AECOM GHD JOINT VENTURE

EDITHVALE AND BONBEACH LEVEL CROSSING REMOVAL PROJECTS

ENVIRONMENT EFFECTS STATEMENT

EES TECHNICAL REPORT G
Traffic Impact Assessment

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Executive summary

The Victorian Government is removing 50 of Melbourne's most dangerous and congested level crossings. The Edithvale Road, Edithvale and Station Street (Bondi Road), Bonbeach level crossing removal projects were referred to the Minister for Planning who decided an Environment Effects Statement (EES) was required.

Traffic and safety context

Level crossings significantly impact travel patterns and the use of the surrounding local road network. In the case of the level crossings at Edithvale and Bonbeach the boom gates are down for extended periods of time during peak periods. Traffic signal data indicates the boom gates are down during the weekday peak from 7:00 am – 9:00 am for an average of 42 minutes at Edithvale and 45 minutes at Bonbeach. This constrains road network capacity, resulting in delays and frustration for road users.

The duration of boom gate closures invites risk-taking behaviour from road users trying to 'beat' the red-lights and boom gates to avoid lengthy waits. This problem may exacerbate with increased traffic volumes and train frequencies in the future.

Statistics provided by Transport Safety Victoria and the Office of the National Rail Safety Regulator for the Edithvale level crossing indicate that in the ten year period ending on 31 December 2014 there was one fatal collision between a train and road vehicle and seven near miss incidents between a train and pedestrian. Statistics for the Bonbeach level crossing indicate that in the same ten year period, there was one non-fatal collision incident between a train and road vehicle, three near miss incidents between a train and road vehicle and five near miss incidents between a train and pedestrian.

Removal of the level crossings at Edithvale and Bonbeach has potential to result in traffic impacts during both the construction and operational phases. Understanding the potential traffic impacts during construction is important so they can be appropriately managed and do not result in unacceptable negative impacts to the community and businesses. Understanding the potential traffic impacts during operation is important so mitigation measures can be developed that optimise the operation and functionality of the transport network post-level crossing removal.

Method

To determine the existing traffic network conditions in the Edithvale and Bonbeach study areas, information has been gathered on the existing local road network and traffic surveys undertaken.

Potential traffic impacts during the construction phase of the project have been identified based on the potential construction methodology and concept designs. These have been assessed and mitigation measures identified.

Potential traffic impacts during the operation phase of the project have been assessed by reviewing the proposed changes to the transport network for all modes and undertaking traffic analysis. Traffic redistribution and estimated growth has been factored into the analysis of intersections.

Existing conditions

The Edithvale Road level crossing is located at the end of Edithvale Road between Station Street and Nepean Highway. Nepean Highway is classified as an arterial road and is a key north-south movement route in the bayside suburban arterial road network. Station Street is a local road under the management of City of Kingston that serves a localised movement and access function. Edithvale Road is the extension of Springvale Road and connects the beachside suburbs between Mordialloc and Patterson River to the Mornington Peninsula Freeway and suburbs to the north and east.

Site observations found that vehicles travelling through the Nepean Highway, Station Street and Edithvale Road intersections are subject to delays under the current operation of the traffic signals and boom gates.

The Station Street level crossing at Bonbeach is located at the intersections of Nepean Highway and Station Street with Bondi Road. Nepean Highway is classified as an arterial road and is a key north-south movement route in the bayside suburban arterial road network. Station Street is a local road under the management of City of Kingston that serves a localised movement and access function. Bondi Road is a local road that serves as an access to residential land use and sporting facilities.

Site observations found that vehicles travelling through the Nepean Highway, Station Street and Bondi Road intersections are subject to delays under the current operation of the traffic signals and boom gates.

Impact assessment – construction

Work during the construction phase of the level crossing removal projects has the potential to impact traffic operations and road safety. Aspects of construction that have been identified as having the greatest potential to result in impacts include:

- lane closures (vehicle and bicycle lanes) and parking removal
- road closures
- rail line closures
- pedestrian crossing and footpath closures
- construction traffic.

These activities could have the following impacts:

- Construction (including rail shutdowns) reduces road capacity and/or increases traffic volumes resulting in delays and increased travel time during the piling and main rail occupation.
- Construction (including rail shutdowns) reduces road capacity and/or increases traffic volumes resulting in delays and increased travel time outside of the piling and main rail occupation.
- Plant and spoil trucks deposit construction debris on public roads leading to dust generation, perceived loss of amenity and public health and safety issues.
- Construction results in disruption to the transport network and/or increases in traffic volumes leading to increased crashes or the perception that the area is less safe.

Key findings from the assessment of potential construction impacts are as follows:

- Reducing Nepean Highway to a single traffic lane southbound during the PM peak whilst maintaining current traffic levels would likely exceed the capacity of one lane, resulting in increased queueing and delays.
- Closure of Edithvale Road and Station Street (Bondi Road) at the boom gates would necessitate the diversion of traffic, increasing traffic volumes on Station Street. The additional traffic would not likely result in the mid-block capacity of Station Street being exceeded.
- Rail line closures could result in a shift to private vehicle use if it is perceived to be a better alternative to the rail replacement bus services. Additional private vehicle traffic in the vicinity of the projects could place further strain on measures to manage traffic impacts and could further exacerbate any issues with congestion and delays.
- Pedestrian crossing and footpath closures have the potential to increase travel distances and journey times resulting in the loss of amenity, particularly for vulnerable groups. Safety could also be impacted if alternate facilities cannot be provided to the same standard or if the closures encourage pedestrians to adopt risky behaviour.
- Traffic volumes near the Edithvale and Bonbeach sites will increase with the addition of construction traffic, however link volumes are expected to remain below the typical mid-block capacity for urban roads with interrupted flow. The percentage of heavy vehicles will increase notably during construction.
- Different combinations of lane closures, road closures, changes to intersection signalling, rail line closures and construction traffic volumes and routing will result in different impacts to traffic operations during construction. Careful consideration will therefore be required of the cumulative impacts.

A range of management and mitigation measures have been developed into Environmental Performance Requirements to be implemented to minimise the impacts as described above. The primary management measures would be the development of plans to manage transport (a Transport Management Plan) and disruptions to public transport in consultation with, and to the satisfaction of relevant road management and transport authorities. Other Environmental Performance Requirements include optimising the works for pedestrian and cyclist connectivity, no debris on roads, reinstating vehicle and pedestrian access and maintaining emergency vehicle access. Implementing these measures would assist to provide for the efficient and safe operation of the transport network during construction, reducing the likelihood of unacceptable impacts to travel time, reliability and road safety. Adopting these controls would result in a moderate risk rating for traffic delay during the main works (piling and main rail occupation), a minor risk rating for traffic delay outside the main works, a negligible risk rating for dirt on roads and a minor risk rating for road safety during construction.

Impact assessment – operational

Removal of the level crossings is expected to result in improved safety by removing the conflict between trains and road users. This will benefit current users of the level crossing as well as traffic that redistributes to the grade separated crossing from other at-grade crossings of the rail corridor.

Removal of the level crossing will allow the traffic signal cycle time that is currently taken up by train phases to be allocated to different movements as required depending on demand and priority. This is expected to result in reduced delays and enhanced reliability for cross-rail corridor trips and allow the competing demands for movement from pedestrians, cyclists, public transport and general traffic to be better balanced. At Edithvale, the arterial-arterial road connection between Nepean Highway and Edithvale Road will be strengthened whilst maintaining local access to Station Street.

Removal of the level crossings and modifying the adjacent road network has potential to result in the following key operational impacts:

- New road network layout and signalling cannot safely and efficiently cater for traffic volumes following level crossing removal, resulting in unacceptable intersection performance and/or increased crashes.
- Connectivity for pedestrians and cyclists is negatively impacted by level crossing removal, resulting in increases to travel distance and/or time resulting in social and business impacts.

A range of management and mitigation measures would be developed to minimise the impacts as described above (Environmental Performance Requirements). The primary management measures would be optimising the works for pedestrian and cyclist connectivity and optimising the intersections' design and construction for performance and safety. Other Environmental Performance Requirements include the replacement of station car parking to ensure no net loss and reinstating vehicle and pedestrian access. Implementing these measures would assist to provide for the safe and efficient operation of the transport network during the operational phase of the projects, reducing the likelihood of unacceptable impacts to travel time, reliability and road safety. Adopting these controls would result in a negligible risk rating.

Abbreviations

Term	Definition
AADT	Annual average daily traffic
ATC	Automated Traffic Count
BPR	Bicycle Priority Route
DDA	Disability Discrimination Act 1992
DOS	Degree of Saturation
EES	Environment Effects Statement
EMF	Environmental Management Framework
EPR	Environmental Performance Requirement
GIS	Geographic information system
IDM	Intersection Diagnostic Monitor
JV	AECOM-GHD Joint Venture
LOS	Level of Service
LXRA	Level Crossing Removal Authority
OD	Origin - destination
PBN	Principal Bicycle Network
PTV	Public Transport Victoria
RCIS	VicRoads Road Crash Information System
SCATS	Sydney Coordinated Adaptive Traffic System
SCC	Strategic Cycling Corridor
SUP	Shared Use Path
TIA	Traffic Impact Assessment
VITM	Victorian Integrated Transport Model
VMS	Variable message sign

Glossary

Term	Definition
95th percentile back of queue (95% Q)	This is the queue length that is not exceeded 95 percent of the time. Ideally, queue lengths should not exceed the turning lane storage or block back into upstream intersections.
Average delay	This is the average amount of time it takes a vehicle to negotiate an intersection, including the time to negotiate corners and the time stopped in queues or waiting for a green signal. This parameter is the most tangible to drivers.
BPR	Priority route for cyclists in the SmartRoads Road Use Hierarchy. May also refer to priority sections of the PBN.
DOS	Ratio of demand to capacity. A DOS of 1.0 or more in theory represents saturated conditions, but a lower practical DOS is used. For a signalised intersection, a DOS of 0.9 is usually adopted as the capacity threshold.
IDM	Data obtained from traffic signal controller on phase and cycle time frequency and duration for a given time period.
LOS	This is an alpha-numeric rating of the overall performance of an intersection, ranging from LOS A (very good) to LOS F (very poor). It is directly related to the average delay. In congested urban environments the target is usually taken to be LOS D.
Mid-block	A location around the mid-point between two (typically significant) intersections
OD	Origin to destination
Other Injury	Injury sustained in a road crash for which a person did not require hospitalisation.
Pedestrian Priority Route	Priority route for pedestrians in the SmartRoads Road Use Hierarchy.
PBN	Network of existing and proposed cycle routes identified to help people ride to major destinations around metropolitan Melbourne. The current plan was released in 2012.
Preferred Traffic Route	The highest degree of priority for traffic in the SmartRoads Road Use Hierarchy.
SCATS	Is an intelligent transport system which provides traffic signal coordination that improves both traffic flow and safety for all road users.
SCC	SCC are a recent addition to bicycle network planning in metropolitan Melbourne. They are corridors development to improve cycling to and around major activity centres. SCC are a subset of the PBN.
Serious Injury	Injury sustained in a road crash for which the person was admitted to hospital.
Shared Use Path (SUP)	Shared paths are areas open to the public that are designated for use by both pedestrians and cyclists.
SmartRoads	Smartroads is an approach that manages competing interests for limited road space by giving priority use of the road to different transport modes at particular times of the day.
Traffic Route	Traffic route in the SmartRoads Road Use Hierarchy that receives a lower level of priority than a Preferred Traffic Route.

1 Introduction

1.1 Purpose

The Victorian Government is removing 50 of Melbourne's most dangerous and congested level crossings, inclusive of the level crossings at Edithvale Road, Edithvale (Edithvale) and Station Street (Bondi Road), Bonbeach (Bonbeach).

The level crossing removal projects have three core objectives. To provide:

- improved productivity from more reliable and efficient transport networks
- better connected, liveable and thriving communities
- safer communities.

The Edithvale and Bonbeach level crossing removal projects were referred to the Minister for Planning on 9 March 2017. On 5 April 2017, the Minister issued a decision determining that an Environment Effects Statement (EES) is required for the projects due to the potential for a range of significant environmental effects.

The purpose of this report is to provide a traffic impact assessment for the Edithvale and Bonbeach level crossing removal projects.

1.2 Why understanding transport impacts is important

The transport impacts resulting from level crossing removal can be divided into two main areas, impacts during construction and impacts during operation. There are different reasons for understanding the transport impacts of both phases.

During construction it is important to understand potential transport impacts so that they can be appropriately managed and do not result in unacceptable negative impacts to the community and businesses. Potential impacts include increased road congestion and delays, restricted access and mobility across the rail corridor, longer travel times and increased crashes.

Potential transport impacts during operation may include unacceptable intersection/network performance, reduced connectivity and increased crashes. Understanding transport impacts is important so mitigation measures can be developed that optimise the functionality, operation and safety of the transport network post-level crossing removal. Understanding the likely operational transport impacts ahead of level crossing removal is also important to inform the community and stakeholders about how the transport network will function on completion of the works.

1.3 Project description

1.3.1 Overview

Edithvale

The Level Crossing Removal Authority (LXRA) proposes to remove the level crossing by lowering the Frankston railway line into a trench under Edithvale Road while maintaining Edithvale Road at the current road level. The trench would be located between Lochiel Avenue and Berry Avenue. It would be up to 1,300 metres in length and 14 metres wide at its narrowest point, widening to up to 24 metres (including pile widths) at the new Edithvale station platforms.

The rail track would be approximately eight metres below ground level, and sit above the trench base slab and infrastructure to collect and divert rain water from the trench. The maximum depth of the excavation would be 15 metres. Pile depths would be a maximum of 24 metres at the deepest point of the trench.

Barriers, fencing and screening would be erected along the trench at road level to prevent unauthorised access by vehicles or people. Decking above the rail trench would provide for the new station building, car parking and a new substation required to ensure sufficient power is available for passenger services on the Frankston railway line. New pedestrian bridges would be constructed to retain pedestrian access across the railway line. A new station is to be constructed with lift, ramp and stair access to the below-ground train platforms.

Bonbeach

LXRA proposes to remove the level crossing by lowering the Frankston railway line into a trench under Bondi Road while maintaining Bondi Road at the current road level. The trench would be located between Golden Avenue and The Glade. It would be up to 1,200 metres in length and 14 metres wide at its narrowest point, widening to up to 24 metres (including pile widths) at the new Bonbeach station platforms.

The rail track would be approximately eight metres below ground level, and sit above the trench base slab and infrastructure to collect and divert rain water from the trench. The maximum depth of the excavation would be 15 metres. Pile depths would be a maximum of 24 metres at the deepest point of the trench.

Barriers, fencing and screening would be erected along the trench at road level to prevent access by vehicles or people. Decking above the rail trench would provide for the new station building and car parking. New pedestrian bridges would be constructed to retain pedestrian access across the railway line. A new station building would be constructed with lift, ramp and stair access to the below-ground train platforms.

1.3.2 Construction

The key construction activities for the Edithvale and Bonbeach level crossing removal projects include:

- site establishment including:
  - clearing of vegetation and ground levelling
  - establishment of site fencing, staff facilities and temporary construction areas
- protection and/or relocation of utility services
- excavation for piling, foundations and the rail trench
- on site waste management including removal, management and appropriate disposal of excavated soil, rock, stormwater and groundwater
- transport of spoil, excavated material and groundwater offsite
- demolition of existing stations and removal of existing rail and road infrastructure
- construction of bridge/deck structures to support Edithvale Road and Station Street/Bondi Road where they cross the railway line
- construction of base slab and waterproofing, including stormwater tanks
- construction of new station infrastructure including platforms and buildings
- construction of pedestrian overpasses and decking over the rail trench
- installation and commissioning of new rail infrastructure including ballast, overhead line equipment and rail

In preparation for the main rail occupation, the existing Edithvale and Bonbeach stations would be closed approximately four weeks in advance. Both projects would be constructed concurrently under the same rail closure which is anticipated to take six weeks.

During the closure of the rail corridor, construction activities would occur 24 hours per day, seven days per week. Additional periodic road closures and lane closures would be required and access along adjacent streets could be restricted. Additional weekend rail shutdowns would likely be required prior to and after the main rail occupation. Construction is expected to be completed within an 18 month period.

1.3.3 Operations and maintenance

Following the construction of the Edithvale and Bonbeach level crossing removal projects, the key operation and maintenance phase activities would include:

- operation – monitoring, controlling and operation of the asset in accordance with the rail and road network requirements
- maintenance – routine inspection and monitoring of the condition of the asset, planned routine maintenance and refurbishment work, and unplanned intervention and repair of the asset.

Operation and maintenance activities would be consistent with existing practices and subject to the evolving operational demands of the road and rail networks.

1.3.4 Traffic considerations in the design

Specific considerations for traffic in the design include:

- removal of the conflict between trains and road users at the level crossings
- intersections to be remodelled with new traffic signals
- Edithvale bus routes to be maintained and stops to be provided in proximity to Edithvale station to facilitate modal interchange
- Bonbeach bus routes to be maintained and stops to be considered for potential future bus routes
- Shared Use Path (SUP) for pedestrians and cyclists to be provided in proximity to Edithvale Station and Bonbeach Station
- traffic management will be required during the construction period to facilitate the works, including rail replacement bus services during rail occupations.

1.4 Project areas

1.4.1 Edithvale

The Edithvale Road, Edithvale level crossing project investigation area (Edithvale project area) extends from Lincoln Parade, Aspendale to Chelsea Road, Chelsea. It includes the rail corridor and all of Station Street and Nepean Highway to the east and west of the rail corridor, and small sections of adjacent road reserves. Refer to Figure 1.

