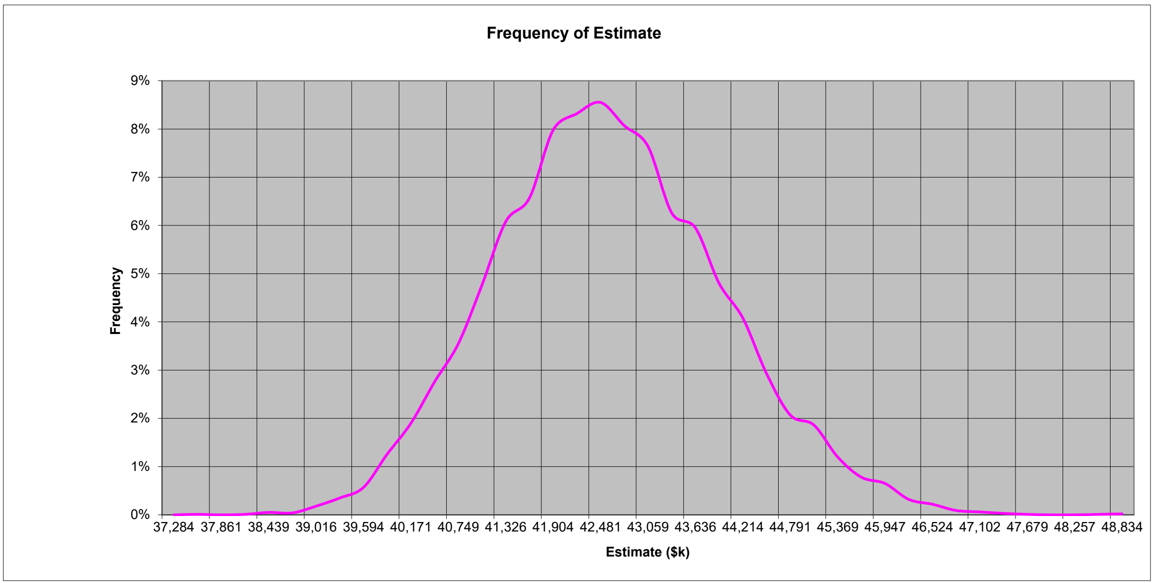
Project:	East-West Link Shepparton
Location:	Wanganui Road - Golf Drive to Goulburn Valley Highway
Estimate Prepared By:	Ajanthan Pillai
Business Area:	Technical department
Estimate Date:	18/01/2018
Estimate Approved By:	Craig Gist
Business Area:	Technical department
Date:	22/01/2018

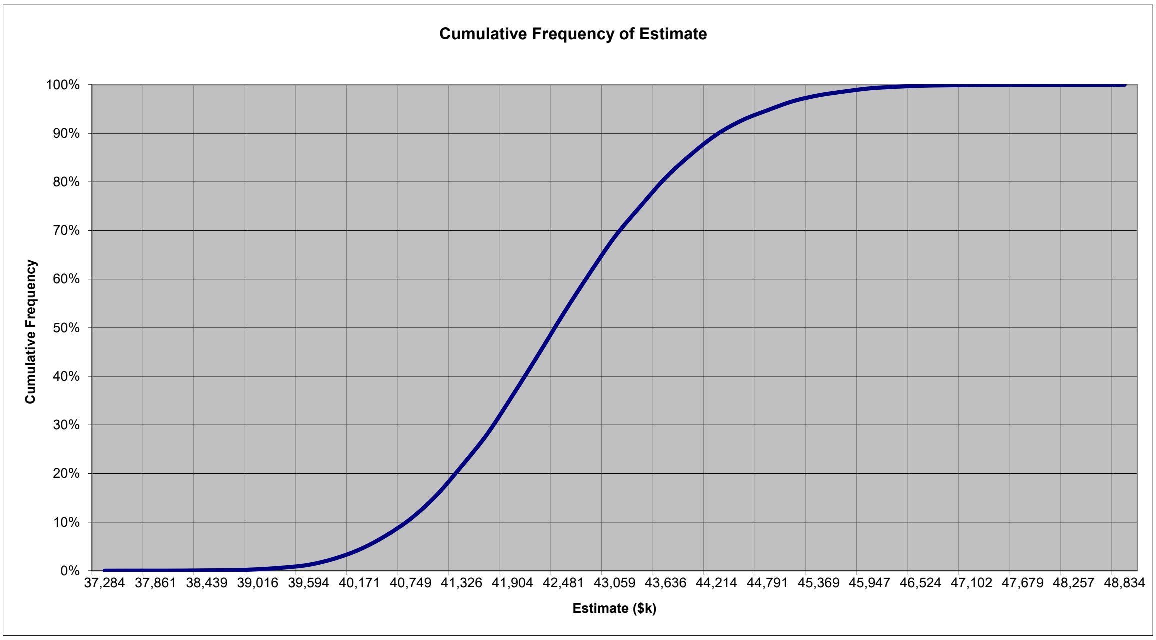
No of Iterations	10000
Correlate between Cost Items?	No
Items to use in Time sheet:	Level 2 cost items
Check Federal Cost Items?	No

ITEM	Description	Level 1 Category	Level 2 Category	UNIT	Prob of Occurrence	QUANTITY				RATE				BASE ESTIMATE COST	COMMENTS
						Risk Profile - Quantity	Likely Quantity	Lowest Quantity	Highest Quantity	Risk Profile -Rate	Likely Rate	Lowest Rate	Highest Rate		
D23.18	Remove Store & Re-erect Existing Signing Allowance	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D23 - Signage, Linemarking, Road Furniture	Each	100%	-5% , +30%	**25**	**23.75**	**32.5**	-10% , +30%	150.00	**135.00**	**195.00**	3,750	
D23.19	Supply and Install Single Metal Sign Posts	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D23 - Signage, Linemarking, Road Furniture	each	100%	-5% , +30%				-5% , +50%	200.00	**190.00**	**300.00**		
	Extruded Thermoplastic Linemarking														
D23.25	Linemarking - Select Road Standard…	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D23 - Signage, Linemarking, Road Furniture	Item	100%	-5% , +30%	**1**	**0.95**	**1.3**	-10% , +30%	80,000.00	**72,000.00**	**104,000.00**	80,000	
D23.26	Statcon holding bar blocks	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D23 - Signage, Linemarking, Road Furniture	block	100%	-5% , +30%				-5% , +50%	500.00	**475.00**	**750.00**		
D23.42	Profiled Edgline (<20km)	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D23 - Signage, Linemarking, Road Furniture	m	100%	-5% , +30%				-5% , +50%	5.00	**4.75**	**7.50**		
	Cold Applied Plastic Roadmarking														
	Linemarking Removal														
	DDA														
D23.66	Construct Kerb Ramp & Install TGSI	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D23 - Signage, Linemarking, Road Furniture	No.	100%	-5% , +30%	**26**	**24.7**	**33.8**	-10% , +30%	1,700.00	**1,530.00**	**2,210.00**	44,200	
D23.67	Reconstruct Kerb Ramp & Install TGSI (corner with LT slip lane)	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D23 - Signage, Linemarking, Road Furniture	No.	100%	-5% , +30%				-5% , +50%	1,700.00	**1,615.00**	**2,550.00**		
D24	**LANDSCAPING WORKS**	D - PRECONSTRUCTION & CONSTRUCTION WORKS													
D24.1	Landscaping works	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D24 - Landscaping	Item	100%	-5% , +30%	**1**	**0.95**	**1.3**	-10% , +30%	300,000.00	**270,000.00**	**390,000.00**	300,000	
D25	**MAINTENANCE**	D - PRECONSTRUCTION & CONSTRUCTION WORKS													
D25.1	Works Maintenance to Practical Completion	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D25 - Maintenance	Item	100%	Constant Value	1	1	1	-10% , +30%	40,000.00	36,000.00	52,000.00	40,000	
D25.2	Defects Management	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D25 - Maintenance	Item	100%	Constant Value	**1**	**1**	**1**	-10% , +30%	18,000.00	**16,200.00**	**23,400.00**	18,000	
E	**CONTINGENT RISKS**	E - CONTINGENT RISKS													
E1	**Project Risks**	E - CONTINGENT RISKS	E1 - Project Risks		80%	**User defined**				**User defined**					
E1.1	Service Relocation	E - CONTINGENT RISKS	E1 - Project Risks	item	100%	**-5% , +30%**	**1**	**0.95**	**1.3**	**-10% , +30%**	**300,000.00**	**270,000.00**	**390,000.00**	300,000	
E1.2	Removal of Trees	E - CONTINGENT RISKS	E1 - Project Risks	item	100%	**-5% , +30%**	**1**	**0.95**	**1.3**	**-10% , +30%**	**5,000.00**	**4,500.00**	**6,500.00**	5,000	
E1.3	Drainage Works	E - CONTINGENT RISKS	E1 - Project Risks	item	100%	**-5% , +30%**	**1**	**0.95**	**1.3**	**-10% , +30%**	**60,000.00**	**54,000.00**	**78,000.00**	60,000	
E1.4	Dayworks	E - CONTINGENT RISKS	E1 - Project Risks	Item	100%	-5% , +30%	**500**	**475**	**650**	-10% , +30%	**600.00**	**540.00**	**780.00**	300,000	
														Total = $36,741,350	

Project:	East-West Link Shepparton
Location:	Wanganui Road - Golf Drive to Goulburn Valley Highway
Estimate Prepared By:	Ajanthan Pillai
Business Area:	Technical department
Estimate Date:	18/01/18
Estimate Approved By:	Craig Gist
Business Area:	Technical department
Date:	22/01/18

Number of Iterations: 10,000 **Units** $ 1,000





TEC (NO PRICE ESCALATION)	Confidence Level		
	10%	50%	90%
	$40,706,880.80	$42,381,966.00	$44,240,967.20

Project Name	East-West Link Shepparton
Location	Wanganui Road/Ford Road/Goulburn Valley Highway Intersection
Prepared by	Ajanthan Pillai
Business Area	Technical department
Estimate Date	18/01/2018

P90 Project Costs	$8,509,000	
State Program On Costs (4%)	$357,160	
On Costs - Unsuccessful Proposals (0.7%)	$62,503	
Final TEI	**$8,929,000**	**Effective Estimate Risk = 20%**

Endorsement of Risk Based Estimate			
Position	**Name (print)**	**Signature**	**Date**
Development Project Manager	Alex Backet		
Development Team Leader	**Your Team Leader Name**		
Delivery Project Manager			
Delivery Team Leader			

Attachments:

Project Details

Estimate

Summary

Estimate Confidence

Est_Profile

Project:	East-West Link Shepparton
Location:	Wanganui Road/Ford Road/Goulburn Valley Highway Intersection
Estimate Prepared By:	Ajanthan Pillai
Business Area:	Technical department
Estimate Date:	18/01/18
Estimate Approved By:	Craig Gist
Business Area:	Technical department
Date:	22/12/17

Item	Base	P50*	P90*
A Project & Program Management	$953,973	$1,116,000	$1,225,000
B Design and Investigation	$199,500	$213,000	$221,000
C Land Acquisition			
D Preconstruction & Construction	$5,739,150	$6,540,000	$6,791,000
SUB-TOTAL (Inherent Risks)	**Base Cost Estimate = $6,892,623**	$7,869,000	$8,237,000
E Contingent Risks		$250,000	$272,000
TOTAL (No Escalation)		$8,119,000	$8,509,000
Escalation		$0	$0
TOTAL (Including Escalation)		**Project Cost Estimate = $8,119,000**	**Total Estimated Investment (TEI) = $8,509,000**
Base Risk Allocation			**Base Risk Allocation = $1,226,378**
Contingency			**Contingency = $390,000**