1.4.2 Bonbeach

The Station Street (Bondi Road), Bonbeach level crossing removal project area (Bonbeach project area) extends from Chelsea Road, Chelsea to Patterson River, Bonbeach. It includes the rail corridor and all of Station Street and Nepean Highway located to the east and west of the rail corridor, and small sections of adjacent road reserves. Refer to Figure 2.

Figure 1 Edithvale project area

Figure 2 Bonbeach project area

1.4.3 Temporary construction areas

The projects will require construction compounds for site offices and storage of materials and plant. Areas would be established at the commencement of works and sites would be reinstated following works to at least their pre-project condition. The location of these temporary construction areas will be identified in consultation with relevant stakeholders and approval authorities.

1.4.4 Traffic study area

The study area for traffic focusses on roads in Edithvale and Bonbeach which have potential to be impacted most during the projects' construction and operation periods. It includes sections of Station Street that are expected to be used by construction traffic up to the point they connect to the surrounding arterial road network. Some impacts might be experienced outside the study area related to construction traffic, though these impacts will likely lesson as construction traffic moves away from the works areas and mixes with other arterial road traffic. Refer to Figure 3 and Figure 4.

Figure 3 Edithvale traffic study area

Figure 4 Bonbeach traffic study area

2 Scoping Requirements

In order to meet statutory requirements, protect environmental values and sustain stakeholder confidence, the EES would include an Environmental Management Framework (EMF). The EMF would provide a transparent framework with clear accountabilities for managing and monitoring environmental effects and hazards associated with the construction and operational phases of the projects.

Section 3.5 of the Scoping Requirements (issued September 2017), states 'Project environmental performance requirements (EPRs) that define project-wide environmental outcomes to be achieved and respond to the draft evaluation objectives should be clearly described in the EMF'. The proposed objectives, indicators and monitoring requirements to be described that are relevant to this study are:

- transport management including managing temporary disruption and changed accessibility during construction
- traffic during construction.

3 Legislation, policy and guidelines

Table 1 summarises the relevant primary legislation that applies to the Edithvale and Bonbeach level crossing removal projects as well as the implications and required approvals.

Table 1 Primary legislation and associated information

Legislation/policy	Key policies/strategies	Implications for this project	Approvals required
Commonwealth			
None			
State			
Road Management Act 2004 (Victoria)	Road Management Act (General) Regulations 2016. Road Management Act (Works and Infrastructure) Regulations 2015.	These acts must be complied with for all public roads of the Victorian road network.	Required immediately before works begin.
Transport Integration Act 2010	The Act provides a legislative framework for transport in Victoria. The Act seeks to integrate land use and transport planning and decision-making by applying the framework to land use agencies whose decisions can significantly impact on transport. The Act requires agencies, including the Department of Transport and Planning Authorities, to consider the potential impact of land use planning proposals on transport.	The Act sets out six transport system objectives and eight decision-making principles. The objectives include triple bottom line assessment: economic prosperity, social and economic inclusion and environmental sustainability. Other objectives include: • Integration of transport and land use • Efficiency, coordination and reliability • Safety and health and wellbeing The objectives and principles need to be considered in the evaluation of this project.	None

Legislation/policy	Key policies/strategies	Implications for this project	Approvals required
VicRoads SmartRoads Framework, 2012	Road Use Hierarchy principles	This Framework manages competing interest for limited road space by giving priority use of the road to different transport modes at particular locations and times of the day. It provides operational direction that supports broader strategies around land use and transport.	None
Road Safety Road Rules, 2017	Road Safety Act 1986	These Rules provide road rules that are substantially consistent across Australia. They also specify behaviour for all road users.	None
Towards Zero 2016-2020 – Victoria's Road Safety Strategy & Action Plan	This strategy is to reduce fatalities and serious injuries by 15%, with the ultimate aim of bringing the annual road toll under 200 per year by 2020	The strategy references making local and busy places safer, and using roads more safely.	None

4 Method

This section describes the method that was used to assess the potential impacts of the Edithvale and Bonbeach level crossing removal projects.

A systematic risk based approach was applied to understand the existing environment, potential impacts of the projects and how to avoid, minimise or manage the risk of impact.

The iterative nature of the assessment is illustrated in Figure 5.

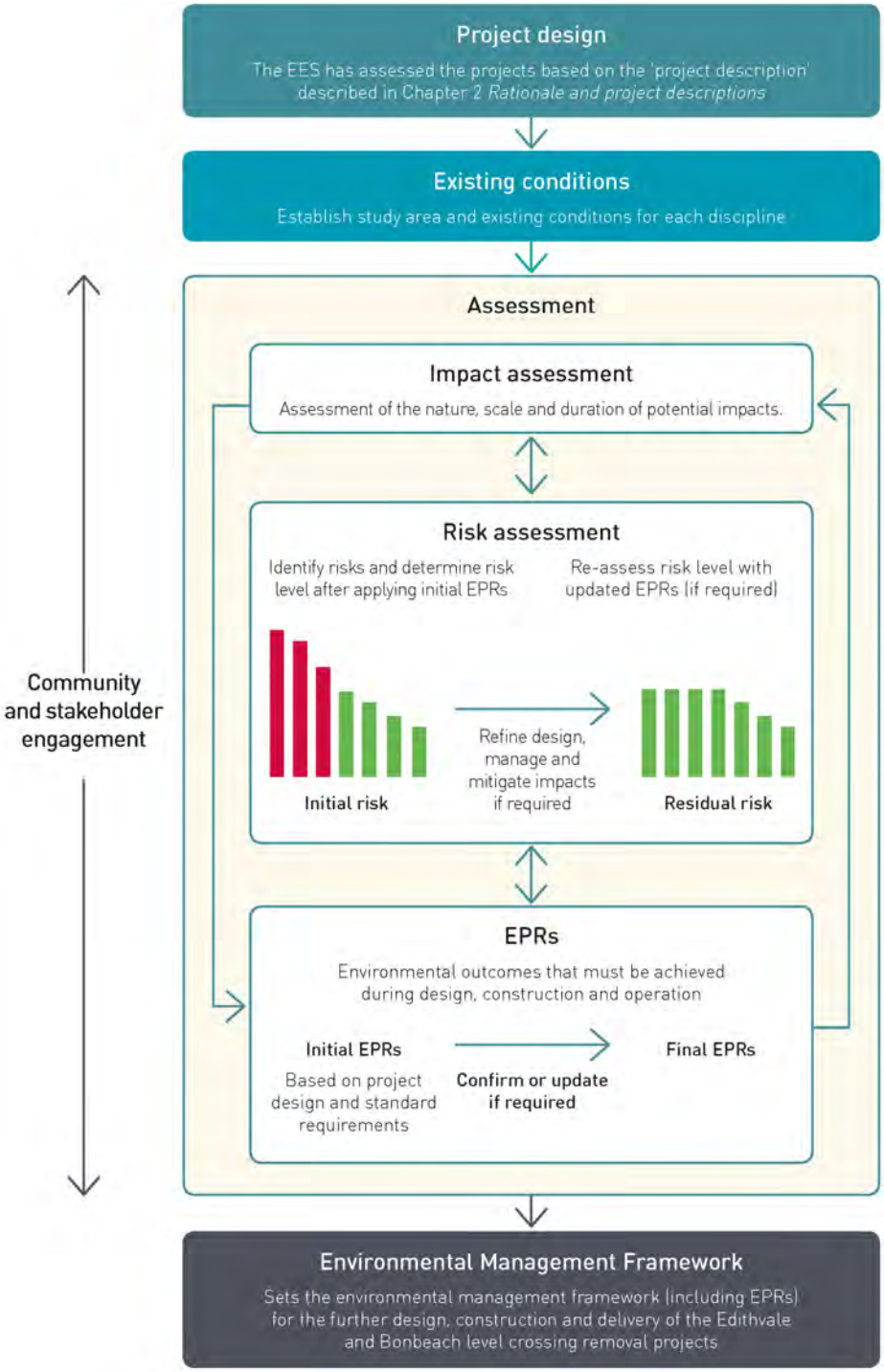

Figure 5 Overview of impact and risk assessment process

The following sections outline the methodology for the traffic impact assessment.

4.1 Existing conditions assessment

Information on the existing road network for the Edithvale and Bonbeach study areas was gathered from a number of sources to establish an overview of the transport conditions at each site. Sources of information included:

- site visit observations
- aerial photos
- City of Kingston
- VicRoads
- Public Transport Victoria
- traffic counts.

Descriptions of the local road network, local area Road Use Hierarchy and crash statistics have been prepared and transport network plans showing bus, cyclist and pedestrian access and movement created. Existing traffic volumes for vehicles, cyclists and pedestrians were obtained by undertaking traffic surveys for Edithvale and Bonbeach at key intersections in the study areas. Pedestrian count data has been analysed to determine key origins and destinations in the area around the level crossings.

The existing conditions information and network plans clearly articulate the provision that is currently made for the different transport modes so the potential impacts of level crossing removal and associated transport network changes can be better understood.

4.2 Risk assessment

A risk-based approach is integral to the EES as required by Section 3 of the Scoping Requirements for the EES.

The risk management approach adopted for the Edithvale and Bonbeach EES is consistent with AS/NZS ISO 31000:2009 Risk Management Process and involves the following steps:

- establishment of the context of the risk assessment – this identifies the boundaries of the projects including the project definition, the duration of construction and operation, the design and environmental controls that would be in place (initial Environmental Performance Requirements (EPRs) – refer to Section 9), and the location of the projects
- risk identification – identification of risk pathways by specialists in each relevant discipline area
- risk analysis – assessment of risk for each risk pathway, whereby risk is a combination of:
    - the likelihood of an event and its associated consequences occurring
    - the magnitude of potential consequences of the event.
- risk evaluation – review key risks posed by the projects to focus effort in terms of impact assessment and mitigation.
- risk treatment – identification of additional management and mitigation where required to reduce risk levels where possible.

An initial risk assessment was undertaken to assess potential risks to the environment arising from the implementation of the projects. Where risks were minor or above, further mitigation was explored. Risks were re-assessed to determine the residual risk based on further mitigation.

A more detailed description of each step in the risk assessment process is provided in EES Attachment II *Environmental Risk Report*.

This technical report describes the risks associated with the projects on traffic.

4.3 Impact assessment

4.3.1 Construction

The components of the Edithvale and Bonbeach level crossing removal projects and the potential construction elements/methodologies have been reviewed. From this information it has been determined that a number of aspects of the likely construction methodology have potential to impact traffic operations and road safety, including:

- lane closures (vehicle and bicycle lanes) and parking removal
- road closures and diversions
- rail line closures and alternative public transport
- pedestrian and cyclist facility closures
- construction traffic.

Using existing conditions assessment information including traffic count data, the above construction aspects have been explored to determine their potential impacts. Impacts have been assessed using both quantitative and qualitative means, including:

- Lane closures have been assessed by comparing observed traffic data to the potential road capacities during construction.
- Major road closures and diversions have been assessed by redistributing current traffic volumes and comparing the estimated volumes to the potential road capacities during construction.
- Construction traffic during the main occupation has been considered by assigning estimated construction traffic volumes to potential site access routes and assessing the impact on road capacities.

Measures to mitigate the identified impacts have been identified and discussed.

The assessment of construction impacts has been informed by feedback received from VicRoads on the initial risk assessment and risk ratings.

4.3.2 Operation

Several aspects of the works have potential to impact traffic operations and road safety during the operational phase, with the most significant elements being the reinstatement and upgrade of the intersections of Nepean Highway, Station Street and Edithvale Road in Edithvale and intersections of Nepean Highway, Station Street, and Bondi Road in Bonbeach.

The future operational traffic volumes at these intersections have been estimated using the Victorian Integrated Transport Model at Edithvale and manual traffic redistribution (to account for network connectivity changes) at Bonbeach. Potential modified layouts of the intersections have been modelled with the estimated traffic volumes using SIDRA software and the results analysed to understand how the intersection layouts might affect traffic operations. In addition, other potential changes to the transport network and their impacts on buses, cyclists and pedestrians have also been explored. Measures to mitigate the traffic and road safety impacts have been identified and discussed.

The assessment of operational impacts has been informed by feedback received from VicRoads on the initial risk assessment and potential intersection modifications and phasing.

4.4 Environmental Performance Requirements

The environmental outcomes that must be achieved during design, construction and operation of the projects are referred to throughout the EES as EPRs. EPRs must be achieved regardless of the construction methodology or design solutions adopted. Measures identified in this EES to avoid or minimise environmental impacts have formed part of the recommended EPRs for the projects.

The development of a final set of EPRs for the project has been iterative.

4.4.1 Initial EPRs

Environmental performance requirements were identified to inform the assessment of initial risk ratings (where appropriate). These initial EPRs were based on compliance with legislation and standard requirements that are typically incorporated into the delivery of construction contracts for rail projects.

4.4.2 Confirm or update EPRs

The risk assessment either confirmed that these EPRs were adequate or identified the need for further refinement.

EPRs were updated or new EPRs were developed for any initial risk that could not be appropriately managed by standard requirements. The risk and impact assessment processes confirmed the effectiveness of new or updated EPRs to determine the residual risk rating.

4.4.3 Final EPRs

The EPRs recommended for the projects are outlined in Section 9 of this report and are included in the EES Environmental Management Framework.

The EPRs are applicable to the final design, construction approach and operation and provide certainty regarding the environmental performance of the projects.

5 Existing conditions

5.1 Edithvale

5.1.1 Site location

The level crossing on Edithvale Road in Edithvale is located between Nepean Highway and Station Street as shown in Figure 6. There are signalised intersections either side of the level crossing that operate as a single traffic signal site. Edithvale Station is located approximately 75 metres to the north of the level crossing. A pedestrian level crossing is also present on the northern side of the Edithvale Road, facilitating movements between the train station and the footpaths along Nepean Highway, Station Street and Edithvale Road.

Figure 6 Aerial photo of Edithvale Road, Nepean Highway and Station Street

5.1.2 Local road network

Table 2 summarises the existing conditions of key roads in proximity to the level crossing. Figure 7 diagrammatically shows the Road Use Hierarchy and Principal Bicycle Network.

Table 2 Existing conditions in Edithvale

Transport element	Edithvale Road	Nepean Highway	Station Street
Road type	Arterial	Arterial	Collector
Speed limit	60 km/h	60 km/h	60 km/h
Managed by	VicRoads	VicRoads	City of Kingston
Carriageway	Single	Single	Single
Total number of lanes (two-way)	Two with extra lanes at Station Street	Four with extra lanes at intersections	Two with extra lanes at intersections
Traffic control	Traffic signals at Nepean Highway and Station Street intersections	Traffic signals at Edithvale Road intersection	Traffic signals at Edithvale Road intersection
Road Use Hierarchy	Traffic Route and Bus Priority Route	Traffic Route, Pedestrian Priority Route between Natal Avenue and Derrybeg Lane	Bicycle Priority Route and Bus Priority Route south of Edithvale Road
On the Principal Bicycle Network?	Yes	No	Yes
On a Strategic Cycling Corridor?	No	No	Yes
Bicycle facilities	On-road bicycle lanes which start and end 80 m east of Station Street	None	On-road bicycle lanes which start and end 80 m north and south of Edithvale Road
Pedestrian facilities	Footpath on both sides. Signalised pedestrian crossing on east side of Station Street.	Footpath on western side. Footpath on eastern side north of Edithvale Road to station entrance. Signalised pedestrian crossing on north side of Edithvale Road.	Footpath on eastern side. Footpath on western side north of Edithvale Road to bus stop and station entrance. Signalised pedestrian crossing on north side of Edithvale Road.

Transport element	Edithvale Road	Nepean Highway	Station Street
Bus facilities	SmartBus route 902 and bus route 858 (eastbound only between Station Street and Kinross Avenue). Bus stops (two eastbound and one westbound) west of Vincent Street.	None	Off Peak 706, SmartBus route 902 (south of Edithvale Road) and bus route 858 (southbound only between Rae Avenue and Edithvale Road). One bus stop either side of Station Street north of Edithvale Road and one bus stop either side of Station Street north of Fraser Avenue.
B-Double Approved Route?	Yes	Yes	No
Truck Over-Dimensional Route?	No	No	No

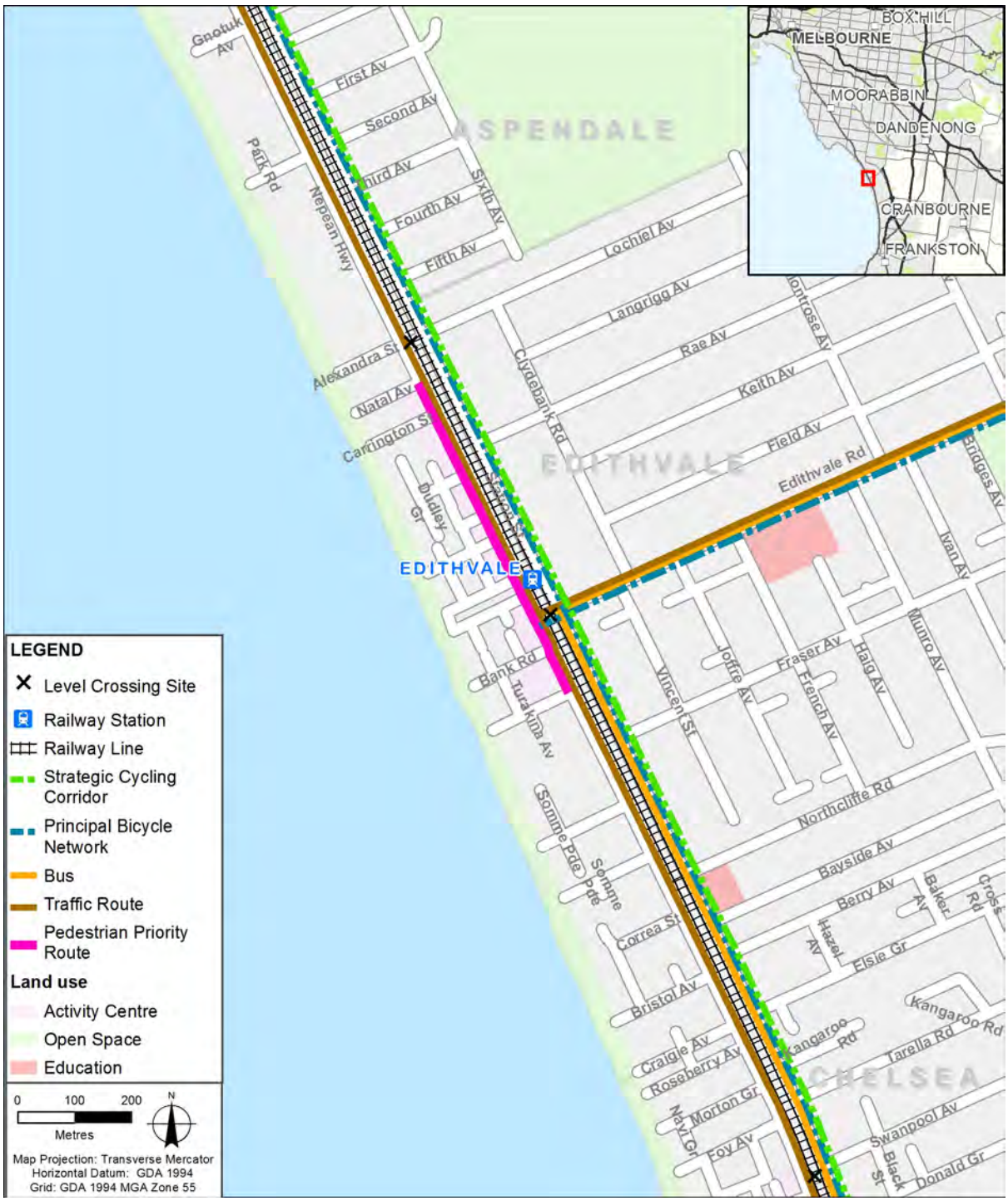

Figure 7 Edithvale Road Use Hierarchy and Principal Bicycle Network

5.1.3 Traffic conditions

The VicRoads Open Data website has been consulted to obtain the annual average daily traffic (AADT) volumes for key roads in proximity to the level crossing. This data has values for 2017 derived from traffic surveys or estimates and applies to road links throughout Melbourne. Where no information was available or the available information was not regarded as being accurate for the area around the level crossing, volumes have been estimated from turning movement counts (see Section 5.1.4). The estimated two-way AADT for Nepean Highway, Station Street and Edithvale Road, Edithvale is presented in Figure 8.

Traffic signal data indicates the level crossing boom gates at the Edithvale Road, Edithvale level crossing are down for an average of 42 minutes during the weekday peak between 7:00 am and 9:00 am. Site observations were undertaken on Wednesday 9 December 2015 during the AM (7:30 am to 9:00 am) and PM (4:30 pm to 6:00 pm) peak periods. Key traffic observations and photographs showing existing conditions (taken in January 2018 during the school holiday period) are as follows:

- Some vehicles on Edithvale Road that may have originally planned to cross the level crossing (and turn right into Nepean Highway) appeared to change their route and turned right into Station Street due to the boom gates being down.
- It was harder for vehicles to turn right from Edithvale Road into Station Street (east approach) when the boom gates were up, due to eastbound traffic travelling across the rail corridor.
- There were some long queues on each approach, however queueing on each approach to the intersections cleared almost every time (after the boom gates were raised) apart from the north approach on Nepean Highway, which extended to the Lochiel Avenue intersection. Figure 9 shows observed queueing on the Edithvale Road approach to the Station Street intersection in the AM peak. Figure 10 shows observed queuing on the northern Station Street approach to the Edithvale Road intersection during the PM peak. Figure 11 shows queuing on the northern Nepean Highway approach to the Edithvale intersection during the PM peak.
- There were long queues on the north approach of Nepean Highway at Edithvale Road during the PM peak period due to the short left-turn lane. This was worse when the boom gates were down due to the build-up of left-turning vehicles. The queuing resulted in turning vehicles blocking one of the southbound through traffic lanes and subsequently creating a bottleneck of vehicles attempting to merge right into the other southbound traffic lane. This resulted in southbound queues on Nepean Highway extending back to Lochiel Avenue a number of times during the site visit. This issue is shown in Figure 12.
- On the north approach on Nepean Highway at Lochiel Avenue, many vehicles turned left from Nepean Highway into Lochiel Avenue, crossing the rail corridor and then turning right into Station Street. This was potentially done to avoid the traffic queuing on Nepean Highway from Edithvale Road as discussed above.

In summary, vehicles travelling through the Nepean Highway, Station Street and Edithvale Road intersections are subject to delays under the current operation of the intersections and boom gates. A number of drivers are suspected to be altering their route due to congestion. Vehicles turning right or through from the east approach of Edithvale Road and Nepean Highway southbound travelling vehicles are experiencing significant negative impacts to their journeys.

Figure 8 Edithvale average annual daily traffic volumes

Figure 9 Edithvale Road eastern approach queueing during the AM peak period

Figure 10 Station Street northern approach queueing during the PM peak period

Figure 11 Nepean Highway northern approach queueing during the PM peak period

Figure 12 Left turners blocking southbound through lane on Nepean Highway

5.1.4 Traffic volumes

Turning movement counts were conducted on Wednesday 28 June 2017 for vehicles at the intersections of Edithvale Road, Swanpool Avenue and Lochiel Avenue with Nepean Highway and Station Street. The surveys were conducted between 6:00 am and 7:00 pm. An Automated Traffic Count (ATC) survey was undertaken on Edithvale Road from Wednesday 28 June 2017 to Tuesday 4 July 2017.

The Nepean Highway, Station Street and Edithvale Road intersections will change significantly due to the project and are analysed in the following sections of this report. The AM peak hour has been taken as 7:30 am to 8:30 am and the PM peak hour 5:15 pm to 6:15 pm. The highest two-way volume of vehicles crossing over the level crossing during the peak periods was 396 vehicles per hour in the PM peak.

A summary of the surveyed hourly total vehicle volumes by approach to the intersections is displayed in Figure 13. Table 3 provides the total and individual peak hourly vehicle volumes for each approach of the intersections during the survey period. Figure 14 shows the existing peak hour turning movement volumes during the identified AM and PM peak periods.

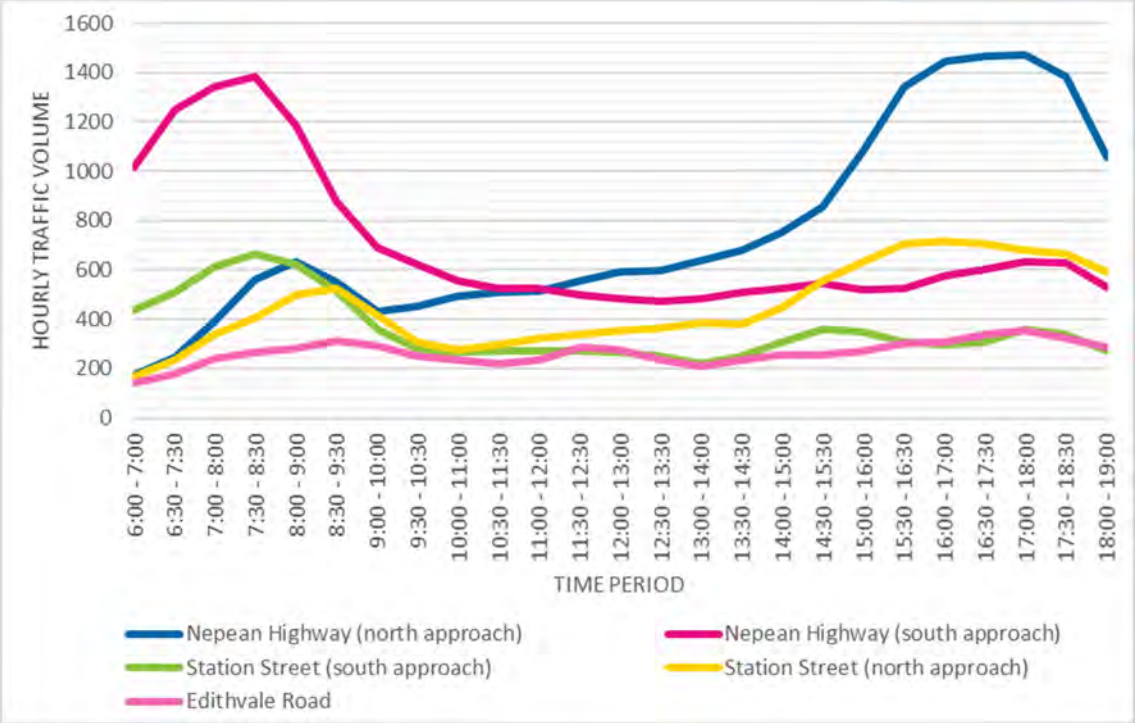

Figure 13 Traffic Survey Data – Nepean Highway, Station Street and Edithvale Road

Table 3 Traffic survey volumes – Nepean Highway, Station Street and Edithvale Road

Intersection approach	Total surveyed vehicle volumes (6:00 am to 7:00 pm)	Peak vehicle hourly volumes	
		Vehicles per hour	Time of peak
Nepean Highway (north)	9675	1469	5:00 pm to 6:00 pm
Nepean Highway (south)	9062	1384	7:30 am to 8:30 am
Station Street (north)	5833	717	4:00 pm to 5:00 pm
Station Street (south)	4694	667	7:30 am to 8:30 am
Edithvale Road (east)	3391	356	5:00 pm to 6:00 pm

The traffic counter for the Automated Traffic Count (ATC) survey undertaken on Edithvale Road was placed approximately 40 metres west of Kinross Avenue. The following has been found from this survey:

- AM peak hour for Wednesday 28 June 2017 was 8:00 am to 9:00 am with 778 vehicles per hour vehicles travelling eastbound and 477 vehicles per hour westbound. The peak hour for Edithvale Road was half an hour after the intersection peak.
- PM peak hour for Wednesday 28 June 2017 was 5:00 pm to 6:00 pm with 527 vehicles travelling eastbound and 910 westbound. The peak hour for Edithvale Road was 15 minutes prior to the intersection peak.

The closest level crossing to the north of Edithvale Road is Lochiel Avenue. Turning movement counts at the intersections of Nepean Highway, Station Street, Lochiel Avenue and Alexandria Street have found the following:

- AM peak was 7:45 am to 8:45 am and 4:45 pm to 5:45 pm for the PM peak.
- Nepean Highway peak hourly volume was 1,486 vehicles per hour from the north approach and 1,449 vehicles per hour from the south.
- Station Street peak hourly volume was 928 vehicles per hour from the north approach and 679 vehicles per hour from the south.
- 136 vehicles per hour was the highest two-way volume of vehicles crossing over the level crossing during the peak periods, occurring in the AM peak.

The closest level crossing to the south of Edithvale road is at Swanpool Avenue. Turning movement counts at the intersections of Nepean Highway, Station Street, Swanpool Avenue and Kelvin Grove have found the following:

- AM peak was 7:45 am to 8:45 am and 5:00 pm to 6:00 pm for the PM peak.
- Nepean Highway peak hourly volume was 1,433 vehicles per hour from the north approach and 1,319 vehicles per hour from the south.
- Station Street peak hourly volume was 666 vehicles per hour from the north approach and 561 vehicles per hour from the south.
- 342 vehicles per hour was the highest two-way volume of vehicles crossing over the level crossing during the peak periods, occurring in the evening peak.

Figure 14 Edithvale existing network traffic volumes summary

5.1.5 Incidents

The frequency and length of closure of boom gates at the level crossing is a significant source of frustration for motorists, cyclists, and pedestrians. The duration of boom gate closures encourages risky behaviour from road users trying to 'beat' the red-lights and boom gates to avoid lengthy waits. This problem may exacerbate with increased traffic volumes and train frequencies in the future.

Statistics provided by Transport Safety Victoria and the Office of the National Rail Safety Regulator indicate that in the ten year period ending on 31 December 2014 there was one fatal collision between a train and road vehicle and seven near miss incidents between a train and pedestrian. Statistics taken from VicRoads Crashstats database for the same period indicate that there were 11 casualty crashes that did not involve a train, recorded within 20 metres of the level crossing on Edithvale Road.

Further interrogation of VicRoads Crashstats data was undertaken to assess crash types and trends along Nepean Highway, Station Street, Lochiel Avenue and Edithvale Road near the level crossings for the five year period between 1 July 2010 and 30 June 2015. The crash trends identified were as follows:

- There were four crashes (one serious injury crash and three other injury crashes) at Lochiel Avenue involving right turning vehicles not giving way to traffic on Station Street. Two of these crashes involved a collision with a cyclist.
- There were several crashes at or near Edithvale Road. There is a crash trend of loss of control crashes where three Other Injury crashes included two southbound vehicles on Station Street involving either a head-on crash or a vehicle that lost control and went off the road.
- There were six crashes (one Serious Injury crash and five Other Injury crashes) at Nepean Highway and Bank Road (which is south of Edithvale Road). There is a crash trend of incidents involving vehicles turning right in or out of Bank Road.

5.1.6 Pedestrians

Due to the rail corridor, footpaths are predominately provided on the eastern side of Station Street and western side of Nepean Highway. Footpaths are however provided on both sides of the roads near Edithvale Station to facilitate station access. Edithvale Road and other local roads have footpaths provided on both sides of the road.

The signalised intersections of Nepean Highway, Station Street and Edithvale Road include signalised crosswalks on Nepean Highway (north of Edithvale Road), Station Street (north of Edithvale Road) and Edithvale Road (east of Station Street). These crosswalks provide access to Edithvale Station and facilitate movement between residential, commercial and recreational land uses. For pedestrians to travel between platforms they have to use the pedestrian level crossing on the north side of Edithvale Road.

The access and mobility for pedestrians is shown in Figure 15.

Figure 15 Edithvale existing pedestrian access and mobility

A pedestrian survey was conducted on Wednesday 28 June 2017 at the signalised intersections of Nepean Highway, Station Street and Edithvale Road. An overview of the survey locations is shown in Figure 16.

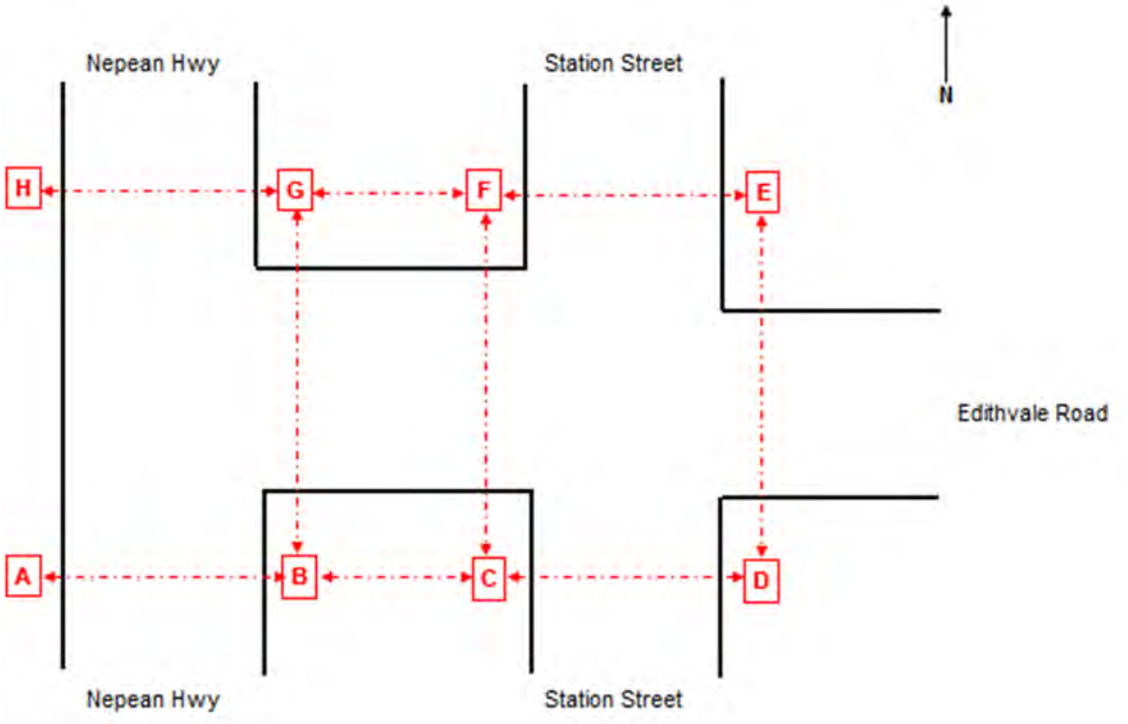

Figure 16 Pedestrian survey data locations at Nepean Highway, Station Street and Edithvale Road

Table 4 provides a summary of the survey data for pedestrian movements during peak periods and across the survey day at each of the signalised pedestrian crossings. The results show that Station Street had the highest overall pedestrian volumes across the day but the highest hourly volumes were in the AM peak at the pedestrian level crossing. The pedestrian peak hours are different to the vehicular peak hours.