	Base	P50*	P90*
A - PROJECT & PROGRAM MANAGEMENT			
A2 - Project Management - Development	$ 324,158	$ 379,214	$ 416,252
A3 - Project Management - Construction	$ 624,815	$ 730,937	$ 802,328
A4 - Stakeholder Management	$ 5,000	$ 5,849	$ 6,421
SUB-TOTAL	**$ 953,973**	**$ 1,116,000**	**$ 1,225,000**
B - DESIGN AND INVESTIGATION			
B1 - Planning Activities	$ 40,000	$ 42,707	$ 44,311
A1 - Project Management - Planning	$ 25,000	$ 26,692	$ 27,694
B2 - Ground Surveys	$ 55,000	$ 58,722	$ 60,927
B3 - Environmental Studies	$ 10,000	$ 10,677	$ 11,078
B5 - Detailed Design	$ 69,500	$ 74,203	$ 76,990
SUB-TOTAL	**$ 199,500**	**$ 213,000**	**$ 221,000**
D - PRECONSTRUCTION & CONSTRUCTION WORKS			
D1 - Contractor Management	$ 252,000	$ 287,164	$ 298,186
D5 - Site Preparation	$ 10,000	$ 11,395	$ 11,833
D6 - Utility Service Relocations	$ 1,560,000	$ 1,777,685	$ 1,845,911
D7 - Traffic Management	$ 212,000	$ 241,583	$ 250,855
D10 - Environmental Offsets	$ 6,500	$ 7,407	$ 7,691
D11 - Earthworks	$ 476,850	$ 543,390	$ 564,245
D24 - Landscaping	$ 723,200	$ 824,116	$ 855,745
D12 - Drainage	$ 364,800	$ 415,705	$ 431,659
D13 - Pavements	$ 1,658,000	$ 1,889,360	$ 1,961,872
D14 - Structures	$ 274,600	$ 312,918	$ 324,928
D17 - Traffic Signals & Lighting	$ 106,000	$ 120,791	$ 125,427
D23 - Signage, Linemarking, Road Furniture	$ 81,200	$ 92,531	$ 96,082
D25 - Maintenance	$ 14,000	$ 15,954	$ 16,566
SUB-TOTAL	**$ 5,739,150**	**$ 6,540,000**	**$ 6,791,000**
E - CONTINGENT RISKS			
E1 - Project Risks	$ 218,000	$ 250,000	$ 272,000
SUB-TOTAL	**$ 218,000**	**$ 250,000**	**$ 272,000**

***Note: The P50 and P90 values in the tables above are proportioned to ensure they add to the total cost P90 values. True P90 values are detailed in the Est_Confidence sheet.**

Project Cost Estimate Input

Project:	East-West Link Shepparton
Location:	Wanganui Road/Ford Road/Goulburn Valley Highway Intersection
Estimate Prepared By:	Ajanthan Pillai
Business Area:	Technical department
Estimate Date:	18/01/2018
Estimate Approved By:	Craig Gist
Business Area:	Technical department
Date:	22/12/2017

No of Iterations	20000
Correlate between Cost Items?	No
Items to use in Time sheet:	Level 2 cost items
Check Federal Cost Items?	No

ITEM	Description	Level 1 Category	Level 2 Category	UNIT	Prob of Occurrence	QUANTITY Risk Profile - Quantity	Likely Quantity	Lowest Quantity	Highest Quantity	RATE Risk Profile -Rate	Likely Rate	Lowest Rate	Highest Rate	BASE ESTIMATE COST	COMMENTS
A	PROJECT & PROGRAM MANAGEMENT														
A1	PROJECT PLANNING														
A1.1	Project Planning/ Business Case	A - PROJECT & PROGRAM MANAGEMENT	A1 - Project Management - Planning												
A2	PROJECT DEVELOPMENT														
A2.1	VicRoads/ Council - Project Scoping, Scheduling & Reporting	A - PROJECT & PROGRAM MANAGEMENT	A2 - Project Management - Development	%	100%	Constant Value	1	1	1	-20% , +30%	5.00	4.00	6.50	309,158	
A2.2	Traffic Investigations	A - PROJECT & PROGRAM MANAGEMENT	A2 - Project Management - Development	Item	100%	Constant Value				User defined					
A2.3	Consultancy/ Concept Design	A - PROJECT & PROGRAM MANAGEMENT	A2 - Project Management - Development	Item	100%	Constant Value	1	1	1	Constant Value	15,000.00	15,000.00	15,000.00	15,000	
A3	PROJECT MANAGEMENT CONSTRUCTION														
A3.1	Contract administration / management	A - PROJECT & PROGRAM MANAGEMENT	A3 - Project Management - Construction	%	100%	Constant Value	1	1	1	-20% , +30%	10.00	8.00	13.00	618,315	
A3.2	Network Operations Advice	A - PROJECT & PROGRAM MANAGEMENT	A3 - Project Management - Construction	Item	100%	Constant Value	1	1	1	-10% , +30%	1,500.00	1,350.00	1,950.00	1,500	
A3.3	Signal Operations Advice	A - PROJECT & PROGRAM MANAGEMENT	A3 - Project Management - Construction	Item	100%	Constant Value	1	1	1	-10% , +30%	3,000.00	2,700.00	3,900.00	3,000	
A3.4	TMP Review	A - PROJECT & PROGRAM MANAGEMENT	A3 - Project Management - Construction	Item	100%	Constant Value	1	1	1	-10% , +30%	2,000.00	1,800.00	2,600.00	2,000	
A4	STAKEHOLDER MANAGEMENT														
A4.1	Stakeholder Management	A - PROJECT & PROGRAM MANAGEMENT	A4 - Stakeholder Management	Item	100%	Constant Value	1	1	1	-10% , +30%	5,000.00	4,500.00	6,500.00	5,000	
A5	PROGRAM ADMINISTRATION														
A5.1	Overhead costs - unsuccessful jobs	A - PROJECT & PROGRAM MANAGEMENT	A5 - Program Administration												
A5.2	On costs - Road Safety Department (3%) [DO NOT INCLUDE HERE - Refer Cover Sheet]	A - PROJECT & PROGRAM MANAGEMENT	A5 - Program Administration												This item does not calculated accurately on this sheet. Therefore this item is included to the Final Summary Sheet
A5.3	On costs - State (4%) [DO NOT INCLUDE HERE - Refer Cover Sheet]	A - PROJECT & PROGRAM MANAGEMENT	A5 - Program Administration												This item does not calculated accurately on this sheet. Therefore this item is included to the Final Summary Sheet
B	DESIGN AND INVESTIGATION														
B1	PLANNING ACTIVITIES														
B1.2	Landscape designs	B - DESIGN AND INVESTIGATION	B1 - Planning Activities	Item	100%	Constant Value	1	1	1	-10% , +30%	40,000.00	36,000.00	52,000.00	40,000	
B1.3	Functional Design	B - DESIGN AND INVESTIGATION	A1 - Project Management - Planning	Item	100%	Constant Value	1	1	1	-10% , +30%	25,000.00	22,500.00	32,500.00	25,000	
B2	GROUND SURVEYS														
B2.1	Feature surveys	B - DESIGN AND INVESTIGATION	B2 - Ground Surveys	Item	100%	Constant Value	1	1	1	-10% , +30%	20,000.00	18,000.00	26,000.00	20,000	
B2.2	Service Proofing (detail)	B - DESIGN AND INVESTIGATION	B2 - Ground Surveys	Item	100%	Constant Value	1	1	1	-10% , +30%	35,000.00	31,500.00	45,500.00	35,000	
B3	ENVIRONMENTAL STUDIES														
B3.1	Detailed Cultural Heritage Studies	B - DESIGN AND INVESTIGATION	B3 - Environmental Studies	item	100%	Constant Value	1	1	1	-10% , +30%	5,000.00	4,500.00	6,500.00	5,000	
B3.2	Detailed Flora and Fauna Studies	B - DESIGN AND INVESTIGATION	B3 - Environmental Studies	item	100%	Constant Value	1	1	1	-10% , +30%	5,000.00	4,500.00	6,500.00	5,000	
B4	REFERENCE DESIGN		B4 - Reference Design												
B4.1	Reference Design	B - DESIGN AND INVESTIGATION													
B4.2	Reference Design 2	B - DESIGN AND INVESTIGATION													
B5	DETAILED DESIGN														
B5.1	Detailed road design (including final plans)	B - DESIGN AND INVESTIGATION	B5 - Detailed Design	Item	100%	Constant Value	1	1	1	-10% , +30%	65,000.00	58,500.00	84,500.00	65,000	
B5.2	Road Safety Audit	B - DESIGN AND INVESTIGATION	B5 - Detailed Design	Item	100%	Constant Value	1	1	1	-10% , +30%	4,500.00	4,050.00	5,850.00	4,500	
C	LAND ACQUISITION														
C1	PROPERTY MANAGEMENT	C - LAND ACQUISITION	C1 - Property Management	item	100%	Constant Value				User defined					
C1.1	Property Services	C - LAND ACQUISITION	C1 - Property Management												
C1.2	Title survey	C - LAND ACQUISITION	C1 - Property Management												
C1.3	Developing Plan of Subdivision	C - LAND ACQUISITION	C2 - Land Compensation												
C2	LAND COMPENSATION	C - LAND ACQUISITION	C2 - Land Compensation												
C2.1	Compensation Payments	C - LAND ACQUISITION	C2 - Land Compensation												
C2.2	Stamp Duties	C - LAND ACQUISITION	C2 - Land Compensation												
D	PRECONSTRUCTION AND CONSTRUCTION WORKS	D - PRECONSTRUCTION & CONSTRUCTION WORKS													
D1	CONTRACTOR MANAGEMENT	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D1 - Contractor Management												
D1.1	Site Establishment	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D1 - Contractor Management	Item	100%	Constant Value				-10% , +30%	20,000.00	18,000.00	26,000.00		
D1.2	Site Management & Supervision	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D1 - Contractor Management	week	100%	-5% , +30%	40	38	52	-10% , +30%	6,000.00	5,400.00	7,800.00	240,000	
D1.4	Service Relocation Management, programming, co-ordination of all service asset works including associated documentation	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D1 - Contractor Management	Item	100%	Constant Value	1	1	1	-10% , +30%	5,000.00	4,500.00	6,500.00	5,000	
D1.5	As Constructed Plans	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D1 - Contractor Management	Item	100%	Constant Value	1	1	1	-10% , +30%	4,000.00	3,600.00	5,200.00	4,000	
D1.6	Environment Management Plan	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D1 - Contractor Management	Item	100%	Constant Value	1	1	1	-10% , +30%	3,000.00	2,700.00	3,900.00	3,000	
D2	CONTRACTOR'S OFFSITE OVERHEAD & MARGIN	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D2 - Contractor's Offsite Overhead & Margin												
D3	SPECIAL CONTRACTING COSTS	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D3 - Special Contracting Costs												
D4	DETAILED DESIGN	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D4 - Detailed Design												

Project Cost Estimate Input

Project:	East-West Link Shepparton
Location:	Wanganui Road/Ford Road/Goulburn Valley Highway Intersection
Estimate Prepared By:	Ajanthan Pillai
Business Area:	Technical department
Estimate Date:	18/01/2018
Estimate Approved By:	Craig Gist
Business Area:	Technical department
Date:	22/12/2017