Table 4 Pedestrian survey volumes at pedestrian crossings

Intersection crossing	Direction of travel	AM peak (7:30 am to 8:30 am)	PM peak (3:30 pm to 4:30 pm)	Daily (6:00 am to 7:00 pm)
Nepean Highway (north)	West to east (H to G)	18	13	169
	East to west (G to H)	3	38	195
Level Crossing (north)	West to east (G to F)	9	24	214
	East to west (F to G)	255	75	790
Station Street (north)	West to east (F to E)	15	94	542
	East to west (E to F)	193	48	548
Edithvale Road	North to south (E to D)	3	28	121
	South to north (D to E)	31	13	131

Table 5 provides a similar summary of the survey data at each of the informal crossing locations at the level crossing intersections. The results show a high volume of pedestrians informally crossing Edithvale Road east of the rail corridor (northbound) in the AM peak. This is likely due to pedestrians travelling from the existing car-parking on Station Street south of Edithvale Road.

Table 5 Pedestrian survey volumes at informal intersection crossings

Intersection crossing	Direction of travel	AM peak (7:30 am to 8:30 am)	PM peak (3:30 pm to 4:30 pm)	Daily (6:00 am to 7:00 pm)
Nepean Highway (south)	West to east (A to B)	3	0	6
	East to west (B to A)	0	0	2
Level Crossing (south)	West to east (B to C)	0	0	2
	East to west (C to B)	2	0	11
Level Crossing (west)	North to south (G to B)	3	0	26
	South to north (B to G)	25	0	60
Level Crossing (east)	North to south (F to C)	1	8	93
	South to north (C to F)	47	3	112
Station Street (south)	West to east (C to D)	0	0	4
	East to west (D to C)	0	0	4

The pedestrian survey also captured origin-destination (OD) movements of pedestrians moving around Edithvale Station, Station Street and Nepean Highway. A summary of the pedestrian OD survey results is provided in Figure 17. The highest volumes both across the day and during the pedestrian AM peak period were pedestrians crossing the rail corridor from Station Street to the western side of Edithvale Station. Pedestrians were travelling to the western platform of Edithvale Station (city bound platform). In the PM peak, the majority of pedestrians travelled eastbound to Station Street (north) from the eastern side of the rail corridor.

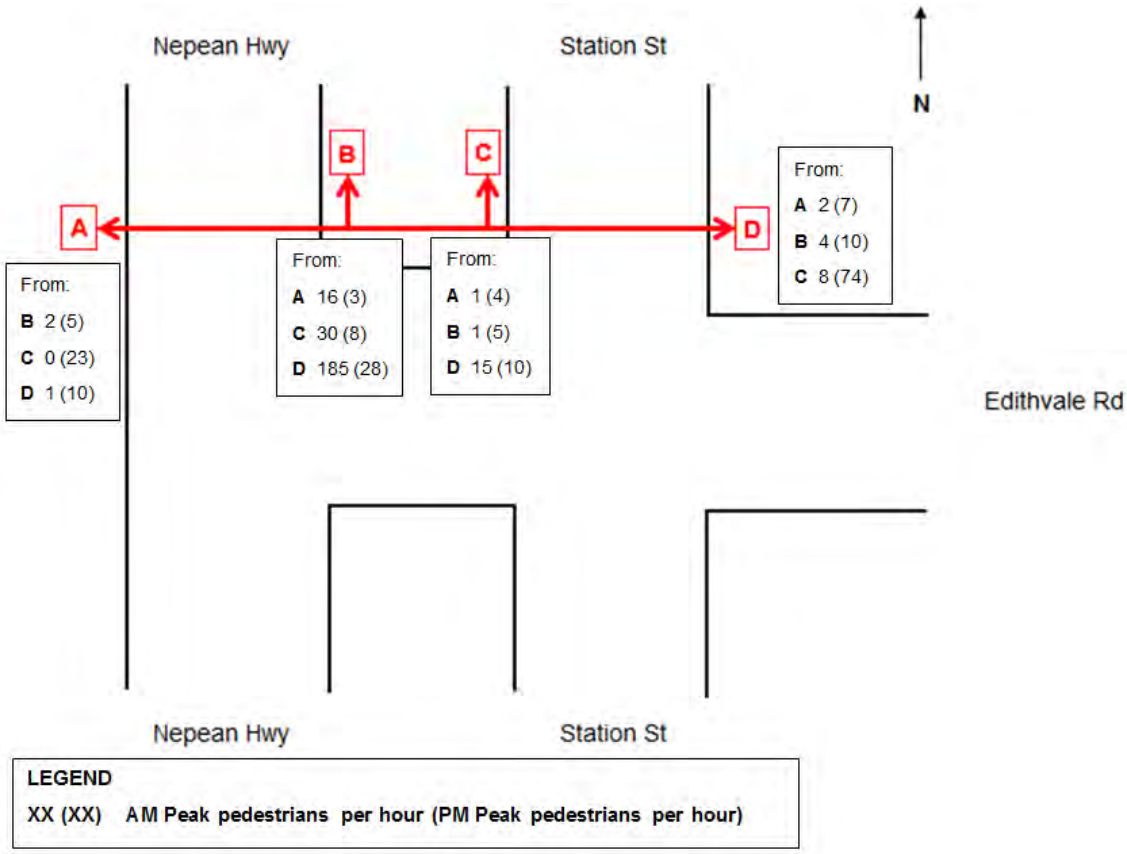

Figure 17 Pedestrian origin and destination survey volumes

5.1.7 Cyclists

Station Street and Edithvale Road have on-road bicycle lanes for each direction of travel, however these are discontinued at the intersection. The bicycle lanes on Station Street discontinue approximately 80 metres north and south of Edithvale Road. The bicycle lanes on Edithvale Road bicycle lanes discontinue approximately 80 metres east of Station Street.

Station Street and Edithvale Road are designated Principle Bicycle Network routes, with Station Street also being classified as a Strategic Cycling Corridor. The access and mobility for cyclists is shown in Figure 18.

Figure 18 Edithvale existing cyclist access and mobility

The number of cyclists travelling through the signalised intersections of Nepean Highway, Station Street and Edithvale Road have been analysed from the survey undertaken on Wednesday 28 June 2017 between 6:00 am and 7:00 pm. Table 6 provides a summary of the bicycle volumes.

Table 6 Cycle survey volumes at Nepean Highway, Station Street and Edithvale Road

Intersection approach	Total surveyed vehicle volumes (6:00 am to 7:00 pm)	Peak vehicle hourly volumes	
		Vehicles per hour	Time of peak
Nepean Highway (north)	98	59	6:00 am to 7:00 am
Nepean Highway (south)	120	21	7:00 am to 8:00 am
Station Street (north)	105	20	10:30 am to 11:30 am
Station Street (south)	114	35	6:00 am to 7:00 am
Edithvale Road	6	2	Not applicable

As shown in Table 6, cyclist volumes are relatively evenly spread between Nepean Highway and Station Street with very low number of cyclists observed using Edithvale Road.

5.1.8 Public Transport

Three local bus routes operate in close proximity to the Edithvale Road level crossing and Edithvale Railway Station. Bus route 858, SmartBus 902 and off-peak bus route 706 use Station Street and Edithvale Road but do not cross the level crossing. The bus routes are shown on Figure 19 and described below:

- Bus route 858 travels southbound along Station Street and does a loop around the local roads to travel south to Chelsea. The bus frequency is every 30 minutes throughout the weekdays.
- SmartBus 902 travels along Edithvale Road and Station Street south of Edithvale Road. This SmartBus route is one of nine regional key cross-town bus routes which typically operate every 15 minutes throughout the weekdays. This bus route operates between Chelsea and Airport West.
- Off-peak bus route 706 operates along Station Street between Mordialloc and Chelsea. This bus operates three times a day between 10:00 am and 2:30 pm.

Edithvale Railway Station is located to the north of the Edithvale Road level crossing. Edithvale Station serves the Frankston railway line. Trains typically operate every 10 minutes to the city in the peak periods.

Figure 19 Edithvale Local Public Transport

5.2 Bonbeach

5.2.1 Site location

The level crossing on Station Street (Bondi Road) in Bonbeach is located between Nepean Highway and Station Street as shown in Figure 20. There are signalised intersections either side of the crossing that operate as a single traffic signal site. Bonbeach Station is located approximately 75 metres to the north. A pedestrian level crossing is also present on the northern side of the crossing, facilitating movements between the train station and the footpaths along Nepean Highway, Station Street and Bondi Road.

It is noted that the short section of road between Nepean Highway and Station Street that crosses the rail corridor and connects to Bondi Road is part of Station Street. In this report this short link is generally referred to as Station Street (Bondi Road).

Figure 20 Aerial photo of Nepean Highway, Station Street and Bondi Road

5.2.2 Local road network

Table 7 summarises the existing conditions of key roads in proximity to the level crossing. Figure 21 diagrammatically shows the Road Use Hierarchy and Principle Bicycle Network.

Table 7 Existing conditions in Bonbeach

Transport element	Nepean Highway	Station Street	Bondi Road
Road type	Arterial	Local Collector	Local
Speed limit	60 km/h	60 km/h	50 km/h
Managed by	VicRoads	City of Kingston	City of Kingston
Carriageway	Single	Single	Single
Total number of lanes (two-way)	Four with extra lanes at intersections	Two with extra lanes at intersections. The section of Station Street that crosses the rail corridor is marked as two lanes westbound and one lane eastbound	Two but not marked
Traffic control	Traffic signals at Station Street intersection	Traffic signals at Nepean Highway and Bondi Road intersections	Traffic signals at Station Street intersection
Road Use Hierarchy	Traffic Route, Bicycle Priority Route and Pedestrian Priority Route north of Bondi Road	None	None
On the Principal Bicycle Network?	Yes	No	No
On a Strategic Cycling Corridor?	Yes	No	No
Bicycle facilities	None	Bicycle lanes but they start/stop 80 m north/south of Bondi Road	None

Transport element	Nepean Highway	Station Street	Bondi Road
Pedestrian facilities	Footpath on western side. Pedestrian crossing on north side of Nepean Highway at signals with Station Street (Bondi Road).	Footpath on eastern side. Pedestrian crossing on north side of signals with Bondi Road. Pedestrian level crossing over the rail line on north side of Station Street (Bondi Road).	Footpath on both sides. Pedestrian crossing on east side of Station Street.
Bus facilities	None	None	None
B-Double Approved Route?	Yes	No	No
Truck Over-Dimensional Route?	No	No	No

Figure 21 Bonbeach local area showing the road use hierarchy and Principal Bicycle Network

5.2.3 Traffic conditions

The VicRoads Open Data website has been consulted to obtain the annual average daily traffic (AADT) volumes for key roads in proximity to the level crossing. This data has values for 2017 derived from traffic surveys or estimates and applies to road links throughout Melbourne. Where no information was available or the available information was not regarded as being accurate for the area around the level crossing, volumes have been estimated from turning movement counts (see Section 5.2.4). The estimated two-way AADT for Nepean Highway, Station Street and Bondi Road, Bonbeach is presented in Figure 22.

Traffic signal data indicates the level crossing boom gates at the Bonbeach level crossing are down for an average of 45 minutes during the weekday 7:00 am – 9:00 am peak period. Site observations were undertaken on Wednesday 9 December 2015 during the morning (7:30 am to 9:00 am) and afternoon (4:30 pm to 6:00 pm) periods. Key traffic observations were:

- There were not significant queues at the intersections, but due to complicated signal phasing there were substantial delays at times for vehicles turning across the level crossing.
- When boom gates were down queue lengths were short and cleared quickly once boom gates went up.
- The left turn from Nepean Highway blocked the southbound movement even though there were not many vehicles turning left. There was some confusion as to whether left turning vehicles were supposed to stop on Nepean Highway or at the level crossing. Where there was only one car stopped at the level crossing then southbound vehicles were not blocked.
- There was some congestion when there were two trains close together and the boom gates were down for a longer period of time.

In summary, the vehicles travelling through the Nepean Highway, Station Street and Bondi Road intersections are subject to delays under the current operation of the intersections and boom gates, in particular those heading southbound on Nepean Highway.

Figure 22 Bonbeach average annual daily traffic volumes

5.2.4 Traffic volumes

Turning movement counts were conducted on Wednesday 28 June 2017 for vehicles at the intersections of Nepean Highway and Station Street with Bondi Road and Harding Avenue. The surveys were conducted between 6:00 am and 7:00 pm.

The Nepean Highway, Station Street and Bondi Road intersections will change significantly due to the project and are analysed in the following sections of this report. The peak hour for the AM peak has been taken as 7:45 am to 8:45 am and 5:00 pm to 6:00 pm for the PM peak. The highest two-way volume of vehicles crossing over the level crossing during the peak periods was 246 vehicles per hour in the PM peak.

Table 8 provides the total and individual peak hourly vehicle volumes for each approach of the intersections during the survey period. Figure 23 shows the existing peak hour turning movement volumes during the identified AM and PM peak periods.

Table 8 Traffic survey volumes – Nepean Highway, Station Street, Bondi Road and Harding Avenue

Intersection approach	Total surveyed vehicle volumes (6:00 am to 7:00 pm)	Peak vehicle hourly volumes	
		Vehicles per hour	Time of peak
Nepean Highway (north)	8974	1316	4:00 pm to 5:00 pm
Nepean Highway (south)	8551	1181	7:00 am to 8:00 am
Station Street (north)	2273	282	5:00 pm to 6:00 pm
Station Street (south)	2151	231	8:00 am to 9:00 am
Bondi Road	723	78	8:30 am to 9:30 am
Harding Avenue	149	19	7:30 am to 8:30 am

The closest level crossing to the north of Station Street is near Argyle Avenue. Turning movement counts at the intersections of Nepean Highway, Station Street, Argyle Avenue and Maury Road have found the following:

- AM peak was 7:45 am to 8:45 am and 5:00 pm to 6:00 pm for the PM peak.
- Nepean Highway peak hourly volume was 1,237 vehicles per hour from the north approach and 1,236 vehicles per hour from the south.
- Station Street peak hourly volume was 383 vehicles per hour from the north approach and 316 vehicles per hour from the south.
- 294 vehicles per hour was the highest two-way volume of vehicles crossing over the level crossing during the peak periods, occurring in the evening peak.

Figure 23 Bonbeach existing network traffic volumes summary

5.2.5 Incidents

The frequency and length of closure of boom gates at the level crossing is a significant source of frustration for motorists, cyclists, and pedestrians. The duration of boom gate closures encourages risky behaviour from road users trying to 'beat' the red-lights and boom gates to avoid lengthy waits. This problem may exacerbate with increased traffic volumes and train frequencies in the future.

Statistics provided by Transport Safety Victoria and the Office of the National Rail Safety Regulator indicate that in the ten year period ending on 31 December 2014 there was one non-fatal collision incident between a train and road vehicle, three near miss incidents between a train and road vehicle and five near miss incidents between a train and pedestrian. Statistics taken from VicRoads Crashstats database for the same period indicate that there were 16 casualty crashes that did not involve a train, recorded within 20 metres of the level crossing on Station Street (Bondi Road).

Further interrogation of VicRoads Crashstats data was undertaken to assess crash types and trends at the existing Nepean Highway, Station Street and Bondi Road signalised intersections for the five year period between 1 July 2010 and 30 June 2015. A total of six crashes were recorded, with the following of note:

- Two crashes were Serious Injury crashes and the remaining four were Other Injury crashes.
- One Other Injury crash involved a truck being stationary on the train tracks and being hit by a train.
- Three of the crashes (including one serious injury crash) involved right turning cars, with one car hitting a cyclist on Station Street.

5.2.6 Pedestrians

Due to the rail corridor, footpaths are predominately provided on the eastern side of Station Street and western side of Nepean Highway. Footpaths are however provided on both sides of the roads in proximity to Bonbeach Station to facilitate station access. Bondi Road and other local roads have footpaths provided on both sides of the road.

The signalised intersections of Nepean Highway, Station Street and Bondi Road include signalised crosswalks on Nepean Highway (north), Station Street (north) and Bondi Road. These crosswalks provide access to Bonbeach Station and facilitate movement between residential, commercial and recreational land uses.

The access and mobility for pedestrians is shown in Figure 24.

Figure 24 Bonbeach existing pedestrian access and mobility

A pedestrian survey was conducted on Wednesday 28 June 2017 at the signalised intersections of Nepean Highway, Station Street and Bondi Road. Given there are car parking spaces without footpaths or a signalised crossing to Bonbeach Station, the survey included all crossing points rather than just surveying the formal pedestrian crossings. The purpose of this was to see if there were many pedestrians undertaking crossings at locations with no formal pedestrian facilities.

Figure 25 shows the locations where pedestrians and cyclists were surveyed at the intersections of Nepean Highway, Station Street, Bondi Road and Harding Avenue.