No of Iterations	20000
Correlate between Cost Items?	No
Items to use in Time sheet:	Level 2 cost items
Check Federal Cost Items?	No

ITEM	Description	Level 1 Category	Level 2 Category	UNIT	Prob of Occurrence	QUANTITY				RATE				BASE ESTIMATE COST	COMMENTS
						Risk Profile - Quantity	Likely Quantity	Lowest Quantity	Highest Quantity	Risk Profile -Rate	Likely Rate	Lowest Rate	Highest Rate		
D5	**SITE PREPARATION**	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D5 - Site Preparation												
D5.5	Survey Set outs	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D5 - Site Preparation	item	100%	Constant Value	1	1	1	-10% , +30%	10,000.00	9,000.00	13,000.00	10,000	
D6	**UTILITY SERVICE RELOCATIONS**	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D6 - Utility Service Relocations												
D6.1	Power	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D6 - Utility Service Relocations	Item	100%	Constant Value	5	5	5	-5% , +40%	60,000.00	57,000.00	84,000.00	300,000	Operation and Maintenance contracts etc.
D6.2	Telecommunications (Telstra / Optus)	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D6 - Utility Service Relocations	Item	100%	Constant Value	1	1	1	-5% , +40%	650,000.00	617,500.00	910,000.00	650,000	
D6.3	Gas	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D6 - Utility Service Relocations	Item	100%	Constant Value	1	1	1	-5% , +40%	80,000.00	76,000.00	112,000.00	80,000	
D6.4	Water	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D6 - Utility Service Relocations	Item	100%	Constant Value	1	1	1	-5% , +40%	80,000.00	76,000.00	112,000.00	80,000	
D6.5	Sewerage	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D6 - Utility Service Relocations	Item	100%	Constant Value	1	1	1	-5% , +40%	450,000.00	427,500.00	630,000.00	450,000	
D7	**TRAFFIC MANAGEMENT**	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D7 - Traffic Management												
D7.1	Provision for Traffic Control	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D7 - Traffic Management	week	100%	-5% , +30%	40	38	52	-10% , +30%	5,000.00	4,500.00	6,500.00	200,000	
D7.2	Electronic Variable Message Sign	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D7 - Traffic Management	Item	100%	-5% , +30%	10	9.5	13	-10% , +30%	1,200.00	1,080.00	1,560.00	12,000	
D8	**RAIL MANAGEMENT**	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D8 - Rail Management												
D9	**ENVIRONMENTAL MANAGEMENT**	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D9 - Environmental Management												
D10	**ENVIRONMENTAL OFFSETS**	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D10 - Environmental Offsets												
D10.1	Planting trees	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D10 - Environmental Offsets	Item	100%	-5% , +30%	10	9.5	13	-10% , +30%	450.00	405.00	585.00	4,500	
D10.2	Habitats welfare	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D10 - Environmental Offsets	Item	100%	Constant Value	1	1	1	-10% , +30%	2,000.00	1,800.00	2,600.00	2,000	
D11	**EARTHWORKS**	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D11 - Earthworks												
D11.1	Lump Sum Allowance for Formation Construction	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D11 - Earthworks	Item	100%	**Constant Value**	**1**	**1**	**1**	**-10% , +30%**	30,000.00	**27,000.00**	**39,000.00**	30,000	
D11.2	Clearing & Grubbing	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D11 - Earthworks	m^2	100%	-5% , +30%	**13500**	**12825**	**17550**	-10% , +30%	3.00	**2.70**	**3.90**	40,500	
D11.3	Removal of Trees (significant), Includes grub up & cart away	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D11 - Earthworks	item	100%	-5% , +30%	**5**	**4.75**	**6.5**	-10% , +30%	1,000.00	**900.00**	**1,300.00**	5,000	
D11.4	Stripping & Stockpiling of Topsoil	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D11 - Earthworks	m^2	100%	-5% , +30%	**4000**	**3800**	**5200**	-10% , +30%	7.00	**6.30**	**9.10**	28,000	
D11.7	Earthworks - Cut to Fill	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D11 - Earthworks	m^3 solid	100%	-5% , +30%	**1800**	**1710**	**2340**	-10% , +30%	30.00	**27.00**	**39.00**	54,000	
D11.8	Earthworks - Cut to Waste (place "on-site")	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D11 - Earthworks	m^3 solid	100%	-5% , +30%	**2500**	**2375**	**3250**	-10% , +30%	25.00	**22.50**	**32.50**	62,500	
D11.9	Earthworks - Cut to waste (place "off site")	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D11 - Earthworks	m^3 solid	100%	-5% , +30%	**1500**	**1425**	**1950**	-5% , +50%	40.00	**38.00**	**60.00**	60,000	
D11.10	Earthworks - Import to Fill (type B material)	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D11 - Earthworks	m^3 solid	100%	-5% , +30%	**2250**	**2137.5**	**2925**	-5% , +50%	45.00	**42.75**	**67.50**	101,250	
D11.11	Construct Table Drains & Verges	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D11 - Earthworks	m	100%	-5% , +30%	**200**	**190**	**260**	-10% , +30%	28.00	**25.20**	**36.40**	5,600	
D11.14	Topsoiling (include fertilising & seeding)	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D11 - Earthworks	m^2	100%	-5% , +30%	**4500**	**4275**	**5850**	-10% , +30%	20.00	**18.00**	**26.00**	90,000	
D11.15	Landscaping - Supply, Plant & Maintain	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D24 - Landscaping	m2	100%	**-5% , +30%**	**4360**	**4142**	**5668**	**-10% , +30%**	120.00	**108.00**	**156.00**	523,200	
D12	**DRAINAGE WORKS**	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D12 - Drainage												
D12.1	Lump Sum Allowance for drainage works	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D12 - Drainage	Item	100%	**User defined**				**User defined**	10,000.00	**7,000.00**	**13,000.00**		
D12.2	Supply & Install 450x300 RC Box Culvert	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D12 - Drainage	m	100%	-5% , +30%	**200**	**190**	**260**	-10% , +30%	450.00	**405.00**	**585.00**	90,000	
D12.3	Supply & Install 600x300 RC Box Culvert	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D12 - Drainage	m	100%	-5% , +30%				-5% , +50%	500.00	**475.00**	**750.00**		
D12.15	Supply & Install Class 3 375mm dia RCP	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D12 - Drainage	m	100%	-5% , +30%	**200**	**190**	**260**	-10% , +30%	250.00	**225.00**	**325.00**	50,000	
D12.16	Supply & Install Class 2 450mm dia RCP	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D12 - Drainage	m	100%	-5% , +30%				-5% , +50%	320.00	**304.00**	**480.00**		
D12.23	Supply & Install Wingwalls	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D12 - Drainage	No.	100%	-5% , +30%				-5% , +50%	1,450.00	**1,377.50**	**2,175.00**		
D12.24	Supply & Install Subsurface Drains (Fabric around trench) Type 2	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D12 - Drainage	m	100%	-5% , +30%	**1960**	**1862**	**2548**	-10% , +30%	55.00	**49.50**	**71.50**	107,800	
D12.26	Supply & Install Subsurface Drain Risers	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D12 - Drainage	No.	100%	-5% , +30%	**15**	**14.25**	**19.5**	-10% , +30%	600.00	**540.00**	**780.00**	9,000	
D12.27	Supply & Install Subsurface Drain Pit	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D12 - Drainage	No.	100%	-5% , +30%	**15**	**14.25**	**19.5**	-10% , +30%	800.00	**720.00**	**1,040.00**	12,000	
D12.29	Supply & Install Junction Pits	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D12 - Drainage	No.	100%	-5% , +30%	**15**	**14.25**	**19.5**	-10% , +30%	2,000.00	**1,800.00**	**2,600.00**	30,000	
D12.30	Supply & Install SEP's (1.5m x 600 x 450)	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D12 - Drainage	No.	100%	-5% , +30%	**30**	**28.5**	**39**	-10% , +30%	2,200.00	**1,980.00**	**2,860.00**	66,000	
D13	**PAVEMENT CONSTRUCTION**	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D13 - Pavements												
D13.1	Lump Sum Item for Pavement construction	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D13 - Pavements	Item	100%	**User defined**				**User defined**					
D13.3	Construct deep strength pavement, including wearing course (530mm depth)	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D13 - Pavements	m^2	100%	-5% , +30%	**9800**	**9310**	**12740**	-10% , +30%	160.00	**144.00**	**208.00**	1,568,000	
D13.4	Construct granular pavement, including double application seal (550mm depth)	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D13 - Pavements	m^2	100%	-5% , +30%				-5% , +50%	90.00	**85.50**	**135.00**		

Project Cost Estimate Input

Project:	East-West Link Shepparton
Location:	Wanganui Road/Ford Road/Goulburn Valley Highway Intersection
Estimate Prepared By:	Ajanthan Pillai
Business Area:	Technical department
Estimate Date:	18/01/2018
Estimate Approved By:	Craig Gist
Business Area:	Technical department
Date:	22/12/2017

No of Iterations	20000
Correlate between Cost Items?	No
Items to use in Time sheet:	Level 2 cost items
Check Federal Cost Items?	No