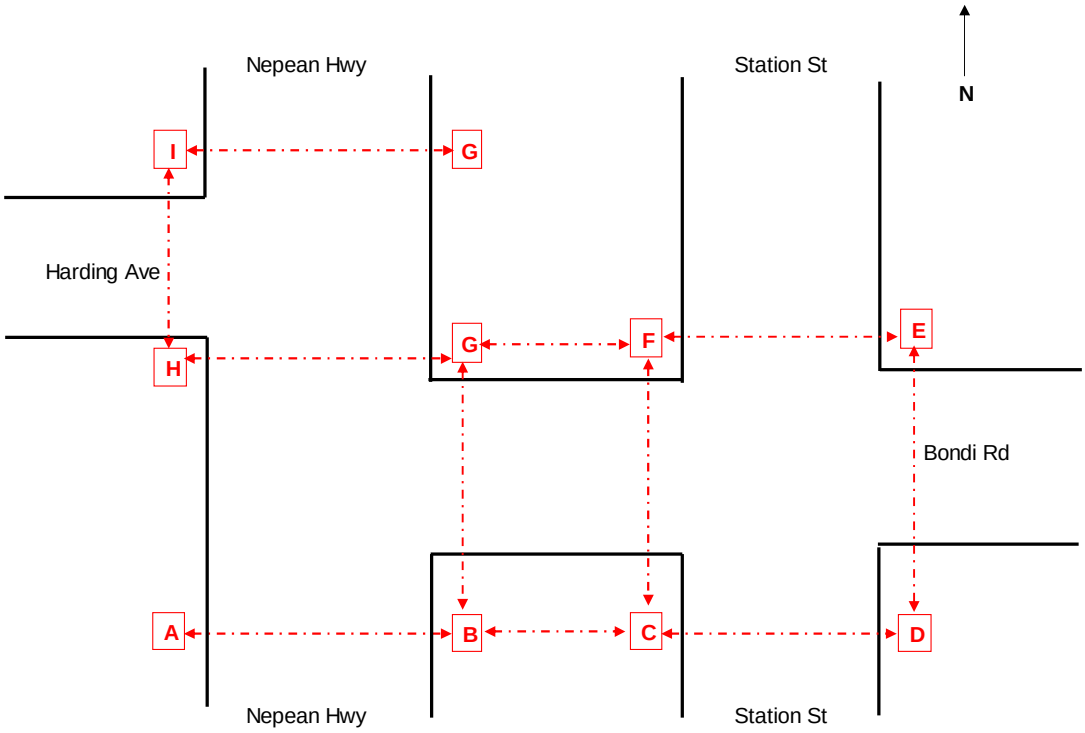

Figure 25 Pedestrian survey data locations at Nepean Highway, Station Street, Bondi Road and Harding Avenue

Table 9 provides a summary of survey data at each of the formal crossing points. The east-to-west movement across the level crossing has the highest daily and AM peak pedestrian volumes. The west-to-east movement at Station Street (north) has the highest volume in the PM peak. The pedestrian peak hours are different to the vehicular peak hours.

Table 9 Pedestrian survey volumes at formal intersection crossings

Intersection crossing	Direction of travel	AM peak (7:30 am to 8:30 am)	PM peak (4:30 pm to 5:30 pm)	Daily (6:00 am to 7:00 pm)
Harding Avenue	North to south (I to H)	2	10	48
	South to north (H to I)	2	7	77
Nepean Highway (north)	West to east (H to G)	21	19	93
	East to west (G to H)	3	26	120
Level Crossing (north)	West to east (G to F)	4	33	142
	East to west (F to G)	117	27	420
Station Street (north)	West to east (F to E)	3	36	200
	East to west (E to F)	55	7	195
Bondi Road	North to South (E to D)	0	0	34
	South to North (D to E)	2	0	21

Table 10 provides a summary of the survey data at each of the informal crossing locations at the level crossing intersections. The results show a high volume of pedestrians informally crossing the level crossing from east-to-west and travelling south-to-north at the intersection of Nepean Highway towards the station during the AM peak. In the PM peak, pedestrians crossed from north-to-south at the intersection of Station Street, likely to be returning to their car parked on the western side of Station Street.

Table 10 Pedestrian survey volumes at informal intersection crossings

Intersection crossing	Direction of travel	AM peak (7:30 am to 8:30 am)	PM peak (4:30 pm to 5:30 pm)	Daily (6:00 am to 7:00 pm)
Nepean Highway (south)	West to east (A to B)	1	0	1
	East to west (B to A)	0	0	0
Level Crossing (south)	West to east (B to C)	1	1	4
	East to west (C to B)	39	0	88
Level Crossing (west)	North to south (G to B)	1	1	4
	South to north (B to G)	40	0	92
Level Crossing (east)	North to south (F to C)	0	16	46
	South to north (C to F)	9	1	24
Station Street (south)	West to east (C to D)	0	0	0
	East to west (D to C)	0	0	3

The pedestrian survey also captured origin-destination (OD) movements of pedestrians moving to and from the Bonbeach Station platforms via Nepean Highway and Station Street. The key movements of the pedestrian OD survey results are provided in Figure 26.

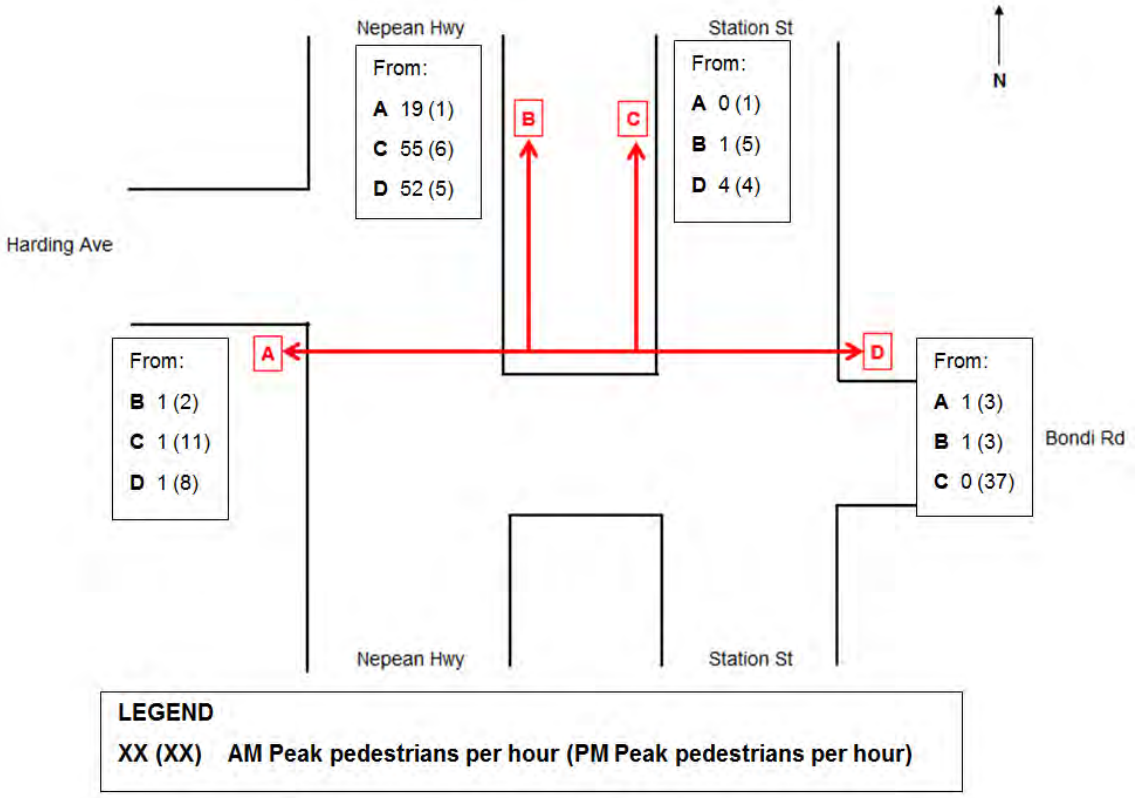

Figure 26 Pedestrians travelling between Nepean Highway, Station Street and Bonbeach Station

The highest volumes in the AM peak were pedestrians crossing the level crossing from the western and eastern sides of Station Street to Bonbeach Station western platform (to travel on city-bound trains). Pedestrians coming from the west side of Station Street are likely to have parked either on Station Street north of Bondi Road or come from the local streets. It is likely that they are crossing Station Street prior to the formal crossing as there is a footpath for the train replacement bus stop. In the PM peak, most pedestrians crossed eastbound at Station Street from the western side of Station Street (getting off the train at Bonbeach Station eastern platform).

In addition to this a number of key observations were made in relation to pedestrians during the site visits to Bonbeach on Wednesday 9 December 2015 during the AM (7:30 am to 9:00 am) and PM (4:30 pm to 5:30 pm) periods. These were:

- There were substantial delays for pedestrians crossing Station Street and Nepean Highway. Many pedestrians did not wait for their green signal as no vehicles were moving through the intersection.
- A number of pedestrians who were not going to the train station used the intersection.
- There is no footpath between the carpark and station. The designated route for pedestrians connecting the two is circuitous.

5.2.7 Cyclists

Station Street has on-road bicycle lanes in both directions, however these are typically discontinued through signalised intersections. The bicycle lanes discontinue approximately 80 metres north and south of Bondi Road.

Station Street near Bonbeach Railway Station is not part of the Principle Bicycle Network (PBN). The PBN on Station Street transitions to Nepean Highway at the signalised intersection with Chelsea Road. Nepean Highway is part of the PBN and a Strategic Cycling Corridor but does not have bicycle facilities.

The access and mobility for cyclists is shown in Figure 27.

Figure 27 Bonbeach existing cyclist access and mobility

Cyclists travelling through the intersections of Nepean Highway, Station Street, Bondi Road and Harding Avenue has been analysed from the survey undertaken on Wednesday 28 June 2017 between 6:00 am and 7:00 pm. Table 11 provides a summary of the surveyed bicycle volumes.

Table 11 Cycle survey volumes at Nepean Highway, Station Street, Bondi Road and Harding Avenue

Intersection approach	Total surveyed vehicle volumes 6:00 am to 7:00 pm	Peak cyclist hourly volumes	
		Cyclists per hour	Peak time
Nepean Highway (north)	99	65	6:00 am to 7:00 am
Nepean Highway (south)	124	35	6:00 pm to 7:00 pm
Station Street (north)	105	21	10:30 am to 11:30 am
Station Street (south)	100	30	6:00 am to 7:00 am 10:30 am to 11:30 am
Bondi Road	0	0	Not applicable
Harding Avenue	1	1	Not applicable

The results as shown in Table 11 indicate that cyclist volumes are evenly spread across Nepean Highway and Station Street, although there is an early southbound movement on Nepean Highway.

A previous survey that was undertaken for traffic analysis of the interim Patterson River Bridge design captured cyclists on Saturday 27 May 2017 between the hours of 11:00 am to 1:00 pm for the intersection of Bondi Road and Station Street. The highest hourly volumes observed were as follows:

- Station Street (south) – 17 cyclists per hour.
- Station Street (north) – 11 cyclists per hour.
- Station Street (west) – one cyclist per hour.

Cyclist volumes are expected to be greater earlier in the morning due to the popularity of recreational cycling in the area.

5.2.8 Public transport

Bonbeach Railway Station is located immediately north of the Station Street level crossing. Bonbeach Station serves the Frankston railway line. Trains typically operate on average every six minutes to the city during the AM peak.

Bus route 857 and Bonbeach Railway Station are shown in Figure 28. Bus route 857 is the only bus route close to Bonbeach Station but does not provide a transfer between bus and train. Bus route 857 travels between Chelsea and Dandenong via Patterson Lakes.

Figure 28 Bonbeach existing local public transport

6 Risk assessment

An assessment of risks to the environment posed by the projects was undertaken in accordance with the method described in Section 4.2. Risks were assessed for the construction and design/operation phases (where relevant).

The traffic risks during the construction and design/operation phases of the projects and post the post mitigation risk levels are listed in Table 12 .

Table 12 Construction and operation risks

Risk ID	Event name	Risk pathway	EPR ID	Risk level (after mitigation)
Construction risks				
T 28	Traffic (delay during main works)	Construction (including rail shutdowns) reduces road capacity and/or increases traffic volumes resulting in delays and increased travel time during the piling and main rail occupation.	EPR T1 Transport Management Plan EPR T2 Public Transport Disruption Management Plan EPR T3 Pedestrian and cyclist connectivity EPR T8 Emergency services	Moderate
T 29	Traffic (delay outside main works)	Construction (including rail shutdowns) reduces road capacity and/or increases traffic volumes resulting in delays and increased travel time outside of the piling and main rail occupation.	EPR T1 Transport Management Plan EPR T2 Public Transport Disruption Management Plan EPR T3 Pedestrian and cyclist connectivity EPR T8 Emergency services	Minor
T 30	Traffic (dirt on roads)	Plant and spoil trucks deposit construction debris on public roads leading to dust generation, perceived loss of amenity and public health and safety issues.	EPR T7 Debris on roads	Negligible
T 31	Traffic (road safety during construction)	Construction results in disruption to the transport network and/or increases in traffic volumes leading to increased crashes or the perception that the area is less safe.	EPR T1 Transport Management Plan	Minor

Risk ID	Event name	Risk pathway	EPR ID	Risk level (after mitigation)
Operational risks				
T 26	Traffic (operations)	New road network layout and signalling may not adequately cater for the safe and efficient movement of traffic following level crossing removal, resulting in unacceptable intersection performance and/or increased crashes.	EPR T4 Intersection design and performance	Negligible
T 27	Traffic (connectivity)	Connectivity for pedestrians and cyclists is negatively impacted by level crossing removal, resulting in increases to travel distance and/or time resulting in social and business impacts.	EPR T3 Pedestrian and cyclist connectivity EPR T6 Vehicle and pedestrian access	Negligible
T 32	Traffic (change in air quality)	Changes in traffic flows at the level crossing results in air quality impacts.	EPR T4 Intersection design and performance	Negligible
T 33	Traffic (change in noise)	Changes in traffic flows at the level crossing results in noise impacts.	EPR T4 Intersection design and performance	Negligible

The risk assessment assumes that projects are designed, constructed and operated within the law and to applicable Australian Standards, and that EPRs are met.

The recommended EPRs are outlined in the following sections. All recommended EPRs are incorporated into the Environmental Management Framework for the project (EES Chapter 9 *Environmental Management Framework*).

For further details refer to the EES Attachment II *Environmental Risk Report* which includes the full risk register.

7 Impact assessment – construction

7.1 Edithvale and Bonbeach

7.1.1 Construction impacts

7.1.1.1 Lane closures and parking removal

Lane closures during construction works could have the following impacts:

- Construction (including rail shutdowns) reduces road capacity and/or increases traffic volumes resulting in delays and increased travel time during the piling and main rail occupation **(risk T28)**.
- Construction (including rail shutdowns) reduces road capacity and/or increases traffic volumes resulting in delays and increased travel time outside of the piling and main rail occupation **(risk T29)**.
- Construction results in disruption to the transport network and/or increases in traffic volumes leading to increased crashes or the perception that the area is less safe **(risk T31)**.

To facilitate construction activities for both projects it is expected that lane closures (either full or partial) will be required on Nepean Highway and Station Street at times during the works. Activities that are likely to require lane closures include piling works, which are anticipated to take up to two months to complete. Lane closures or part lane closures are anticipated as follows based on a review of the potential construction methodology:

- Nepean Highway:
  - Nepean Highway southbound kerbside traffic lane (including indented parking bays on east side of Nepean Highway). This is also the leftmost southbound through lane at both the Edithvale Road and Station Street (Bondi Road) intersections.
  - Left turn lane at Edithvale Road intersection.
- Station Street:
  - Station Street northbound traffic lane (including indented parking bays and bus stops on west side of Station Street).
  - Northbound bicycle lane on Station Street.
  - Southbound parking and bicycle lane may also be removed if required.

Nepean Highway

Nepean Highway southbound currently has two lanes between intersections, often adding turn lanes at intersections. The observed peak hour southbound traffic flow is approximately 1500 vehicles per hour at Edithvale and 1400 vehicles per hour at Bonbeach.

The Austroads Guide to Traffic Management states the typical mid-block lane capacity for an urban road with interrupted flow is approximately 900 vehicles per hour per lane, though this can increase depending on a range of factors such as upstream flaring at intersections. This indicates that two southbound traffic lanes are appropriate for the volumes of traffic currently being experienced on Nepean Highway.

Closing the southbound kerbside traffic lane on Nepean Highway in the mid-block (away from intersections) to create space for the operation of plant (for example piling rigs) would reduce the number of lanes available to traffic. The level of impact would depend on when the closure

was undertaken, with impacts likely to be more pronounced during the PM peak period due to the volume of southbound traffic. Reducing Nepean Highway to a single southbound traffic lane during the PM peak whilst maintaining current traffic levels would likely exceed the capacity of one lane, resulting in increased queueing and delays. Outside peak times increased congestion would still be expected, however the level of impact would be lessened due to traffic volumes being lower. Speed limit reductions and additional traffic due to construction activities could further exacerbate the impact of lane closures.

Closing the southbound kerbside traffic lane and left turn lane on Nepean Highway near the Edithvale Road intersection would place all through and turning traffic into a single lane on approach to the intersection. This would likely exceed the capacity of the lane, which is lower than in the mid-block due to the operation of the traffic signals, resulting in increased queueing and delays. If the closure was undertaken whilst trying to maintain turning movements across the operational rail corridor (i.e. outside the main occupation) it is expected that there would be a high likelihood of queued turning vehicles blocking through traffic. This would present a significant impediment to southbound traffic movement, further impacting traffic operations. Closing the southbound kerbside traffic lane on Nepean Highway near the Station Street (Bondi Road) intersection would also result in impacts, though they may be less pronounced than at Edithvale due to the lower volume of traffic passing through Bonbeach, which may allow more priority to be given to traffic on Nepean Highway.

Due to the potential impacts, it is regarded that providing a single southbound lane catering for all current through and turning movements at intersections is unlikely to be acceptable without the introduction of ameliorative measures.