ITEM	Description	Level 1 Category	Level 2 Category	UNIT	Prob of Occurrence	QUANTITY Risk Profile - Quantity	Likely Quantity	Lowest Quantity	Highest Quantity	RATE Risk Profile -Rate	Likely Rate	Lowest Rate	Highest Rate	BASE ESTIMATE COST	COMMENTS
	Individual Pavement Components														
D13.6	Rip, Mix & Compact Existing Pavement to 250mm	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D13 - Pavements	m^2	100%	-5% , +30%				-5% , +50%	6.00	**5.70**	**9.00**		
D13.7	Profiling	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D13 - Pavements	day	100%	-5% , +30%				User defined					
D13.8	Cold Planning	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D13 - Pavements	m^2	100%	-5% , +30%				-5% , +50%	30.00	**28.50**	**45.00**		
	Pavement Surfacing														
D13.29	Lump Sum Allowance	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D13 - Pavements	Item	100%	**User defined**				**User defined**					
D13.35	Asphalt - Supply & Place Wearing Course - Standard (H/HG)	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D13 - Pavements	Tonne	100%	-5% , +30%	**200**	**190**	**260**	-10% , +30%	450.00	**405.00**	**585.00**	90,000	
D14	**STRUCTURES & CONCRETE WORKS**	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D14 - Structures												
D14.1	Lump Sum Allowance for structural works - Bridge works	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D14 - Structures	Item	100%	Constant Value				-5% , +50%	**800,000.00**	**760,000.00**	**1,200,000.00**		
D14.14	Supply & Cast Edge Strip	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D14 - Structures	m	100%	-5% , +30%				User defined	110.00	**85.00**	**130.00**		
D14.15	Supply & Cast Kerb & Channel (SM2 & SM3)	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D14 - Structures	m	100%	-5% , +30%	**1960**	**1862**	**2548**	-10% , +20%	85.00	**76.50**	**102.00**	166,600	
D14.19	Concrete annulus to Roundabout (150mm depth) with bedding	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D14 - Structures	m^2	100%	-5% , +30%				-5% , +50%	80.00	**76.00**	**120.00**		
D14.20	Construct Bicycle/Pedestrian Path	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D14 - Structures	m^2	100%	-5% , +30%	**1600**	**1520**	**2080**	-10% , +30%	60.00	**54.00**	**78.00**	96,000	
D14.21	Median Paving/Patterned Concrete	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D14 - Structures	m^2	100%	**-5% , +30%**	**150**	**142.5**	**195**	**-10% , +30%**	**80.00**	**72.00**	**104.00**	12,000	
D14.22	Relocate Bus Shelter	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D14 - Structures	No	100%	-5% , +30%				-5% , +50%	5,000.00	**4,750.00**	**7,500.00**		
D14.33	Retaining wall	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D14 - Structures	m	100%	-5% , +30%				-5% , +50%	200.00	**190.00**	**300.00**		
D15	**BUILDING CONSTRUCTION WORKS**	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D15 - Buildings												
D16	**NOISE ATTENUATION WORKS**	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D16 - Noise Attenuation												
D16.1	Noise Attenuation Works	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D16 - Noise Attenuation												
D17	**TRAFFIC SIGNALS & LIGHTING**	D - PRECONSTRUCTION & CONSTRUCTION WORKS													
	Signal Installation														
D17.8	Intersection Signals - T	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D17 - Traffic Signals & Lighting	per site	100%	User defined				-5% , +20%	180,000.00	**171,000.00**	**216,000.00**		
D17.9	Intersection Signals - divided cross	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D17 - Traffic Signals & Lighting	per site	100%	Constant Value				-10% , +30%					
D17.68	Red Light Camera	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D17 - Traffic Signals & Lighting	each	100%	User defined				-5% , +20%					
	Street Lighting														
D17.70	Retirement of Existing Poles	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D17 - Traffic Signals & Lighting	No.	100%	Constant Value	**5**	**5**	**5**	-10% , +30%	2,000.00	**1,800.00**	**2,600.00**	10,000	
D17.71	New Lighting Pole (all inclusive)	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D17 - Traffic Signals & Lighting	No.	100%	-10% , +30%	**12**	**10.8**	**15.6**	-10% , +30%	8,000.00	**7,200.00**	**10,400.00**	96,000	
D17.94	Solar Panel	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D17 - Traffic Signals & Lighting	each	100%	User defined				-5% , +50%		**0.00**	**0.00**		
D18	**INTELLIGENT TRANSPORT SYSTEMS**	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D18 - Intelligent Transport Systems												
D18.1	Intelligent Transport System	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D18 - Intelligent Transport Systems	Item	100%	**Constant Value**				**-20% , +30%**					
D19	**RAIL TRACK WORKS**	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D19 - Rail Track												
D20	**RAIL POWER WORKS**	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D20 - Rail Power												
D21	**RAIL SIGNALLING WORKS**	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D21 - Rail Signalling												
D22	**RAIL COMMUNICATIONS WORKS**	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D22 - Rail Communications												
D23	**SIGNAGE, LINEMARKING, ROAD FURNITURE**	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D23 - Signage, Linemarking, Road Furniture												
D23.1	Lump Sum Allowance for Signs and Linemarking	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D23 - Signage, Linemarking, Road Furniture	Item	100%	**User defined**				**User defined**					
D23.2	Guideposts - Supply & Install	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D23 - Signage, Linemarking, Road Furniture	No.	100%	-5% , +30%				-5% , +50%	60.00	**57.00**	**90.00**		
D23.3	RRPM's - Supply & Install	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D23 - Signage, Linemarking, Road Furniture	each	100%	-5% , +30%				-5% , +50%	15.00	**14.25**	**22.50**		
	Guard fence & Wire Rope Safety Barrier														
D23.4	Guard fence - Supply & Erect (Armco) (<1km length)	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D23 - Signage, Linemarking, Road Furniture	m	100%	-5% , +30%				User defined	170.00	**160.00**	**250.00**		2014 reviewed Rates
D23.7	Breakaway Cable End Terminal (BCTA/BCTB) (<10 terminals)	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D23 - Signage, Linemarking, Road Furniture	No.	100%	-5% , +30%		**0**	**0**	-5% , +50%	2,400.00	**2,280.00**	**3,600.00**		

Project Cost Estimate Input

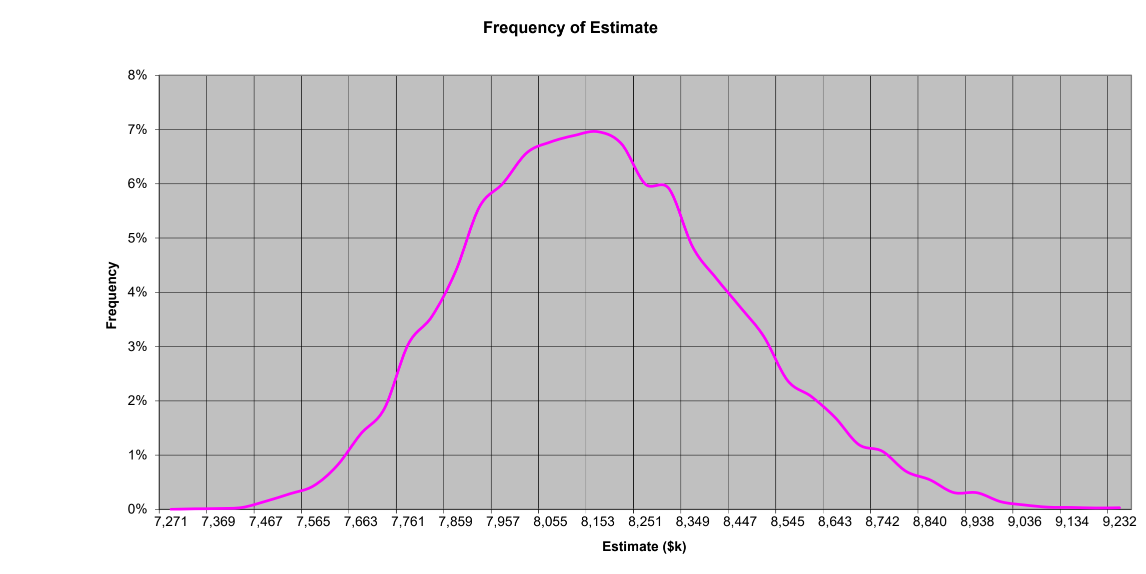
Project:	East-West Link Shepparton
Location:	Wanganui Road/Ford Road/Goulburn Valley Highway Intersection
Estimate Prepared By:	Ajanthan Pillai
Business Area:	Technical department
Estimate Date:	18/01/2018
Estimate Approved By:	Craig Gist
Business Area:	Technical department
Date:	22/12/2017

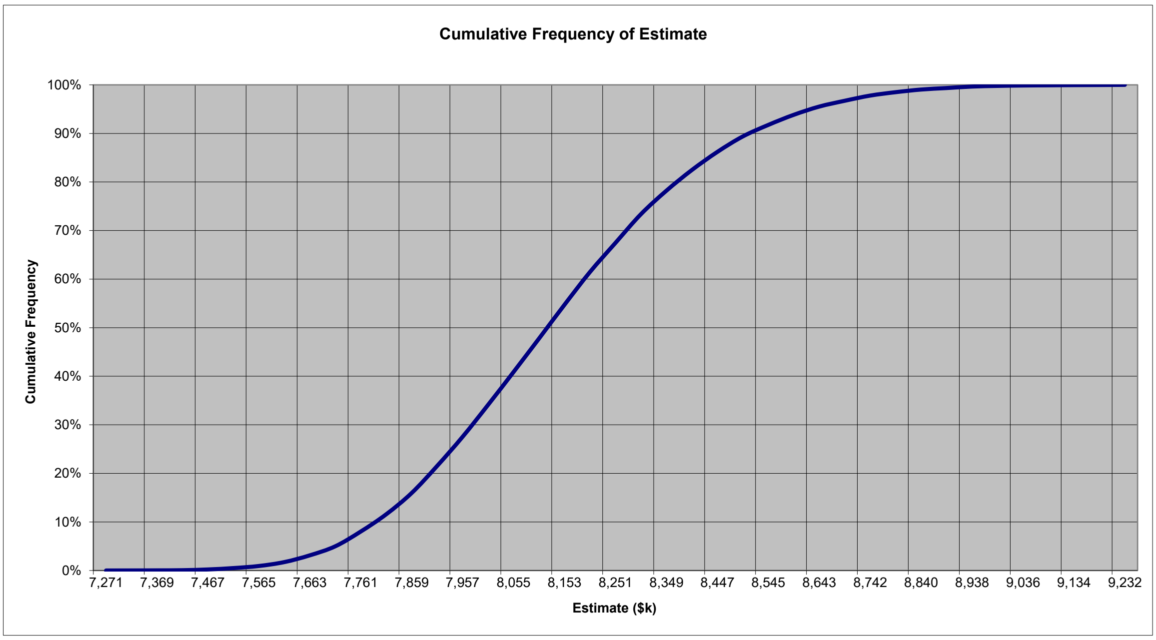
No of Iterations	20000
Correlate between Cost Items?	No
Items to use in Time sheet:	Level 2 cost items
Check Federal Cost Items?	No

ITEM	Description	Level 1 Category	Level 2 Category	UNIT	Prob of Occurrence	QUANTITY: Risk Profile - Quantity	QUANTITY: Likely Quantity	QUANTITY: Lowest Quantity	QUANTITY: Highest Quantity	RATE: Risk Profile -Rate	RATE: Likely Rate	RATE: Lowest Rate	RATE: Highest Rate	BASE ESTIMATE COST	COMMENTS
D23.8	Breakaway Cable Terminal (BCTA/BCTB) (>10 terminals)	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D23 - Signage, Linemarking, Road Furniture	No.	100%	-5% , +30%				-5% , +50%	1,900.00	**1,805.00**	**2,850.00**		
D23.9	GREAT Guard Fence Terminal - Supply & Install	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D23 - Signage, Linemarking, Road Furniture	No.	100%	User defined				User defined	4,300.00	**3,000.00**	**6,000.00**		2014 reviewed Rates
D23.10	X-Tension Terminal - Supply & Install	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D23 - Signage, Linemarking, Road Furniture	No.	100%	User defined				User defined	4,700.00	**4,000.00**	**6,000.00**		2014 reviewed Rates
D23.12	Wire Rope Safety Barrier (<200m length)	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D23 - Signage, Linemarking, Road Furniture	m	100%	-5% , +30%				User defined	130.00	**114.00**	**180.00**		2014 reviewed Rates
D23.14	Wire Rope Safety Barrier - End Terminals (<10 terminals)	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D23 - Signage, Linemarking, Road Furniture	No.	100%	-5% , +30%				-5% , +50%	4,000.00	**3,800.00**	**6,000.00**		
	Signage														
D23.17	Manufacture & Erect New Signing	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D23 - Signage, Linemarking, Road Furniture	Each	100%	-5% , +30%	**50**	**47.5**	**65**	-10% , +30%	450.00	**405.00**	**585.00**	22,500	
D23.18	Remove Store & Re-erect Existing Signing Allowance	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D23 - Signage, Linemarking, Road Furniture	Each	100%	-5% , +30%	**20**	**19**	**26**	-10% , +30%	150.00	**135.00**	**195.00**	3,000	
D23.24	Supply and install large sign (i.e. direction sign)	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D23 - Signage, Linemarking, Road Furniture	unit	100%	-5% , +30%				-5% , +50%	900.00	**855.00**	**1,350.00**		
	Extruded Thermoplastic Linemarking														
D23.25	Linemarking - Select Road Standard…	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D23 - Signage, Linemarking, Road Furniture	Item	100%	-5% , +30%	**1**	**0.95**	**1.3**	-10% , +30%	25,000.00	**22,500.00**	**32,500.00**	25,000	
D23.26	Statcon holding bar blocks	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D23 - Signage, Linemarking, Road Furniture	block	100%	-5% , +30%				-5% , +50%	500.00	**475.00**	**750.00**		
	Cold Applied Plastic Roadmarking														
D23.44	Chevron bars 600mm wide	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D23 - Signage, Linemarking, Road Furniture	m	100%	-5% , +30%		**0**	**0**	-5% , +50%	65.00	**61.75**	**97.50**		
	Linemarking Removal														
D23.61	Water blasting	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D23 - Signage, Linemarking, Road Furniture	Item	100%	Constant Value	**1**	**1**	**1**	-10% , +30%	3,500.00	**3,150.00**	**4,550.00**	3,500	
	DDA														
D23.66	Construct Kerb Ramp & Install TGSI	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D23 - Signage, Linemarking, Road Furniture	No.	100%	-5% , +30%	**16**	**15.2**	**20.8**	-10% , +30%	1,700.00	**1,530.00**	**2,210.00**	27,200	
D23.74	Bus stop	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D23 - Signage, Linemarking, Road Furniture	Item	100%	-5% , +30%		**0**	**0**	-5% , +50%	3,000.00	**2,850.00**	**4,500.00**		
D23.75	Flashing lights	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D23 - Signage, Linemarking, Road Furniture	Item	100%	-5% , +30%		**0**	**0**	-5% , +50%	2,000.00	**1,900.00**	**3,000.00**		
D24	**LANDSCAPING WORKS**	D - PRECONSTRUCTION & CONSTRUCTION WORKS													
D24.1	Fencing - Pedestrian	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D24 - Landscaping	m	100%	-5% , +30%		**0**	**0**	User defined	300.00	**250.00**	**550.00**		
D24.2	Landscaping	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D24 - Landscaping	Item	100%	Constant Value	**1**	**1**	**1**	-10% , +30%	200,000.00	**180,000.00**	**260,000.00**	200,000	
D25	**MAINTENANCE**	D - PRECONSTRUCTION & CONSTRUCTION WORKS													
D25.1	Works Maintenance to Practical Completion	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D25 - Maintenance	Item	100%	Constant Value	1	1	1	-10% , +30%	10,000.00	9,000.00	13,000.00	10,000	
D25.2	Defects Management	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D25 - Maintenance	Item	100%	Constant Value	**1**	**1**	**1**	-10% , +30%	4,000.00	**3,600.00**	**5,200.00**	4,000	
E	**CONTINGENT RISKS**	E - CONTINGENT RISKS													
E1	**Project Risks**	E - CONTINGENT RISKS	E1 - Project Risks		80%	**User defined**				**User defined**					
E1.1	Service Relocation	E - CONTINGENT RISKS	E1 - Project Risks	item	100%	**-5% , +30%**	**1**	**0.95**	**1.3**	**-10% , +30%**	**100,000.00**	**90,000.00**	**130,000.00**	100,000	
E1.2	Removal of Trees	E - CONTINGENT RISKS	E1 - Project Risks	item	100%	**-5% , +30%**	**1**	**0.95**	**1.3**	**-10% , +30%**	**2,000.00**	**1,800.00**	**2,600.00**	2,000	
E1.3	Drainage Works	E - CONTINGENT RISKS	E1 - Project Risks	item	100%	**-5% , +30%**	**1**	**0.95**	**1.3**	**-10% , +30%**	**20,000.00**	**18,000.00**	**26,000.00**	20,000	
E1.4	Dayworks	E - CONTINGENT RISKS	E1 - Project Risks	Item	100%	-5% , +30%	**120**	**114**	**156**	-10% , +30%	**800.00**	**720.00**	**1,040.00**	96,000	
														Total = $7,110,623	

Project:	East-West Link Shepparton
Location:	Wanganui Road/Ford Road/Goulburn Valley Highway Intersection
Estimate Prepared By:	Ajanthan Pillai
Business Area:	Technical department
Estimate Date:	18/01/18
Estimate Approved By:	Craig Gist
Business Area:	Technical department
Date:	22/12/17

Number of Iterations: 20,000 **Units** $ 1,000





TEC (NO PRICE ESCALATION)	Confidence Level		
	10%	50%	90%
	$7,789,523.60	$8,119,138.50	$8,508,841.00

Project Name	East-West Link Shepparton
Location	Ford Road - Goulburn Valley Highway to Grahamvale Road
Prepared by	Ajanthan Pillai
Business Area	Technical department
Estimate Date	18/01/2018

P90 Project Costs	$43,159,000	
State Program On Costs (4%)	$1,811,520	
On Costs - Unsuccessful Proposals (0.7%)	$317,016	
Final TEI	**$45,288,000**	**Effective Estimate Risk = 19%**

Endorsement of Risk Based Estimate			
Position	**Name (print)**	**Signature**	**Date**
Development Project Manager	Alex Backet		
Development Team Leader	**Your Team Leader Name**		
Delivery Project Manager			
Delivery Team Leader			

Attachments:

Project Details

Estimate

Summary

Estimate Confidence

Est_Profile

Project:	East-West Link Shepparton
Location:	Ford Road - Goulburn Valley Highway to Grahamvale Road
Estimate Prepared By:	Ajanthan Pillai
Business Area:	Technical department
Estimate Date:	18/01/18
Estimate Approved By:	Craig Gist
Business Area:	Technical department
Date:	22/02/18

Item	Base	P50*	P90*
A Project & Program Management	$4,841,450	$5,680,000	$6,240,000
B Design and Investigation	$820,000	$872,000	$918,000
C Land Acquisition			
D Preconstruction & Construction	$29,843,000	$34,114,000	$35,210,000
SUB-TOTAL (Inherent Risks)	**Base Cost Estimate = $35,504,450**	$40,666,000	$42,368,000
E Contingent Risks		$754,000	$821,000
TOTAL (No Escalation)		$41,420,000	$43,189,000
Escalation		$0	$0
TOTAL (Including Escalation)		**Project Cost Estimate = $41,420,000**	**Total Estimated Investment (TEI) = $43,189,000**
Base Risk Allocation			**Base Risk Allocation = $5,915,550**
Contingency			**Contingency = $1,769,000**

	Base	P50*	P90*
A - PROJECT & PROGRAM MANAGEMENT			
A2 - Project Management - Development	$ 1,652,150	$ 1,938,306	$ 2,129,407
A3 - Project Management - Construction	$ 3,164,300	$ 3,712,364	$ 4,078,372
A4 - Stakeholder Management	$ 25,000	$ 29,330	$ 32,222
SUB-TOTAL	**$ 4,841,450**	**$ 5,680,000**	**$ 6,240,000**
B - DESIGN AND INVESTIGATION			
B1 - Planning Activities	$ 100,000	$ 106,341	$ 111,951
A1 - Project Management - Planning	$ 80,000	$ 85,073	$ 89,561
B2 - Ground Surveys	$ 130,000	$ 138,244	$ 145,537
B3 - Environmental Studies	$ 50,000	$ 53,171	$ 55,976
B5 - Detailed Design	$ 460,000	$ 489,171	$ 514,976
SUB-TOTAL	**$ 820,000**	**$ 872,000**	**$ 918,000**
D - PRECONSTRUCTION & CONSTRUCTION WORKS			
D1 - Contractor Management	$ 1,250,000	$ 1,428,895	$ 1,474,801
D5 - Site Preparation	$ 40,000	$ 45,725	$ 47,194
D6 - Utility Service Relocations	$ 3,790,000	$ 4,332,408	$ 4,471,598
D7 - Traffic Management	$ 1,048,000	$ 1,197,985	$ 1,236,474
D8 - Rail Management	$ 90,000	$ 102,880	$ 106,186
D10 - Environmental Offsets	$ 43,500	$ 49,726	$ 51,323
D11 - Earthworks	$ 2,772,150	$ 3,168,888	$ 3,270,697
D24 - Landscaping	$ 3,717,600	$ 4,249,647	$ 4,386,178
D12 - Drainage	$ 2,191,500	$ 2,505,138	$ 2,585,622
D13 - Pavements	$ 5,997,000	$ 6,855,264	$ 7,075,507
D14 - Structures	$ 4,654,000	$ 5,320,060	$ 5,490,981
D17 - Traffic Signals & Lighting	$ 2,536,000	$ 2,898,941	$ 2,992,077
D19 - Rail Track	$ 1,000,000	$ 1,143,116	$ 1,179,841
D20 - Rail Power	$ 200,000	$ 228,623	$ 235,968
D21 - Rail Signalling	$ 200,000	$ 228,623	$ 235,968
D23 - Signage, Linemarking, Road Furniture	$ 243,250	$ 278,063	$ 286,996
D25 - Maintenance	$ 70,000	$ 80,018	$ 82,589
SUB-TOTAL	**$ 29,843,000**	**$ 34,114,000**	**$ 35,210,000**
E - CONTINGENT RISKS			
E1 - Project Risks	$ 655,000	$ 754,000	$ 821,000
SUB-TOTAL	**$ 655,000**	**$ 754,000**	**$ 821,000**

***Note: The P50 and P90 values in the tables above are proportioned to ensure they add to the total cost P90 values. True P90 values are detailed in the Est_Confidence sheet.**

Project Cost Estimate Input

Project:	East-West Link Shepparton
Location:	Ford Road - Goulburn Valley Highway to Grahamvale Road
Estimate Prepared By:	Ajanthan Pillai
Business Area:	Technical department
Estimate Date:	18/01/2018
Estimate Approved By:	Craig Gist
Business Area:	Technical department
Date:	22/02/2018

No of Iterations	10000
Correlate between Cost Items?	No
Items to use in Time sheet:	Level 2 cost items
Check Federal Cost Items?	No