Removal of parking on Nepean Highway may result in additional vehicle movements if drivers are required to circulate around the area to find a parking space. Removal of parking could also have economic and social impacts (discussed in Technical report K *Business* and Technical report L *Social*).

Lane closures have potential to increase the likelihood of crashes or create the perception that the area is less safe if they are not implemented with consideration of site conditions and in accordance with good practice and safe systems principles.

Station Street

Station Street currently has one lane in each direction between intersections, often adding lanes at intersections. The observed peak hour northbound traffic flow is approximately 650 vehicles per hour at Edithvale and 250 vehicles per hour at Bonbeach.

The works will potentially necessitate the closure or partial closure of the Station Street northbound traffic lane, angle/indented parking bays, bus bays at Edithvale (Public Transport Victoria (PTV) bus route and/or rail replacement), western footpath and left turn lane (either formal or informal) at the level crossings. Lane closures will create space for the operation of plant (for example piling rigs) and loading zones for spoil trucks and other construction vehicles.

Assuming a single lane in each direction can be maintained on Station Street, the main impact to road capacity would be the reduction of lanes at intersections. This could potentially result in an increase in congestion that impacts travel time and reliability for general traffic and buses (at Edithvale), particularly at Edithvale where traffic volumes are greater. As with Nepean Highway, lane closures near intersections whilst maintaining turning movements could increase the risk of through lanes being blocked, further exacerbating queuing and delays.

Bicycle lane closures on Station Street would ideally be avoided or minimised where possible. Removal of mid-block bicycle lanes on Station Street during construction could make Station Street less attractive for cyclists as they would be required to mix with other traffic in a more

constrained road environment. Cyclist safety could also be impacted if the removal of mid-block lanes is not appropriately managed. Although the speed limit on Station Street is anticipated to be reduced during the works, cyclists may still not feel safe as they no longer have a mid-block bicycle lane.

The short sections of footpath on the western side of Station Street next to Edithvale and Bonbeach stations are anticipated to be removed in conjunction with the lane closures. As this footpath is mostly used for accessing parking (Edithvale) and bus stops (Edithvale), which are likely to be removed during the lane closures, the impact to pedestrian movements should be minimal.

Removal or relocation of bus stops on Station Street at Edithvale could impact pedestrian travel time and distance, with the impacts being more pronounced for vulnerable user groups or the mobility impaired.

Removal of parking on Station Street may result in additional vehicle movements if drivers are required to circulate around the area to find a parking space. Removal of parking could also have economic and social impacts (discussed in Technical report K *Business* and Technical report L *Social*).

Lane closures have potential to increase the likelihood of crashes or create the perception that the area is less safe if they are not implemented with consideration of the conditions on site and in accordance with good practice and safe systems principles.

Management and mitigation

The projects would prepare and implement a Transport Management Plan **(EPR_T1)** and Public Transport Disruption Management Plan **(EPR_T2)** in consultation with, and to the satisfaction of, relevant road management and transport authorities. The projects would also optimise the works for pedestrian and cyclist connectivity **(EPR_T3)**, reinstate vehicle and pedestrian access **(EPR_T6)** and maintain access requirements to emergency services **(EPR_T8)**.

Options to mitigate the impacts of lane closures, bicycle lane removal, parking removal, bus stop removal and changes to pedestrian and cyclist connectivity that may be considered as part of the measures could include:

- Optimise traffic capacity by reallocating road space (parking and/or lanes) to maintain traffic lanes, particularly in the peak direction.
- Time restrictions on when traffic lanes can be removed in order to maximise road capacity at peak times.
- Relocate turning movements away from the works (i.e. detour routes) if there is a risk that queued vehicles could block other traffic movements.
- Advance notification of works to encourage motorists and cyclists to seek alternate routes that do not take them in close proximity to the works.
- Traffic signal plan modifications to provide additional green time for movements with reduced capacity or improve the operation of detour routes.
- Directing rail replacement bus services to alternate routes where possible if congestion levels are anticipated to have an impact on travel time and reliability.
- Maintaining bicycle lanes where possible to avoid cyclists having to mix with vehicles where they currently do not.
- Reduce speed limit where bicycle lanes are removed to 40 km/h.

- Development and implementation of signed detour routes for cyclists if bicycle lanes must be closed and acceptable alternatives can be identified.
- Identification of alternate parking areas during the works to replace those lost during lane closures.
- Temporary relocation of bus stops, including the provision of wayfinding signage.
- Implementing all traffic management in accordance with appropriate standards and guidelines.
- Traffic management to be subject to Road Safety Audits where appropriate.

Implementing significant transport infrastructure projects (such as level crossing removals) in constrained urban areas often results in a level of disruption to access and mobility. The removal of traffic lanes to facilitate construction of the projects would likely reduce road capacity at times and result in increased levels of congestion when compared to existing conditions. The level and duration of impact resulting from the works would be strongly influenced by the EPRs that are adopted. Implementing the EPRs **(EPR_T1)**, **(EPR_T2) (EPR_T3)**, **(EPR_T6)** and **(EPR_T8)** described would assist to provide for the efficient and safe operation of the transport network during construction, reducing the likelihood of unacceptable impacts to travel time, reliability and road safety. Adopting these controls would result in a moderate risk rating during the main works (piling and main rail occupation) and minor risk rating outside the main works.

7.1.1.2 Road closures

Road closures during construction works could have the following impacts:

- Construction (including rail shutdowns) reduces road capacity and/or increases traffic volumes resulting in delays and increased travel time during the piling and main rail occupation **(risk T28)**.
- Construction (including rail shutdowns) reduces road capacity and/or increases traffic volumes resulting in delays and increased travel time outside of the piling and main rail occupation **(risk T29)**.
- Construction results in disruption to the transport network and/or increases in traffic volumes leading to increased crashes or the perception that the area is less safe **(risk T31)**.

Road closures anticipated to be required to facilitate construction include:

- Edithvale:
    - Closure of Edithvale Road between Nepean Highway and Station Street.
    - Closure or part closure of the Edithvale Road intersection with Station Street.
- Bonbeach:
    - Closure of Station Street (Bondi Road) between Nepean Highway and Station Street.
    - Closure or part closure of the Station Street intersection with Bondi Road.

It is expected there will be two main significant closures of Edithvale Road between Nepean Highway and Station Street and Station Street (Bondi Road) between Nepean Highway and Station Street:

- During piling and abutment works (estimated duration of one week).
- During the main occupation (estimated duration of two weeks).

Other short-term closures may be required to facilitate other ancillary works such as service relocations.

Road closures have potential to affect movement and access in the project area, particularly across the rail corridor. Road closures will necessitate road users to take alternate routes that may be longer and/or less direct that the closed route. The main traffic impacts resulting from road closures are expected to be increased travel time and reduced travel time reliability due to longer travel distances and congestion on diversion routes. The level of impact on motorised traffic will vary depending on when the closures are conducted, with peak hour weekday closures expected to have a greater impact than night time closures. Seasonality may also play a part in influencing the level of impact, with more traffic expected in the project areas on weekends in the summer due to their proximity to the beach.

The arterial road connection of Nepean Highway and Edithvale Road is of regional significance and it will therefore be necessary to maintain traffic movements through the implementation of traffic diversions. This would potentially be via the intersections of Nepean Highway, Station Street and Lochiel Avenue (north of the level crossing) and Nepean Highway, Station Street and Swanpool Avenue (south of the level crossing). The Swanpool Avenue intersection may require temporary signalisation to safely facilitate the increased traffic volumes. As works will likely be conducted during a shutdown of the railway line, the boom gates should not affect the operation of road traffic diversions.

The diversion of traffic to maintain connectivity across the rail corridor would increase the total volume of traffic on Station Street. If observed (current) cross-rail corridor traffic movements to/from Nepean Highway north of the level crossing are redistributed to Lochiel Avenue and movements to/from Nepean Highway south of the level crossing are redistributed to Swanpool Avenue, the total change in traffic volumes on Station Street are estimated to be as follows:

- Station Street north of level crossing northbound – 116 vehicles in AM peak and 120 vehicles in PM peak.
- Station Street north of level crossing southbound – 44 vehicles in AM peak and 109 vehicles in PM peak.
- Station Street south of level crossing northbound – 47 vehicles in AM peak and 73 vehicles in PM peak.
- Station Street south of level crossing southbound – 62 vehicles in AM peak and 94 vehicles in PM peak.

The redistribution would result the total volume of vehicles on Station Street increasing but not exceeding the typical mid-block capacity for a single lane with interrupted flow (900 vehicles per hour) according to the Austroads Guide to Traffic Management. Construction traffic will be in addition to diversion traffic and is discussed in Section 7.1.1.5.

Vehicle diversions during closure of Station Street (Bondi Road) level crossing could potentially be via the Argyle Avenue level crossing. As with the closure of Edithvale Road, the intersections either side of the level crossing may require temporary signalisation to safely facilitate the increased traffic volumes. The shutdown of the railway line would assist the operation of the road traffic diversion. Current traffic volumes on Station Street at Bonbeach are relatively low and therefore amenable to the redistribution of the low volume of traffic that has been observed using the level crossing. In the event that other level crossing works (such as Patterson River Bridge) change traffic patterns in the area, it is possible that traffic volumes on Station Street could be higher.

Management and mitigation

The projects would prepare and implement a Transport Management Plan **(EPR_T1)** and Public Transport Disruption Management Plan **(EPR_T2)** in consultation with, and to the satisfaction of, relevant road management and transport authorities. Design of the projects would also optimise the works for pedestrian and cyclist connectivity **(EPR_T3)**, reinstate vehicle and pedestrian access **(EPR_T6)** and consider access requirements to emergency services **(EPR_T8)**.

Options to mitigate the impacts of road closures could include:

- Undertake road closures at times when traffic volumes are lower so fewer road users are impacted.
- Development of a communication strategy including advanced notification of works to encourage motorists and cyclists to seek alternate routes that do not take them in close proximity to road closures.
- Development and implementation of signed diversion routes for general traffic, buses, cyclists and pedestrians, including temporary bus stops if required.
- Infrastructure upgrades to diversion routes to better facilitate traffic movements.
- Implementing all traffic management in accordance with appropriate standards and guidance.
- Monitoring site conditions and optimising traffic management as required.
- Traffic management to be subject to Road Safety Audits where appropriate.

Implementing the EPRs **(EPR_T1)**, **(EPR_T2)**, **(EPR_T3)**, **(EPR_T6)** and **(EPR_T8)** would assist to provide for the efficient and safe operation of the transport network during road closures, reducing the likelihood of unacceptable impacts to travel time, reliability and road safety. Adopting these controls would result in a moderate risk rating during the main works (piling and main rail occupation) and minor risk rating outside the main works.

7.1.1.3 Rail line closures

Rail closures during construction works could have the following impacts:

- Construction (including rail shutdowns) reduces road capacity and/or increases traffic volumes resulting in delays and increased travel time during the piling and main rail occupation **(risk T28)**.
- Construction (including rail shutdowns) reduces road capacity and/or increases traffic volumes resulting in delays and increased travel time outside of the piling and main rail occupation **(risk T29)**.
- Construction results in disruption to the transport network and/or increases in traffic volumes leading to increased crashes or the perception that the area is less safe **(risk ID T31)**.

To facilitate construction activities for both projects it is expected that closures of the Frankston rail line will be required between Mordialloc and Frankston. This is due to spatial constraints which prevent level crossing removals and new stations from being constructed offline whilst trains continue to operate as normal.

Rail line closures (particularly during the six week main occupation) are expected to result in disruption to the movement and access of Frankston line patrons with an origin or destination between Mordialloc and Frankston. It is also anticipated that shorter rail line closures such as

weekend occupations could occur during the construction phase. Whist it is common practice to run rail replacement bus services during rail line closures, these generally end up operating at a reduced level of service when compared to the rail line they are replacing. Rail replacement bus services operate on public roads and therefore need to contend with traffic congestion and other impediments to movement. This may result in a longer travel time and potentially reduced public transport capacity. Rail replacement buses that need to operate along Nepean Highway or Station Street may also be affected by road network disruptions related to the projects and associated increases in congestion.

It is possible that rail line closures may result in a shift to private vehicle use if it is perceived to be a better alternative to the rail replacement bus services. Additional private vehicle traffic in the vicinity of the projects could place further strain on measures to manage traffic impacts and could further exacerbate any issues with congestion and delays. Traffic impacts associated with the rail line closures are expected to be greatest during the AM and PM peak periods when existing traffic volumes and the demand for public transport travel are highest.

Replacement buses are likely to operate between Mordialloc Station and Frankston Station due to Mordialloc Station's ability to operate as a turn-back stop for train services from the city. Rail replacement bus services are likely to include services that stop at all stations between Mordialloc and Frankston in order to maintain connectivity. In addition, it may be possible to operate express bus services between Carrum and Mordialloc (possibly via Wells Road), which avoid travelling through the two project work sites and may offer improved travel time as a result.

Management and mitigation

The projects would prepare and implement a Transport Management Plan **(EPR_T1)** and Public Transport Disruption Management Plan **(EPR_T2)** in consultation with, and to the satisfaction of, relevant road management and transport authorities.

Options to mitigate the impacts of rail line closures could include:

- Rail replacement bus services implemented as part of an integrated traffic management plan.
- Minimise the number and duration of rail line closures.
- Undertake rail line closures at times during the year when travel demand is lowest.
- Use of 'stopping all stations' and express bus services to serve the needs of different users whilst striking a balance between movement and access requirements.
- Advanced notification of rail line closures to train patrons and road users.
- Advanced notification of replacement bus timetables and route maps to allow users to choose their preferred option and commute time.
- Implementation of appropriate wayfinding signage from train stations to associated bus stops.

Implementing the EPRs **(EPR_T1)** and **(EPR_T2)** would assist to minimise disruption to public transport services and provide for the efficient and safe operation of the transport network during construction. This would assist to reduce the likelihood of unacceptable impacts to travel time, reliability and road safety. Adopting these controls would result in a moderate risk rating during the main works (piling and main rail occupation) and minor risk rating outside the main works.

7.1.1.4 Pedestrian crossing and footpath closures

Pedestrian crossing and footpath closures during construction works could have the following impacts:

- Construction results in disruption to the transport network and/or increases in traffic volumes leading to increased crashes or the perception that the area is less safe **(risk T31)**.

It is expected that a number of pedestrian crossings and footpaths will need to be closed at times during the works to facilitate construction. Potential closures include:

- Pedestrian crossing of rail corridor on the north side of Edithvale Road.
- Nepean Highway pedestrian crosswalk at the Edithvale Road intersection.
- Station Street pedestrian crosswalk at the Edithvale Road intersection.
- Edithvale Road pedestrian crosswalk at the intersection with Station Street.
- Informal north-south crossings of Edithvale Road at the boom gates.
- Denman Avenue pedestrian level crossing of the rail corridor (north of Edithvale Road).
- Fraser Avenue pedestrian level crossing of the rail corridor (south of Edithvale Road).
- Pedestrian crossing of rail corridor on the north side of Station Street (Bondi Road).
- Nepean Highway pedestrian crosswalk at the Station Street (Bondi Road) intersection.
- Station Street pedestrian crosswalk at the Bondi Road intersection.
- Bondi Road pedestrian crosswalk at the intersection with Station Street.
- Informal north-south crossings of Station Street at the boom gates.
- Golden Avenue pedestrian level crossing of the rail corridor (north of Bondi Road).
- Wellwood Road pedestrian level crossing of the rail corridor (north of Bondi Road).
- The Glade pedestrian level crossing of the rail corridor (south of Bondi Road).
- Footpaths near the level crossing and in the vicinity of the works at both sites.

Pedestrian crossing and footpath closures have the potential to impact safety if alternate facilities cannot be provided to the same standard or if the closures encourage pedestrians to adopt risky behaviour.

Pedestrian crossing and footpath closures also have the potential to increase travel distances (longer journey times) resulting in the loss of amenity, particularly for vulnerable groups. Social and business impacts around disruption to pedestrian facilities are discussed in Technical Report K *Business* and Technical Report L *Social*.

Management and mitigation

The projects would prepare and implement a Transport Management Plan **(EPR_T1)** in consultation with, and to the satisfaction of, relevant road management authorities. The projects would also optimise the works for pedestrian and cyclist connectivity (**EPR_T3)**, reinstate vehicle and pedestrian access **(EPR_T6)** and consider access requirements to emergency services **(EPR_T8)**.

There are a number of options that could be considered to mitigate the impacts of pedestrian crossing and footpath closures. These would need to be safe and Disability Discrimination Act compliant. Options could include:

- Provision of temporary crossing facilities (including of the rail corridor) in close proximity to the existing or diversion to unaffected crossings.
- Where footpaths are closed, divert pedestrians to unaffected footpaths via appropriate road crossings (the form of temporary crossing will be contingent on the construction methodology).
- Construction works to be undertaken in a way that seeks to minimise the number and duration of pedestrian crossing and footpath closures.
- Construction and commissioning of pedestrian overpasses of rail corridor prior to removal of at-grade pedestrian crossings.
- Provision of wayfinding signage for pedestrian diversion routes that takes them between areas where connectivity is impacted by the works. For longer distance diversions or where pedestrian diversions are infeasible, consider provision of a shuttle bus to reduce travel time impacts.
- Advance notification of works (e.g. on-site signage, website, social media, print media, tv and radio) to inform pedestrians that access and mobility will be affected around the construction site and encourage them to plan their journey and avoid the works area if possible. Advance notification could also include maps showing diversion routes.
- Conducting particularly disruptive activities outside times where large volumes of pedestrians are expected (i.e. trying to avoid weekday peak period travel or weekends during summer when the number of beachgoers will be greater).
- Traffic management to be subject to Road Safety Audits where appropriate.