ITEM	Description	Level 1 Category	Level 2 Category	UNIT	Prob of Occurrence	QUANTITY				RATE				BASE ESTIMATE COST	COMMENTS
						Risk Profile - Quantity	Likely Quantity	Lowest Quantity	Highest Quantity	Risk Profile -Rate	Likely Rate	Lowest Rate	Highest Rate		
A	**PROJECT & PROGRAM MANAGEMENT**														
A1	**PROJECT PLANNING**														
A1.1	Project Planning/ Business Case	A - PROJECT & PROGRAM MANAGEMENT	A1 - Project Management - Planning												
A2	**PROJECT DEVELOPMENT**														
A2.1	VicRoads/ Council - Project Scoping, Scheduling & Reporting	A - PROJECT & PROGRAM MANAGEMENT	A2 - Project Management - Development	%	100%	Constant Value	1	1	1	-20% , +30%	5.00	4.00	6.50	1,572,150	
A2.2	Traffic Investigations	A - PROJECT & PROGRAM MANAGEMENT	A2 - Project Management - Development	Item	100%	Constant Value				User defined					
A2.3	Consultancy/ Concept Design	A - PROJECT & PROGRAM MANAGEMENT	A2 - Project Management - Development	Item	100%	Constant Value	1	1	1	Constant Value	80,000.00	80,000.00	80,000.00	80,000	
A3	**PROJECT MANAGEMENT CONSTRUCTION**														
A3.1	Contract administration / management	A - PROJECT & PROGRAM MANAGEMENT	A3 - Project Management - Construction	%	100%	Constant Value	1	1	1	-20% , +30%	10.00	8.00	13.00	3,144,300	
A3.2	Network Operations Advice	A - PROJECT & PROGRAM MANAGEMENT	A3 - Project Management - Construction	Item	100%	Constant Value	1	1	1	Constant Value	5,000.00	5,000.00	5,000.00	5,000	
A3.4	TMP Review	A - PROJECT & PROGRAM MANAGEMENT	A3 - Project Management - Construction	Item	100%	Constant Value	1	1	1	-10% , +30%	15,000.00	13,500.00	19,500.00	15,000	
A4	**STAKEHOLDER MANAGEMENT**														
A4.1	Stakeholder Management	A - PROJECT & PROGRAM MANAGEMENT	A4 - Stakeholder Management	Item	100%	Constant Value	1	1	1	-10% , +30%	25,000.00	22,500.00	32,500.00	25,000	
A5	**PROGRAM ADMINISTRATION**														
A5.1	Overhead costs - unsuccessful jobs	A - PROJECT & PROGRAM MANAGEMENT	A5 - Program Administration												
A5.2	On costs - Road Safety Department (3%) [DO NOT INCLUDE HERE - Refer Cover Sheet]	A - PROJECT & PROGRAM MANAGEMENT	A5 - Program Administration												This item does not calculated accurately on this sheet. Therefore this item is included to the Final Summary Sheet
A5.3	On costs - State (4%) [DO NOT INCLUDE HERE - Refer Cover Sheet]	A - PROJECT & PROGRAM MANAGEMENT	A5 - Program Administration												This item does not calculated accurately on this sheet. Therefore this item is included to the Final Summary Sheet
B	**DESIGN AND INVESTIGATION**														
B1	**PLANNING ACTIVITIES**														
B1.1	Landscape designs	B - DESIGN AND INVESTIGATION	B1 - Planning Activities	Item	100%	Constant Value	1	1	1	-10% , +30%	100,000.00	90,000.00	130,000.00	100,000	
B1.2	Functional Design	B - DESIGN AND INVESTIGATION	A1 - Project Management - Planning	Item	100%	Constant Value	1	1	1	-10% , +30%	80,000.00	72,000.00	104,000.00	80,000	
B2	**GROUND SURVEYS**														
B2.1	Feature surveys	B - DESIGN AND INVESTIGATION	B2 - Ground Surveys	Item	100%	Constant Value	1	1	1	-10% , +30%	50,000.00	45,000.00	65,000.00	50,000	
B2.2	Service Proofing (detail)	B - DESIGN AND INVESTIGATION	B2 - Ground Surveys	Item	100%	Constant Value	1	1	1	-10% , +30%	80,000.00	72,000.00	104,000.00	80,000	
B3	**ENVIRONMENTAL STUDIES**														
B3.1	Detailed Cultural Heritage Studies	B - DESIGN AND INVESTIGATION	B3 - Environmental Studies	item	100%	Constant Value	1	1	1	-10% , +30%	25,000.00	22,500.00	32,500.00	25,000	
B3.2	Detailed Flora and Fauna Studies	B - DESIGN AND INVESTIGATION	B3 - Environmental Studies	item	100%	Constant Value	1	1	1	-10% , +30%	25,000.00	22,500.00	32,500.00	25,000	
B4	**REFERENCE DESIGN**		B4 - Reference Design												
B4.1	Reference Design	B - DESIGN AND INVESTIGATION													
B4.2	Reference Design 2	B - DESIGN AND INVESTIGATION													
B5	**DETAILED DESIGN**														
B5.1	Detailed road design (including final plans)	B - DESIGN AND INVESTIGATION	B5 - Detailed Design	Item	100%	Constant Value	1	1	1	-10% , +30%	400,000.00	360,000.00	520,000.00	400,000	
B5.2	Road Safety Audit	B - DESIGN AND INVESTIGATION	B5 - Detailed Design	Item	100%	Constant Value	1	1	1	-10% , +30%	60,000.00	54,000.00	78,000.00	60,000	
C	**LAND ACQUISITION**														
C1	**PROPERTY MANAGEMENT**	C - LAND ACQUISITION	C1 - Property Management	item	100%	Constant Value				User defined					
C1.1	Property Services	C - LAND ACQUISITION	C1 - Property Management												
C1.2	Title survey	C - LAND ACQUISITION	C1 - Property Management												
C1.3	Developing Plan of Subdivision	C - LAND ACQUISITION	C2 - Land Compensation												
C2	**LAND COMPENSATION**	C - LAND ACQUISITION	C2 - Land Compensation												
C2.1	Compensation Payments	C - LAND ACQUISITION	C2 - Land Compensation												
C2.2	Stamp Duties	C - LAND ACQUISITION	C2 - Land Compensation												
D	**PRECONSTRUCTION AND CONSTRUCTION WORKS**	D - PRECONSTRUCTION & CONSTRUCTION WORKS													
D1	**CONTRACTOR MANAGEMENT**	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D1 - Contractor Management												
D1.1	Site Establishment	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D1 - Contractor Management	Item	100%	Constant Value				-10% , +30%	100,000.00	90,000.00	130,000.00		
D1.2	Site Management & Supervision	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D1 - Contractor Management	week	100%	-5% , +30%	200	190	260	-10% , +30%	6,000.00	5,400.00	7,800.00	1,200,000	
D1.4	Service Relocation Management, programming, co-ordination of all service asset works including associated documentation	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D1 - Contractor Management	Item	100%	Constant Value	1	1	1	-10% , +30%	10,000.00	9,000.00	13,000.00	10,000	
D1.5	As Constructed Plans	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D1 - Contractor Management	Item	100%	Constant Value	1	1	1	-10% , +30%	20,000.00	18,000.00	26,000.00	20,000	
D1.6	Environment Management Plan	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D1 - Contractor Management	Item	100%	Constant Value	1	1	1	-10% , +30%	20,000.00	18,000.00	26,000.00	20,000	
D2	**CONTRACTOR'S OFFSITE OVERHEAD & MARGIN**	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D2 - Contractor's Offsite Overhead & Margin												
D3	**SPECIAL CONTRACTING COSTS**	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D3 - Special Contracting Costs												
D4	**DETAILED DESIGN**	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D4 - Detailed Design												
D5	**SITE PREPARATION**	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D5 - Site Preparation												

Project Cost Estimate Input

Project:	East-West Link Shepparton
Location:	Ford Road - Goulburn Valley Highway to Grahamvale Road
Estimate Prepared By:	Ajanthan Pillai
Business Area:	Technical department
Estimate Date:	18/01/2018
Estimate Approved By:	Craig Gist
Business Area:	Technical department
Date:	22/02/2018

No of Iterations	10000
Correlate between Cost Items?	No
Items to use in Time sheet:	Level 2 cost items
Check Federal Cost Items?	No

ITEM	Description	Level 1 Category	Level 2 Category	UNIT	Prob of Occurrence	QUANTITY				RATE				BASE ESTIMATE COST	COMMENTS
						Risk Profile - Quantity	Likely Quantity	Lowest Quantity	Highest Quantity	Risk Profile -Rate	Likely Rate	Lowest Rate	Highest Rate		
D5.5	Survey Set outs	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D5 - Site Preparation	item	100%	Constant Value	1	1	1	-10% , +30%	40,000.00	36,000.00	52,000.00	40,000	
D6	**UTILITY SERVICE RELOCATIONS**	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D6 - Utility Service Relocations												
D6.1	Power	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D6 - Utility Service Relocations	Item	100%	Constant Value	14	14	14	-5% , +40%	60,000.00	57,000.00	84,000.00	840,000	Operation and Maintenance contracts etc.
D6.2	Telecommunications (Telstra / Optus)	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D6 - Utility Service Relocations	Item	100%	Constant Value	1	1	1	-5% , +40%	700,000.00	665,000.00	980,000.00	700,000	
D6.3	Gas	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D6 - Utility Service Relocations	Item	100%	Constant Value	1	1	1	-5% , +40%	500,000.00	475,000.00	700,000.00	500,000	
D6.4	Water	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D6 - Utility Service Relocations	Item	100%	Constant Value	1	1	1	-5% , +40%	800,000.00	760,000.00	1,120,000.00	800,000	
D6.5	Sewerage	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D6 - Utility Service Relocations	Item	100%	Constant Value	1	1	1	-5% , +40%	950,000.00	902,500.00	1,330,000.00	950,000	
D7	**TRAFFIC MANAGEMENT**	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D7 - Traffic Management												
D7.1	Provision for Traffic Control	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D7 - Traffic Management	week	100%	-5% , +30%	200	190	260	-10% , +30%	5,000.00	4,500.00	6,500.00	1,000,000	
D7.2	Electronic Variable Message Sign	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D7 - Traffic Management	Item	100%	-5% , +30%	40	38	52	-10% , +30%	1,200.00	1,080.00	1,560.00	48,000	
D8	**RAIL MANAGEMENT**	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D8 - Rail Management												
D8.1	Rail Management	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D8 - Rail Management	week	100%	-10% , +30%	60	54	78	-5% , +30%	1,500.00	1,425.00	1,950.00	90,000	
D9	**ENVIRONMENTAL MANAGEMENT**	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D9 - Environmental Management												
D10	**ENVIRONMENTAL OFFSETS**	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D10 - Environmental Offsets												
D10.1	Planting trees	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D10 - Environmental Offsets	Item	100%	-5% , +30%	30	28.5	39	-10% , +30%	450.00	405.00	585.00	13,500	
D10.2	Habitats welfare	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D10 - Environmental Offsets	Item	100%	Constant Value	1	1	1	-10% , +30%	30,000.00	27,000.00	39,000.00	30,000	
D11	**EARTHWORKS**	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D11 - Earthworks												
D11.1	Lump Sum Allowance for Formation Construction	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D11 - Earthworks	Item	100%	**Constant Value**	**1**	**1**	**1**	**-10% , +30%**	200,000.00	**180,000.00**	**260,000.00**	200,000	
D11.2	Clearing & Grubbing	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D11 - Earthworks	m^2	100%	-5% , +30%	**77300**	**73435**	**100490**	-10% , +30%	3.00	**2.70**	**3.90**	231,900	
D11.3	Removal of Trees (significant), Includes grub up & cart away	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D11 - Earthworks	item	100%	-5% , +30%	**30**	**28.5**	**39**	-10% , +30%	500.00	**450.00**	**650.00**	15,000	
D11.4	Stripping & Stockpiling of Topsoil	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D11 - Earthworks	m^2	100%	-5% , +30%	**31250**	**29687.5**	**40625**	-10% , +30%	7.00	**6.30**	**9.10**	218,750	
D11.7	Earthworks - Cut to Fill	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D11 - Earthworks	m^3 solid	100%	-5% , +30%	**7000**	**6650**	**9100**	-10% , +30%	30.00	**27.00**	**39.00**	210,000	
D11.8	Earthworks - Cut to Waste (place "on-site")	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D11 - Earthworks	m^3 solid	100%	-5% , +30%	**12500**	**11875**	**16250**	-10% , +30%	25.00	**22.50**	**32.50**	312,500	
D11.9	Earthworks - Cut to waste (place "off site")	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D11 - Earthworks	m^3 solid	100%	-5% , +30%	**12500**	**11875**	**16250**	-5% , +50%	40.00	**38.00**	**60.00**	500,000	
D11.10	Earthworks - Import to Fill (type B material)	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D11 - Earthworks	m^3 solid	100%	-5% , +30%	**15000**	**14250**	**19500**	-5% , +50%	45.00	**42.75**	**67.50**	675,000	
D11.11	Construct Table Drains & Verges	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D11 - Earthworks	m	100%	-5% , +30%	**500**	**475**	**650**	-10% , +30%	28.00	**25.20**	**36.40**	14,000	
D11.14	Topsoiling (include fertilising & seeding)	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D11 - Earthworks	m^2	100%	-5% , +30%	**19750**	**18762.5**	**25675**	-10% , +30%	20.00	**18.00**	**26.00**	395,000	
D11.15	Landscaping - Supply, Plant & Maintain	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D24 - Landscaping	m2	100%	**-5% , +30%**	**29730**	**28243.5**	**38649**	**-10% , +30%**	120.00	**108.00**	**156.00**	3,567,600	
D12	**DRAINAGE WORKS**	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D12 - Drainage												
D12.1	Lump Sum Allowance for drainage works	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D12 - Drainage	Item	100%	**User defined**				**User defined**	10,000.00	**7,000.00**	**13,000.00**		
D12.2	Supply & Install 450x300 RC Box Culvert	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D12 - Drainage	m	100%	-5% , +30%	**1000**	**950**	**1300**	-10% , +30%	450.00	**405.00**	**585.00**	450,000	
D12.14	Supply & Install Class 2 375mm dia RCP	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D12 - Drainage	m	100%	-5% , +30%		**0**	**0**	User defined	250.00	**237.00**	**375.00**		
D12.15	Supply & Install Class 3 375mm dia RCP	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D12 - Drainage	m	100%	-5% , +30%	**5000**	**4750**	**6500**	-10% , +30%	200.00	**180.00**	**260.00**	1,000,000	
D12.16	Supply & Install Class 2 450mm dia RCP	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D12 - Drainage	m	100%	-5% , +30%				-5% , +50%	320.00	**304.00**	**480.00**		
D12.24	Supply & Install Subsurface Drains (Fabric around trench) Type 2	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D12 - Drainage	m	100%	-5% , +30%	**5500**	**5225**	**7150**	-10% , +30%	55.00	**49.50**	**71.50**	302,500	
D12.26	Supply & Install Subsurface Drain Risers	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D12 - Drainage	No.	100%	-5% , +30%	**55**	**52.25**	**71.5**	-10% , +30%	600.00	**540.00**	**780.00**	33,000	
D12.27	Supply & Install Subsurface Drain Pit	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D12 - Drainage	No.	100%	-5% , +30%	**55**	**52.25**	**71.5**	-10% , +30%	800.00	**720.00**	**1,040.00**	44,000	
D12.29	Supply & Install Junction Pits	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D12 - Drainage	No.	100%	-5% , +30%	**60**	**57**	**78**	-10% , +30%	2,000.00	**1,800.00**	**2,600.00**	120,000	
D12.30	Supply & Install SEP's (1.5m x 600 x 450)	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D12 - Drainage	No.	100%	-5% , +30%	**110**	**104.5**	**143**	-10% , +30%	2,200.00	**1,980.00**	**2,860.00**	242,000	
D13	**PAVEMENT CONSTRUCTION**	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D13 - Pavements												
D13.1	Lump Sum Item for Pavement construction	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D13 - Pavements	Item	100%	**User defined**				**User defined**					
D13.3	Construct deep strength pavement, including wearing course (530mm depth)	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D13 - Pavements	m^2	100%	-5% , +30%	**37200**	**35340**	**48360**	-10% , +30%	160.00	**144.00**	**208.00**	5,952,000	
D13.4	Construct granular pavement, including double application seal (550mm depth)	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D13 - Pavements	m^2	100%	-5% , +30%				-5% , +50%	90.00	**85.50**	**135.00**		