Implementing the EPRs **(EPR_T1)**, **(EPR_ T3)**, **(EPR_T6)** and **(EPR_T8)** would assist to provide appropriate pedestrian facilities during construction, reducing the likelihood of unacceptable impacts to travel time, travel distances, road safety and personal safety. Adopting these controls would result in a minor risk rating.

7.1.1.5 Construction traffic

Construction traffic during construction works could have the following impacts:

- Construction (including rail shutdowns) reduces road capacity and/or increases traffic volumes resulting in delays and increased travel time during the piling and main rail occupation **(risk T28)**.
- Construction (including rail shutdowns) reduces road capacity and/or increases traffic volumes resulting in delays and increased travel time outside of the piling and main rail occupation **(risk T29)**.
- Plant and spoil trucks deposit construction debris on public roads leading to dust generation, perceived loss of amenity and public health and safety issues **(risk T30)**.
- Construction results in disruption to the transport network and/or increases in traffic volumes leading to increased crashes or the perception that the area is less safe **(risk T31)**.

The works will involve a range of activities that will generate traffic in the area around the level crossings. The types of vehicular trips associated with demolition and construction activities that are expected to be generated include:

- Heavy vehicles (e.g. semi-trailers, truck and dog, concrete trucks, cranes) delivering goods to site.
- Heavy vehicles (e.g. low loaders) delivering plant to site and mobile plant travelling to site.
- Heavy vehicles (e.g. semi-trailers, truck and dog) removing spoil and construction debris.
- Light vehicles, light trucks and commercial vehicles travelling to/from site and laydown areas/compounds (moving people and smaller goods).
- Oversize and special purpose vehicles.
- Workers travelling to/from work.

During the first half of the main occupation the number of vehicle movements to each site is expected to peak between 1,300 and 1,600 vehicles per day (2,600 to 3,200 trips total including those both from and to site). This includes vehicles of all types, with approximately 1,000 trucks per day removing spoil and 300 staff vehicles travelling from the construction compounds to site. For the remainder of the occupation the number of vehicle movements to each site is expected to be between 400 and 600 per day (800 to 1,200 trips total) comprising of workforce, supervisors and material deliveries.

The construction compounds will also generate traffic as a result of construction workers traveling to work and deliveries. During the first half of the main occupation approximately 150 to 250 vehicle movements are expected to each site's construction compounds by construction workers travelling to work each day. The same number of movements is expected in the reverse direction when workers travel home. The number of workers travelling to/from site is expected to be lower outside the main occupation.

The total number of vehicle movements to the construction compounds will depend on how the delivery of materials and plant to site is managed. If the compounds are used as staging points for the delivery of materials to site (other than them being delivered directly to site) and the delivery vehicles do not use the roads between the site and construction compounds, the total number of construction vehicle movements on key roads near the works should be unchanged.

Vehicle movements between the construction compounds and the sites will follow a predetermined route developed in consultation with the City of Kingston and VicRoads. It is expected that vehicle movements to and from the construction sites and compounds/laydown areas will aim to use arterial roads where possible, although some use of Station Street will be required. It is also regarded that construction traffic should desirably avoid travelling through one site to access the other if possible to help limit the cumulative impacts of construction traffic.

The works will generate vehicle trips in addition to existing traffic volumes in the area, potentially resulting in an overall increase in traffic if there is no change in travel patterns in the area. At the same time, traffic management measures are likely to be implemented to facilitate the works, which could impact road capacity. The combination of increased traffic volumes and reduced road network capacity has potential to result in a number of traffic and road safety impacts if not appropriately managed.

To help understand the potential impacts of construction traffic during the main occupation an assessment has been conducted which considers the potential change in traffic volumes during peak hours. This considers:

- current peak hour traffic volumes
- potential construction traffic routes for a range of possible scenarios

- construction traffic volumes during the main occupation.

The link volumes have been compared against typical link capacities obtained from the Austroads Guide to Traffic Management.

The potential routes for construction vehicles at Edithvale and Bonbeach are shown in Figure 29 and Figure 30, respectively. The exact routing of heavy vehicles is not confirmed; however it is viewed that vehicles will likely access the Edithvale site via Edithvale Road, Nepean Highway and Station Street and the Bonbeach site via Nepean Highway, Station Street and McLeod Road. In the event that the Carrum level crossing removal is completed before the Bonbeach level crossing removal works, southbound construction traffic would access the extension of McLeod Road via a new intersection with Nepean Highway rather than using Station Street.

It has been assumed that construction vehicles will access both sites from the western side of Station Street, with all travel on Station Street to be in northbound direction (i.e. northbound lane abutting the work sites). This results in an anti-clockwise movement of vehicles around each site using Nepean Highway for the southbound movement and existing/temporary east-west connections across the rail corridor. It has been assumed that construction traffic routing will be planned in such a way that negates the need for construction vehicles to travel through the Edithvale site to access Bonbeach and vice-versa. This this may be unavoidable for some deliveries such as oversized and over-dimensional vehicles carrying Super-T beams, which may be brought in via Edithvale Road.

Figure 29 Potential routing for construction vehicles – Edithvale

Figure 30 Potential routing for construction vehicles – Bonbeach

A number of construction routing scenarios have been considered, each of which use different combinations of the roads highlighted in Figure 29 and Figure 30. In each scenario, it was assumed that 1600 vehicle movements to site would be added to the network in a 24 hour period, commensurate with the peak number of movements expected during the first half of the main occupation. This equates on average to 67 vehicles per hour travelling to site.

Assuming vehicle loading/unloading is split evenly between the northern and southern sections of each site (either side of the level crossing); some routing scenarios require vehicles to travel on a particular section of road twice. For example, vehicles requiring access to the south side of the Edithvale site that come from the east via Edithvale Road and exit to the north via Nepean Highway use Station Street north of Edithvale Road in the northbound direction twice as outlined below:

- Right turn from Edithvale Road into Station Street (northbound).
- Two left turns to travel southbound on Nepean Highway via Lochiel Avenue.
- Two left turns to travel northbound on Station Street via a temporary haul route across the rail corridor located south of Bayside Avenue.
- Access site to load/unload south of Edithvale Road.
- Exit site and travel northbound on Station Street.
- Use Lochiel Avenue to access Nepean Highway and travel northbound away from the site.

The maximum number of construction vehicles estimated on each road link during the critical peak hour (maximum of the AM or PM peak) is shown in Table 13 for Edithvale and Table 14 for Bonbeach. The table also shows the existing critical peak hour traffic volumes for each road (taken from Section 5) and the typical mid-block road capacities for each link taken from the Austroads Guide to Traffic Management. This assumes that the number of lanes available to traffic is similar to existing and that no traffic diversions are in place that could increase the volume of traffic on Station Street (and conversely reduce the volume of traffic on Nepean Highway near the level crossing). The additional volumes due to construction activities presented in the tables are the highest volumes estimated for each road out of all routing scenarios tested.

Table 13 Additional construction traffic – Edithvale

Road link	Direction	Typical capacity (veh/h)	Existing peak volume (veh/h)	Construction traffic (veh/h)
Nepean Highway (north approach)	Northbound	1800	1453	67
Nepean Highway (north approach)	Southbound	1800	1474	100
Nepean Highway (south approach)	Northbound	1800	1384	0
Nepean Highway (south approach)	Southbound	1800	1459	100
Station Street (north approach)	Northbound	900	646	100
Station Street (north approach)	Southbound	900	683	0
Station Street (south approach)	Northbound	900	667	100
Station Street (south approach)	Southbound	900	571	33
Edithvale Road (east approach)	Westbound	900	331	67
Edithvale Road (east approach)	Eastbound	900	385	67

Table 14 Additional construction traffic – Bonbeach

Road	Direction	Typical capacity (veh/h)	Existing peak volume (veh/h)	Construction traffic (veh/h)
Nepean Highway (north approach)	Northbound	1800	1096	0
Nepean Highway (north approach)	Southbound	1800	1308	67
Nepean Highway (south approach)	Northbound	1800	1077	0
Nepean Highway (south approach)	Southbound	1800	1375	67
Station Street (north approach)	Northbound	900	236	67
Station Street (north approach)	Southbound	900	282	0
Station Street (south approach)	Northbound	900	236	67
Station Street (south approach)	Southbound	900	220	0
Bondi Road (east approach)	Westbound	900	68	0
Bondi Road (east approach)	Eastbound	900	71	0

McLeod Road (east approach)	Westbound	900	684	67
McLeod Road (east approach)	Eastbound	900	565	67

The estimated link volumes with the additional construction traffic are estimated to remain below the typical road capacity on all key roads near the Edithvale and Bonbeach sites. Although the total traffic volume is not estimated to surpass the mid-block capacity of roads used for construction traffic, the percentage of heavy vehicles will increase notably.

This analysis assumes current mid-block capacity is provided during the main occupation, however if one lane is required to be closed on Nepean Highway the additional construction traffic will exacerbate the expected traffic impacts (discussed in Section 7.1.1.1). Changes to intersection stand-up lane configurations and signalling could also have an impact on the capacity of road links. Implementation of diversion routes during road closures (as discussed in Section 7.1.1.2) has potential to further increase the volume of traffic on Station Street, particularly at Edithvale, though adding the assumed diversion volumes as discussed in that section does not result in the volume of traffic exceeding 900 vehicles in the mid-block. Modal shift to private vehicle use during rail line closures may also contribute additional traffic.

The concentration of construction vehicles may damage existing road assets such as kerbs and pavement if they are not designed for heavy vehicles. Damage such as potholes, reduced pavement skid resistance and the creation of tripping hazards may present safety issues for vehicles and pedestrians if it occurs.

Some construction vehicles will need to park at the sites (such as staff vehicles). If the location of parking is not appropriate, it could result in impacts to road network capacity or safety. Insufficient provision of parking for construction vehicles near the sites could result in construction parking taking up spaces that are used by residents, commuters and businesses.

Traffic generated by the works may also impact amenity, which is discussed in Technical report L *Social*.

Management and mitigation

The projects would prepare and implement a Transport Management Plan **(EPR_T1)** in consultation with, and to the satisfaction of relevant road management authorities. The projects would also prepare and implement measures to manage dirt and debris being transferred to roads **(EPR_T7)**.

There are a number of options that could be considered to mitigate the impacts of traffic generated by construction activities. Options could include:

- Use roads with spare traffic capacity for haulage routes where possible.
- Use higher order roads for haulage routes as these are likely to be more suited to catering for high levels of construction traffic.
- Program construction traffic to travel outside peak times.
- Select haul routes to avoid pedestrian, bicycle and public transport priority routes where possible.
- Localised road network or intersection upgrades where peak periods of construction traffic have potential to impact network operations.
- Advance notification of works to promote awareness of construction traffic and encourage motorists and cyclists to seek alternate routes that do not take them in close proximity to the works. This may assist to reduce traffic levels in the area around the works and offset the traffic generated by construction activities.
- Speed reductions around the construction sites.
- Adjustments to intersection signal timing during the different stages of construction to optimise network operations.

- Oversize loads transported outside peak traffic times.
- Provide sufficient construction parking supply in appropriate locations that minimises traffic impacts and maximises safety.
- Monitoring impacts of construction traffic on road assets and rectifying damage, prioritising potential safety issues.
- Traffic management measures to be subject to Road Safety Audits where appropriate.
- Street sweeping and covering loads to minimise the transferral of dirt and debris.

Implementing the EPRs **(EPR_T1)** and **(EPR_T7)** would assist to manage the impacts of construction traffic, reduce the likelihood of unacceptable delays and the likelihood of unacceptable quantities of dirt and debris being transferred to roads. Adopting these controls would result in a moderate risk rating during the main works (piling and main rail occupation) and minor risk rating outside the main works.

8 Impact assessment – operation

8.1 Edithvale

8.1.1 Operational impacts

8.1.1.1 Safety

Statistics provided by Transport Safety Victoria and the Office of the National Rail Safety Regulator indicate that in the ten year period ending on 31 December 2014 there was one fatal collision between a train and road vehicle and seven near miss incidents between a train and pedestrian.

Removal of the level crossings is expected to result in improved safety by removing the conflict between trains and road users. This will benefit current users of the level crossing as well as users that redistribute to the grade separated crossing from other at-grade crossings of the rail corridor.

Upgrades to the road network to address substandard elements of the current road design (such as lane widths and merge distances) and provide continuity of pedestrian and bicycle facilities through the intersections may also assist to reduce the likelihood of crashes.

8.1.1.2 Traffic operations

The layout of the road network and signalling during operation could have the following impact:

- New road network layout and signalling may not adequately cater for the safe and efficient movement of traffic following level crossing removal, resulting in unacceptable intersection performance and/or increased crashes. **(risk T26)**.

The existing layouts of the intersections of Nepean Highway and Station Street with Edithvale Road may not be able to adequately cater for the volume of traffic that is expected in the operation phase of the Edithvale level crossing removal project. Thus, it has been proposed that the intersections layout and signal phasing be upgraded as a key component of the works.

A potential layout for the upgrade of the intersections is shown in Figure 31. This includes the following proposed infrastructure alterations from the existing:

- Extending turn lanes on Nepean Highway.
- Converting the westbound lanes on approach to Nepean Highway to a shared left and right turn lane (kerb side lane), and a right turn lane.
- Having a dedicated right turn lane on the Station Street north approach, therefore only one southbound through lane which is shared with the left turn.
- Removing the short southbound departure lane on Station Street south approach (given there is only one southbound lane).
- Provision of a Shared Use Path on the western side of Station Street including a crossing of the western approach to the intersection of Edithvale Road and Station Street. This facilitates bicycle and pedestrian access to the station as well as accommodating through movements. Bicycle parking provision at the station will be resolved in the final design.
- Maintaining the same number of bus stops but relocating them to align with the entrances to Edithvale Station.

The operation of the upgraded intersection layouts been assessed in order to understand the likely performance and inform the identification of mitigation measures.

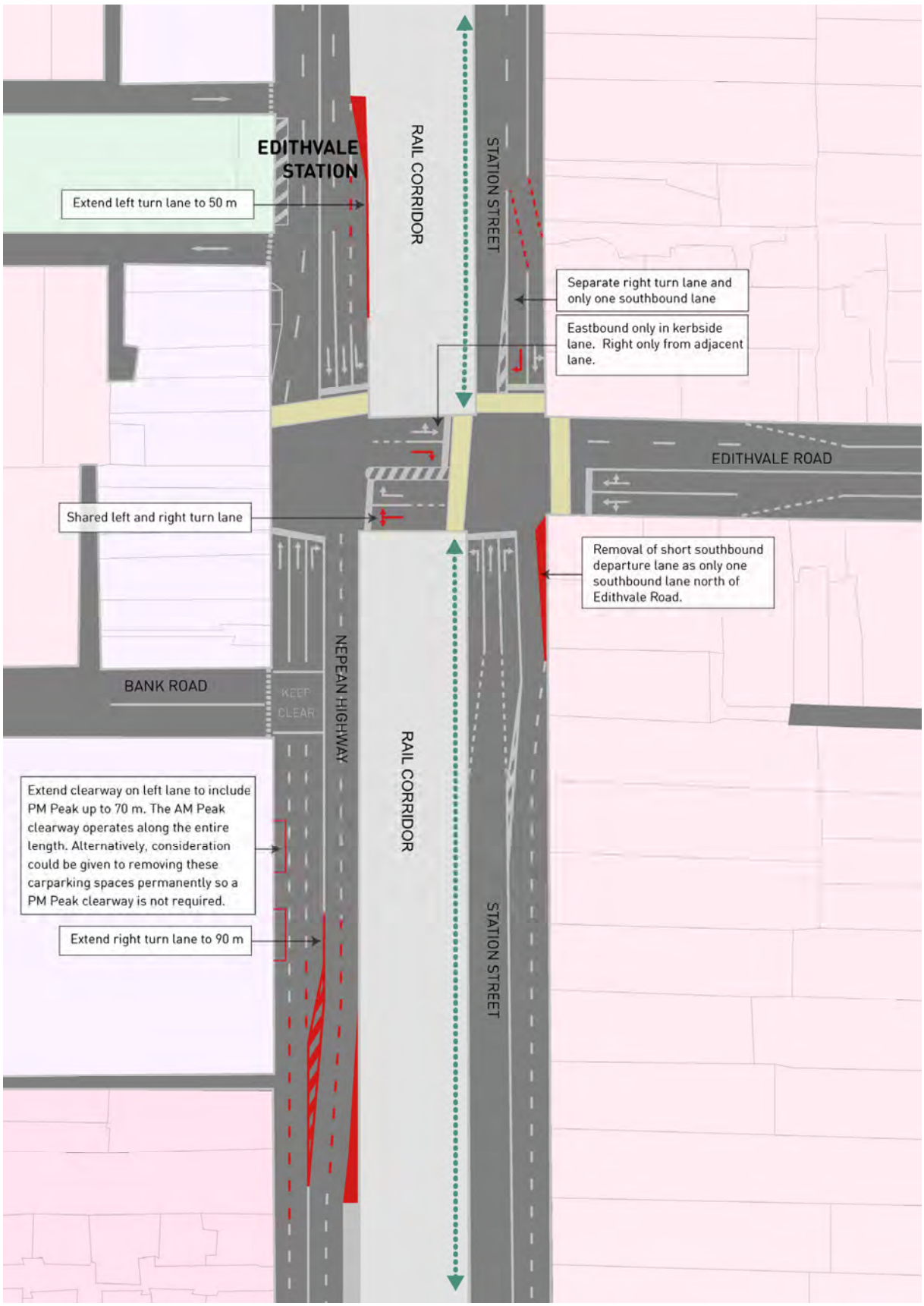

Figure 31 Nepean Highway, Station Street and Edithvale Road intersections proposed layout

Traffic volumes

Strategic modelling was undertaken using a 2015 Victorian Integrated Transport Model (VITM) sub area model of the Frankston Line and surrounds to estimate changes in intersection turning volumes following level crossing removal. These traffic volume changes have been applied to 2017 traffic data to provide an estimate of 2017 traffic volumes if the level crossing was not present. As the level crossing works would be completed after 2017, a separate 2021 VITM model developed for LXRA was used to estimate traffic growth between 2011 and 2021. The traffic growth from this model was applied to the modified 2017 traffic data to provide an estimate of opening year traffic volumes following level crossing removal.