Project Cost Estimate Input

Project:	East-West Link Shepparton
Location:	Ford Road - Goulburn Valley Highway to Grahamvale Road
Estimate Prepared By:	Ajanthan Pillai
Business Area:	Technical department
Estimate Date:	18/01/2018
Estimate Approved By:	Craig Gist
Business Area:	Technical department
Date:	22/02/2018

No of Iterations	10000
Correlate between Cost Items?	No
Items to use in Time sheet:	Level 2 cost items
Check Federal Cost Items?	No

ITEM	Description	Level 1 Category	Level 2 Category	UNIT	Prob of Occurrence	QUANTITY				RATE				BASE ESTIMATE COST	COMMENTS
						Risk Profile - Quantity	Likely Quantity	Lowest Quantity	Highest Quantity	Risk Profile -Rate	Likely Rate	Lowest Rate	Highest Rate		
	Individual Pavement Components														
D13.6	Rip, Mix & Compact Existing Pavement to 250mm	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D13 - Pavements	m^2	100%	-5% , +30%				-5% , +50%	6.00	**5.70**	**9.00**		
D13.7	Profiling	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D13 - Pavements	day	100%	-5% , +30%				User defined					
D13.8	Cold Planning	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D13 - Pavements	m^2	100%	-5% , +30%				-5% , +50%	30.00	**28.50**	**45.00**		
	Pavement Surfacing														
D13.29	Lump Sum Allowance	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D13 - Pavements	Item	100%	**User defined**				**User defined**					
D13.35	Asphalt - Supply & Place Wearing Course - Standard (V/H/HG)	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D13 - Pavements	Tonne	100%	-5% , +30%	**100**	**95**	**130**	-10% , +30%	450.00	**405.00**	**585.00**	45,000	
D13.36	Asphalt - Supply & Place Wearing Course (SMA)	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D13 - Pavements	Tonne	100%	-5% , +30%		**0**	**0**	-5% , +50%	250.00	**237.50**	**375.00**		
D14	**STRUCTURES & CONCRETE WORKS**	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D14 - Structures												
D14.1	Lump Sum Allowance for structural works - Bridge works	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D14 - Structures	Item	100%	Constant Value	**1**	**1**	**1**	-5% , +50%	**3,500,000.00**	**3,325,000.00**	**5,250,000.00**	3,500,000	
D14.2	Precast RC Piles - Supply & Install	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D14 - Structures	m	100%	User defined				User defined					
D14.15	Supply & Cast Kerb & Channel (SM2 & SM3)	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D14 - Structures	m	100%	-5% , +30%	**6400**	**6080**	**8320**	-10% , +20%	85.00	**76.50**	**102.00**	544,000	
D14.19	Concrete annulus to Roundabout (150mm depth) with bedding	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D14 - Structures	m^2	100%	-5% , +30%				-5% , +50%	80.00	**76.00**	**120.00**		
D14.20	Construct Bicycle/Pedestrian Path	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D14 - Structures	m^2	100%	-5% , +30%	**9900**	**9405**	**12870**	-10% , +30%	60.00	**54.00**	**78.00**	594,000	
D14.21	Median Paving/Patterned Concrete	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D14 - Structures	m^2	100%	**-5% , +30%**	**200**	**190**	**260**	**-10% , +30%**	**80.00**	**72.00**	**104.00**	16,000	
D14.22	Relocate Bus Shelter	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D14 - Structures	No	100%	-5% , +30%				-5% , +50%	5,000.00	**4,750.00**	**7,500.00**		
D15	**BUILDING CONSTRUCTION WORKS**	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D15 - Buildings												
D16	**NOISE ATTENUATION WORKS**	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D16 - Noise Attenuation												
D16.1	Noise Attenuation Works	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D16 - Noise Attenuation												
D17	**TRAFFIC SIGNALS & LIGHTING**	D - PRECONSTRUCTION & CONSTRUCTION WORKS													
	Signal Installation														
D17.7	Intersection Signals - cross	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D17 - Traffic Signals & Lighting	per site	100%	Constant Value	**1**	**1**	**1**	-5% , +20%	400,000.00	**380,000.00**	**480,000.00**	400,000	
D17.9	Intersection Signals - divided cross (with boom gate)	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D17 - Traffic Signals & Lighting	per site	100%	Constant Value	**1**	**1**	**1**	-10% , +30%	650,000.00	**585,000.00**	**845,000.00**	650,000	
D17.10	Intersection Signals - Roundabout approach crossing	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D17 - Traffic Signals & Lighting	per site	100%	Constant Value	**3**	**3**	**3**	-10% , +30%	200,000.00	**180,000.00**	**260,000.00**	600,000	
D17.68	Red Light Camera	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D17 - Traffic Signals & Lighting	each	100%	User defined				-5% , +20%		**0.00**	**0.00**		
	Street Lighting														
D17.70	Retirement of Existing Poles	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D17 - Traffic Signals & Lighting	No.	100%	Constant Value	**3**	**3**	**3**	-10% , +30%	2,000.00	**1,800.00**	**2,600.00**	6,000	
D17.71	New Lighting Pole (all inclusive)	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D17 - Traffic Signals & Lighting	No.	100%	-10% , +30%	**110**	**99**	**143**	-10% , +30%	8,000.00	**7,200.00**	**10,400.00**	880,000	
D18	**INTELLIGENT TRANSPORT SYSTEMS**	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D18 - Intelligent Transport Systems												
D18.1	Intelligent Transport System	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D18 - Intelligent Transport Systems	Item	100%	**Constant Value**				**-20% , +30%**		**0.00**	**0.00**		
D19	**RAIL TRACK WORKS**	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D19 - Rail Track												
D19.1	Rail Track Works	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D19 - Rail Track	Item	100%	**Constant Value**	**1**	**1**	**1**	**-5% , +40%**	**1,000,000.00**	**950,000.00**	**1,400,000.00**	1,000,000	
D20	**RAIL POWER WORKS**	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D20 - Rail Power												
D20.1	Rail Power Works	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D20 - Rail Power	Item	100%	**Constant Value**	**1**	**1**	**1**	**-5% , +40%**	**200,000.00**	**190,000.00**	**280,000.00**	200,000	
D21	**RAIL SIGNALLING WORKS**	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D21 - Rail Signalling												
D21.1	Rail Signalling Works	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D21 - Rail Signalling	Item	100%	**Constant Value**	**1**	**1**	**1**	**-5% , +40%**	**200,000.00**	**190,000.00**	**280,000.00**	200,000	
D22	**RAIL COMMUNICATIONS WORKS**	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D22 - Rail Communications												
D22.1	Rail Communications Works	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D22 - Rail Communications	Item	100%	**User defined**									
D23	**SIGNAGE, LINEMARKING, ROAD FURNITURE**	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D23 - Signage, Linemarking, Road Furniture												
D23.1	Lump Sum Allowance for Signs and Linemarking	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D23 - Signage, Linemarking, Road Furniture	Item	100%	**User defined**				**User defined**					
D23.2	Guideposts - Supply & Install	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D23 - Signage, Linemarking, Road Furniture	No.	100%	-5% , +30%				-5% , +50%	60.00	**57.00**	**90.00**		
D23.3	RRPM's - Supply & Install	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D23 - Signage, Linemarking, Road Furniture	each	100%	-5% , +30%				-5% , +50%	15.00	**14.25**	**22.50**		
	Guard fence & Wire Rope Safety Barrier														

Project Cost Estimate Input

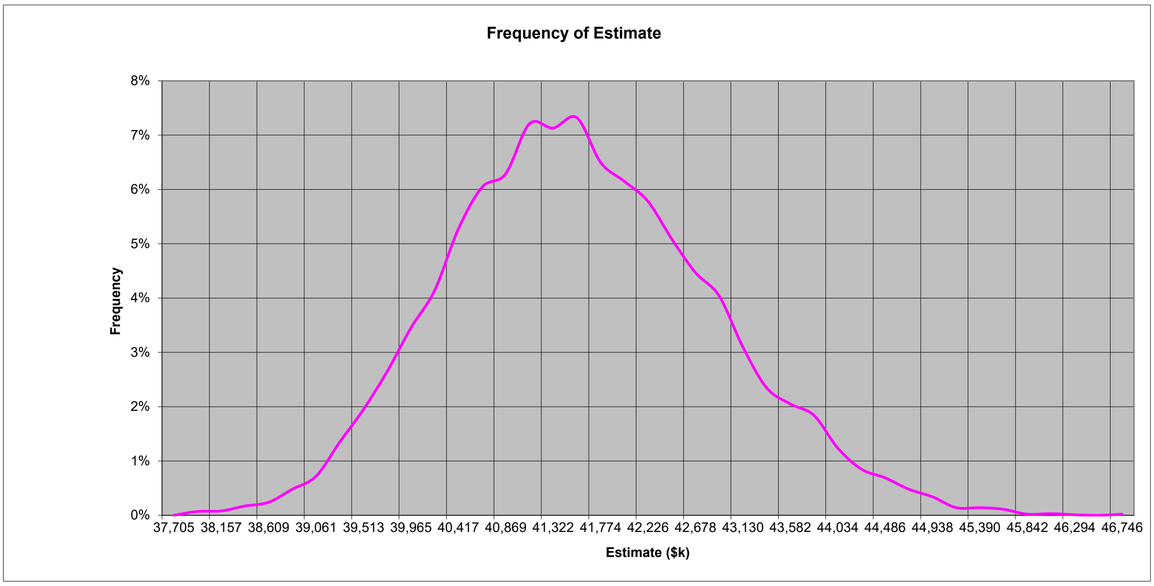
Project:	East-West Link Shepparton
Location:	Ford Road - Goulburn Valley Highway to Grahamvale Road
Estimate Prepared By:	Ajanthan Pillai
Business Area:	Technical department
Estimate Date:	18/01/2018
Estimate Approved By:	Craig Gist
Business Area:	Technical department
Date:	22/02/2018

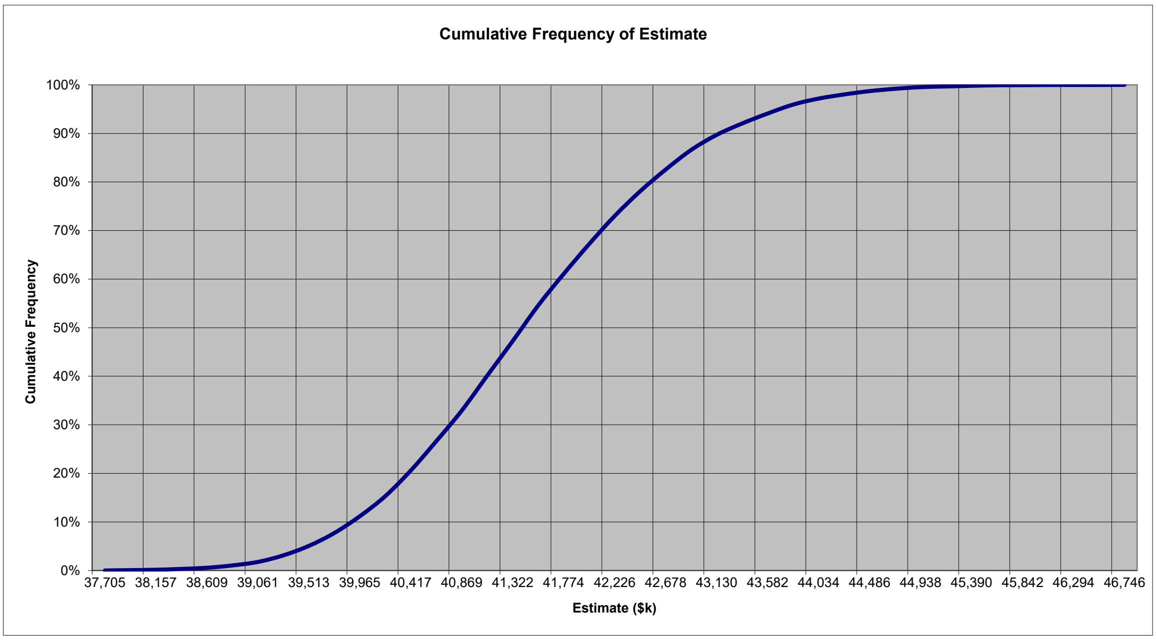
No of Iterations	10000
Correlate between Cost Items?	No
Items to use in Time sheet:	Level 2 cost items
Check Federal Cost Items?	No

ITEM	Description	Level 1 Category	Level 2 Category	UNIT	Prob of Occurrence	QUANTITY				RATE				BASE ESTIMATE COST	COMMENTS
						Risk Profile - Quantity	Likely Quantity	Lowest Quantity	Highest Quantity	Risk Profile -Rate	Likely Rate	Lowest Rate	Highest Rate		
D23.5	Guard fence - Supply & Erect (Armco) (>1km length)	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D23 - Signage, Linemarking, Road Furniture	m	100%	-5% , +30%		0	0	User defined	140.00	130.00	180.00		2014 reviewed Rates
D23.7	Breakaway Cable End Terminal (BCTA/BCTB) (<10 terminals)	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D23 - Signage, Linemarking, Road Furniture	No.	100%	-5% , +30%		0	0	-5% , +50%	2,400.00	2,280.00	3,600.00		
D23.9	GREAT Guard Fence Terminal - Supply & Install	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D23 - Signage, Linemarking, Road Furniture	No.	100%	User defined				User defined	4,300.00	3,000.00	6,000.00		2014 reviewed Rates
D23.13	Wire Rope Safety Barrier (>200m length)	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D23 - Signage, Linemarking, Road Furniture	m	100%	-5% , +30%		0	0	-5% , +50%	100.00	95.00	150.00		
D23.15	Wire Rope Safety Barrier - End Terminals (>10 terminals)	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D23 - Signage, Linemarking, Road Furniture	No.	100%	-5% , +30%		0	0	-5% , +50%	2,500.00	2,375.00	3,750.00		
D23.16	Install stac cushions	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D23 - Signage, Linemarking, Road Furniture	m	100%	-5% , +30%				-5% , +50%	45.00	42.75	67.50		
	Signage														
D23.17	Manufacture & Erect New Signing	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D23 - Signage, Linemarking, Road Furniture	Each	100%	-5% , +30%	120	114	156	-10% , +30%	450.00	405.00	585.00	54,000	
D23.18	Remove Store & Re-erect Existing Signing Allowance	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D23 - Signage, Linemarking, Road Furniture	Each	100%	-5% , +30%	25	23.75	32.5	-10% , +30%	150.00	135.00	195.00	3,750	
D23.19	Supply and Install Single Metal Sign Posts	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D23 - Signage, Linemarking, Road Furniture	each	100%	-5% , +30%				-5% , +50%	200.00	190.00	300.00		
	Extruded Thermoplastic Linemarking														
D23.25	Linemarking - Select Road Standard…	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D23 - Signage, Linemarking, Road Furniture	Item	100%	-5% , +30%	1	0.95	1.3	-10% , +30%	80,000.00	72,000.00	104,000.00	80,000	
D23.26	Statcon holding bar blocks	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D23 - Signage, Linemarking, Road Furniture	block	100%	-5% , +30%		0	0	-5% , +50%	500.00	475.00	750.00		
D23.43	Profiled Edgline (>20km)	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D23 - Signage, Linemarking, Road Furniture	m	100%	-5% , +30%		0	0	-5% , +50%	4.00	3.80	6.00		
	Cold Applied Plastic Roadmarking														
D23.56	Rail Crossing	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D23 - Signage, Linemarking, Road Furniture	each	100%	-5% , +30%	1	0.95	1.3	-10% , +30%	2,500.00	2,250.00	3,250.00	2,500	
	Linemarking Removal														
D23.61	Water blasting	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D23 - Signage, Linemarking, Road Furniture	Item	100%	-5% , +30%	1	0.95	1.3	-10% , +30%	2,000.00	1,800.00	2,600.00	2,000	
D23.62	Grinding	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D23 - Signage, Linemarking, Road Furniture	m^2	100%	-5% , +30%		0	0	-5% , +50%	60.00	57.00	90.00		
	DDA														
D23.66	Cconstruct Kerb Ramp & Install TGSI	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D23 - Signage, Linemarking, Road Furniture	No.	100%	-5% , +30%	30	28.5	39	-10% , +30%	1,700.00	1,530.00	2,210.00	51,000	
D23.75	Flashing lights	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D23 - Signage, Linemarking, Road Furniture	Item	100%	Constant Value	1	1	1	-5% , +50%	50,000.00	47,500.00	75,000.00	50,000	
D24	**LANDSCAPING WORKS**	D - PRECONSTRUCTION & CONSTRUCTION WORKS													
D24.1	Fencing - Pedestrian	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D24 - Landscaping	m	100%	-5% , +30%		0	0	User defined	300.00	250.00	550.00		
D24.2	Landscaping	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D24 - Landscaping	Item	100%	Constant Value	1	1	1	-10% , +30%	150,000.00	135,000.00	195,000.00	150,000	
D25	**MAINTENANCE**	D - PRECONSTRUCTION & CONSTRUCTION WORKS													
D25.1	Works Maintenance to Practical Completion	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D25 - Maintenance	Item	100%	Constant Value	1	1	1	-10% , +30%	50,000.00	45,000.00	65,000.00	50,000	
D25.2	Defects Management	D - PRECONSTRUCTION & CONSTRUCTION WORKS	D25 - Maintenance	Item	100%	Constant Value	1	1	1	-10% , +30%	20,000.00	18,000.00	26,000.00	20,000	
E	**CONTINGENT RISKS**	E - CONTINGENT RISKS													
E1	**Project Risks**	E - CONTINGENT RISKS	E1 - Project Risks		80%	**User defined**				**User defined**					
E1.1	Service Relocation	E - CONTINGENT RISKS	E1 - Project Risks	item	100%	-5% , +30%	1	0.95	1.3	-10% , +30%	300,000.00	270,000.00	390,000.00	300,000	
E1.2	Removal of Trees	E - CONTINGENT RISKS	E1 - Project Risks	item	100%	-5% , +30%	1	0.95	1.3	-10% , +30%	5,000.00	4,500.00	6,500.00	5,000	
E1.3	Drainage Works	E - CONTINGENT RISKS	E1 - Project Risks	item	100%	-5% , +30%	1	0.95	1.3	-10% , +30%	50,000.00	45,000.00	65,000.00	50,000	
E1.4	Dayworks	E - CONTINGENT RISKS	E1 - Project Risks	Item	100%	-5% , +30%	500	475	650	-10% , +30%	600.00	540.00	780.00	300,000	
														Total = $36,159,450	

Project:	East-West Link Shepparton
Location:	Ford Road - Goulburn Valley Highway to Grahamvale Road
Estimate Prepared By:	Ajanthan Pillai
Business Area:	Technical department
Estimate Date:	18/01/18
Estimate Approved By:	Craig Gist
Business Area:	Technical department
Date:	22/02/18

Number of Iterations: 10,000 **Units** $ 1,000





	Confidence Level		
	10%	50%	90%
TEC (NO PRICE ESCALATION)	$39,899,151.20	$41,404,158.00	$43,159,348.40

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