Whilst the Lochiel Avenue level crossing is not proposed to be removed as part of the Edithvale level crossing removal project, it has been assumed in the 2015 VITM model that it would not be open to traffic. This reflects a scenario where Lochiel Avenue is not an attractive traffic route (ostensibly due to boom gate closures) and provides a conservative analysis of the Edithvale Road, Nepean Highway and Station Street intersections.

The estimated AM and PM peak traffic volumes are shown in Figure 32.

Figure 32 Estimated traffic volumes at Nepean Highway, Station Street and Edithvale Road intersections for proposed road network

Signal phasing

The boom gates at the level crossing are down for an average of 42 minutes during the weekday period between 7 am and 9 am. This equates to 35 percent of available traffic signal cycle time being taken up by train phases. Additional cycle time is also allocated to clearance phases that allow vehicles to clear the tracks prior to the arrival of a train. Whilst different combinations of traffic and pedestrian movements can operate during the train phases (depending on demand), the randomness of train arrivals and the variability in the duration of boom gate closure times (observed to range up to 153 seconds) means that signal cycle time cannot always be allocated as desired. This impacts cross-rail corridor movements and can result in extensive queueing, particularly on Edithvale Road.

Elimination of the train phases as part of level crossing removal allows additional traffic signal time to be reallocated to traffic, pedestrian and cycle movements according to demand. It also allows signal cycle time to be apportioned as required without needing to factor in train operations. The result is that movements are able to run more frequently and can be allocated more or less cycle time as required.

The signal phasing adopted for analysis assumes that each phase runs every cycle and that phase and cycle times are fixed. A key element of the phasing is to have the pedestrian and cyclist Shared Use Path on the western side of Station Street operating at a separate time to turning vehicles from Station Street. It is regarded that this arrangement would reduce the risk of conflict between motorised vehicles and cyclists.

The details of each phase time for each peak period are shown in Appendix A.

Intersection analysis

SIDRA version 7 software has been used to assess the operation of the intersections. This produces individual summaries for each intersection even though they are modelled as a single site due to their proximity. The vehicle storage distance between Nepean Highway and Station Street is approximately 13 metres.

To optimise the traffic signals, modifications were made manually to the proposed signal phasing instead of allowing the software to determine the phase splits and cycle times.

The outputs of SIDRA modelling are summarised in Table 15 and Table 16. Full results are provided in Appendix A. Definitions of the terms used in the summary table and how they relate to intersection performance are provided in the Glossary.

Table 15 SIDRA results at Nepean Highway and Edithvale Road intersection

Approach Lane	AM peak period				PM peak period			
	Degree of Saturation (DOS)	Average delay (s/veh)	95% queue (m)	Level of Service (LOS)	Degree of Saturation (DOS)	Average delay (s/veh)	95% queue (m)	Level of Service (LOS)
Nepean Highway (south)	0.825	41	299	D	0.877	38	109	D
Edithvale Road (east)	0.337	12	21	B	0.381	12	19	B
Nepean Highway (north)	0.288	23	75	C	0.857	35	373	D
All vehicles	**0.825**	**32**	**299**	**C**	**0.877**	**33**	**373**	**C**

Table 16 SIDRA results at Station Street and Edithvale Road intersection

Approach Lane	AM peak period				PM peak period			
	Degree of Saturation (DOS)	Average delay (s/veh)	95% queue (m)	Level of Service (LoS)	Degree of Saturation (DOS)	Average delay (s/veh)	95% queue (m)	Level of Service (LOS)
Station Street (south)	0.817	42	226	D	0.448	34	69	C
Edithvale Road (east)	0.869	73	127	E	0.882	78	125	E
Station Street (north)	0.642	42	165	D	0.893	49	362	D
Edithvale Road (west)	0.508	28	21	C	0.722	38	21	D
All vehicles	**0.869**	**47**	**226**	**D**	**0.893**	**51**	**362**	**D**

Discussion

Removal of the level crossing will allow the traffic signal cycle time that is currently taken up by train phases to be reallocated to other movements as required depending on demand and priority. This is expected to result in reduced delays and enhanced reliability for cross-rail corridor trips.

The traffic movements which are expected to benefit most from removal of the level crossing are those that cross the railway corridor when travelling between Nepean Highway, Edithvale Road and Station Street. When compared to existing traffic signal Intersection Diagnostic Monitor (IDM) data the proposed signal phasing results in increased phase time allocation for:

- left turn from Nepean Highway towards Edithvale Road and Station Street
- right turn from Nepean Highway towards Edithvale Road and Station Street
- through movement from Edithvale Road to Nepean Highway.

In particular the right turn from Nepean Highway towards Edithvale Road and Station Street receives a significant increase in cycle time to help accommodate the anticipated increase in right turn traffic across the rail corridor following level crossing removal.

Through movements on Nepean Highway currently receive a significant proportion of cycle time as they are able to operate when the boom gates are down if there is no demand for pedestrian crossing movements. Following level crossing removal it is possible that the through movements on Nepean Highway may receive less cycle time overall. In practice the traffic signal controller (Sydney Coordinated Adaptive Traffic System (SCATS)) will adjust phase times dynamically in response to demand, which it is able to do more effectively without needing to factor in train movements.

North-south bicycle and pedestrian movements on Station Street will also be a beneficiary of the proposed intersection upgrades as the proposed Shared Use Path crossing is able to operate every signal cycle without the risk of conflict from turning vehicles.

The provision of on-street parking in the vicinity of the works will be resolved in consultation with Kingston City Council and VicRoads as part of the final design.

As shown in Table 15 and Table 16 the proposed Nepean Highway, Station Street and Edithvale Road signalised intersections are predicted to operate within capacity (Degree of Saturation (DOS) below 0.9) in both the AM and PM peak periods with estimated opening year volumes. The intersection Level of Service is expected to be C or D, indicating that average delay is within acceptable limits. Based on the analysis the performance of the intersections is estimated to be acceptable.

The end result of the level crossing removal and upgrade of the intersections is expected to be the strengthening of the arterial-arterial road connection between Nepean Highway and Edithvale Road whilst maintaining local access to Station Street. The removal of train services will allow traffic signal cycle time to be allocated in a way that better balances the competing demands for movement from pedestrians, cyclists, public transport and general traffic.

Management and mitigation

The project would be designed and constructed to provide for safe vehicle movements and acceptable intersection performance to the satisfaction of the responsible road management authority **(EPR_T4)**, including road safety audits at appropriate times during design, construction and post-opening. This would reduce the likelihood of unacceptable impacts to travel time, travel time reliability and road safety. Adopting these controls would result in a negligible risk rating.

8.1.1.3 Pedestrian and cyclist connectivity

The configuration of the path network during operation could have the following impacts:

- Connectivity for pedestrians and cyclists is negatively impacted by level crossing removal, resulting in increases to travel distance and/or time resulting in social and business impacts **(risk T27)**.

The project design generally maintains current pedestrian and cyclist connectivity with the following changes:

- Two pedestrian bridges compliant with the *Disability Discrimination Act 1992* (DDA) over the trench, with an additional pedestrian bridge incorporated at grade into the car parking deck. The locations of these bridges would be confirmed in consultation with Council and incorporate community feedback. Pedestrians and cyclists would also be able to use the road bridge over the rail corridor.
- A new Shared Use Path provided on the western side of Station Street from north of the station to south of the carpark.
- A pedestrian and cyclist signalised crossing provided on the western side of Station Street to enable pedestrians and cyclists to cross Edithvale Road.

While pedestrians would potentially have to walk further where there is a pedestrian overpass (rail at or close to current grade), their reliability of travel time would be improved through the removal of the level crossing.

Management and mitigation

The project would be designed and constructed to provide suitable routes for pedestrians and cyclists to maintain connectivity post-construction. These measures would be developed in consultation with relevant road authorities, local councils and transport authorities where appropriate **(EPR_T3)**. This would reduce the likelihood of unacceptable impacts to pedestrian and cyclist connectivity resulting in increases to travel distance and/or time resulting in social and business impacts. Adopting these controls would result in a negligible risk rating.

8.2 Bonbeach

8.2.1 Operational impacts

8.2.1.1 Safety

Statistics provided by Transport Safety Victoria and the Office of the National Rail Safety Regulator indicate that in the ten year period ending on 31 December 2014 there was one non-fatal collision incident between a train and road vehicle, three near miss incidents between a train and road vehicle and five near miss incidents between a train and pedestrian.

Removal of the level crossings is expected to result in improved safety by removing the conflict between trains and road users. This will benefit current users of the level crossing as well as users that redistribute to the grade separated crossing from other at-grade crossings of the rail corridor.

Upgrades to the road network to provide continuity of pedestrian and cycle facilities through the intersections may also assist to reduce the likelihood of crashes.

8.2.1.2 Traffic operations

The layout of the road network and signalling during operation could have the following impacts:

- New road network layout and signalling may not adequately cater for the safe and efficient movement of traffic following level crossing removal, resulting in unacceptable intersection performance and/or increased crashes. **(risk T26).**

The existing intersections of Nepean Highway and Station Street with Bondi Road are likely to be able to adequately cater for the volume of traffic that is expected in the operation phase of the Bonbeach level crossing removal project. Although this is the case, it has been proposed that the intersections layout and signal phasing be optimised as a key component of the works.

A potential layout for the upgrade of the intersections is shown in Figure 33. This includes the following proposed infrastructure alterations from the existing:

- Signalised pedestrian crossings have been assumed present on each intersection approach.
- Provision of a Shared Use Path on the western side of Station Street including a crossing of the western approach to the intersection of Station Street and Bondi Road. This facilitates bicycle and pedestrian access to the station as well as accommodating through movements. Bicycle parking provision at the station will be resolved in the final design.
- Station Street south approach has been converted to one lane through and right lane and a short left-turn lane.
- Nepean Highway south approach right turn lane length has been extended.
- Station Street north approach right turn lane length has been extended.

The operation of the remodelled intersections has been assessed in order to understand their likely performance and inform the identification of mitigation measures.

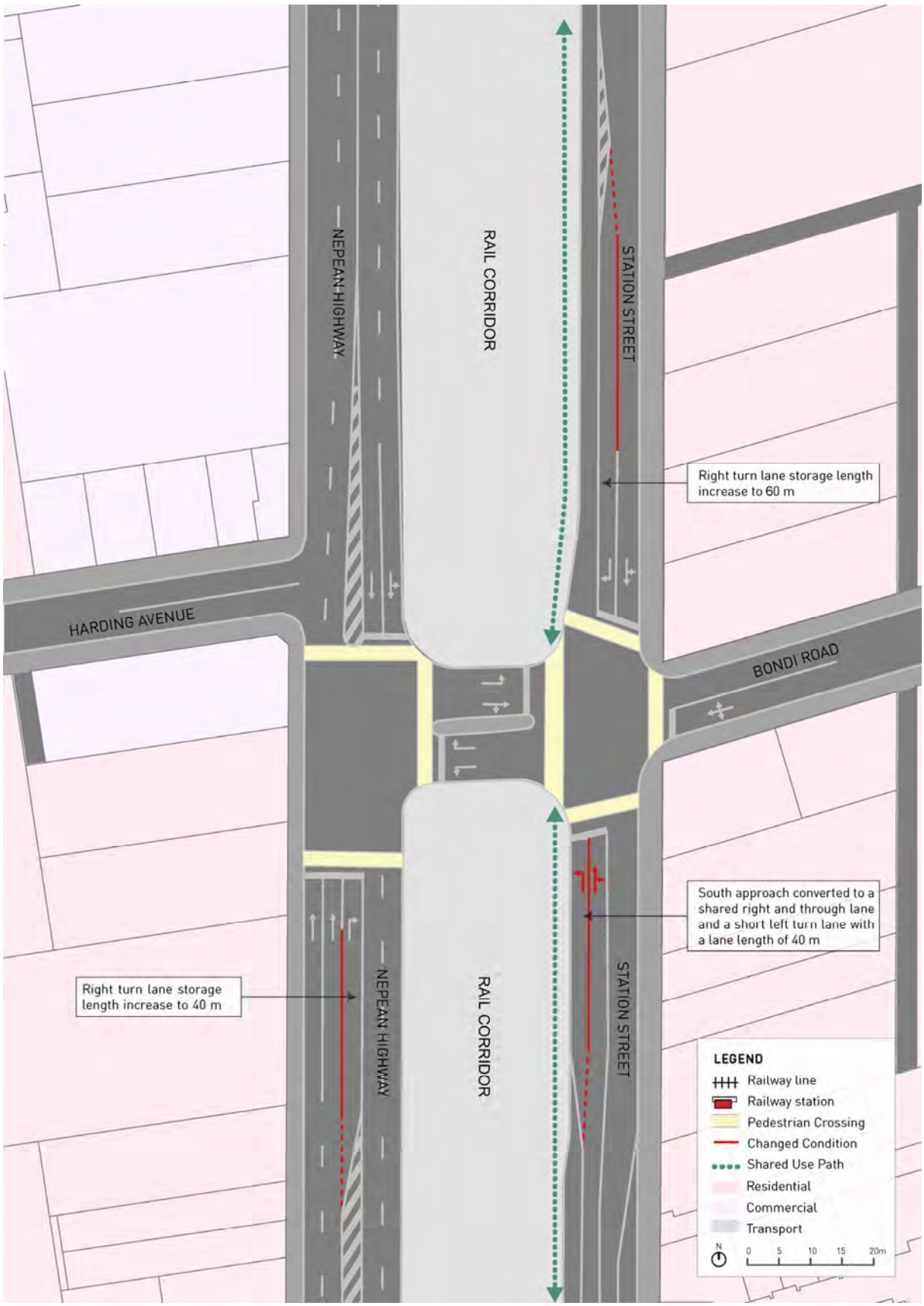

Figure 33 Nepean Highway, Station Street and Bondi Road intersections proposed layout

Traffic volumes

Traffic volumes extracted from 2015 and 2021 Victorian Integrated Transport Model (VITM) models have been compared to understand the level of traffic growth that might be expected in the area around the level crossing. The comparison between the two models indicates that minimal traffic growth is expected to 2021. Traffic data collected for the project in 2017 has therefore been assumed to be a reasonable approximation of traffic volumes at the time the level crossing removal works are completed, and accordingly no traffic growth has been applied. Traffic has however been redistributed to account for changes in network connectivity as described below.

The following methodology was used to estimate the redistributed traffic volumes at the intersections for the proposed road network:

- Turning movement counts and OD data were used to understand how vehicles are currently moving through Carrum and Bonbeach.
- The traffic was redistributed based on the proposed road network, which includes:
    - Grade separation of the Station Street level crossing in Bonbeach.
    - New grade separated signalised intersections of Nepean Highway, Station Street and McLeod Road.
    - Closure of Station Street level crossing near Mascot Avenue, Station Street level crossing near Carrum Station and Eel Race Road level crossing.
    - New road bridge across Patterson River that connects Station Street.

The traffic redistribution assumptions shown in Appendix C were agreed with representatives from LXRA and VicRoads Metropolitan South-East Region at workshops held earlier in the project. The same assumptions have been applied to the current work.

The OD surveys for both the enclosed and wider cordons were surveyed on Thursday 25 May 2017.

A summary of the existing local road network traffic volumes for the AM (8:00 am to 9:00 am) and PM (5:00 pm to 6:00 pm) peak periods is provided in Figure 23. This was taken from the Wednesday 28 June 2017 traffic survey. It should be noted that this survey data is similar to that collected on Thursday 25 May 2017, however the most recent survey data was adopted as this included the Nepean Highway signalised intersection.

The predicted traffic volumes to be used at the intersections, as determined by applying the outlined traffic redistribution methodology and traffic survey volumes are provided in Figure 34. Trips from the intersections between the Station Street signalised intersections with Bondi Road and Mascot Avenue were also added as these were not captured in the OD survey.

Figure 34 Estimated traffic volumes at Nepean Highway, Station Street and Bondi Road intersections for proposed road network

Signal phasing

The boom gates at the level crossing are down for an average of 45 minutes during the weekday period between 7:00 am and 9:00 am. This equates to 38 percent of available traffic signal cycle time being taken up by train phases. Additional cycle time is also allocated to clearance phases that allow vehicles to clear the tracks prior to the arrival of a train. Whilst different combinations of traffic and pedestrian movements can operate during the train phases (depending on demand), the randomness of train arrivals and the variability in the duration of boom gate closure times (observed to range up to 159 seconds) means that signal cycle time cannot always be allocated as desired. This impacts cross-rail corridor movements and can result in queueing and delays.

Elimination of train phases as part of level crossing removal allows traffic signal phase time to be allocated to traffic, pedestrian and cycle movements according to demand. The result is that currently constrained movements are able to run more frequently if required.

The signal phasing adopted for analysis assumes that each phase runs every cycle and that phase and cycle times are fixed. A key element of the phasing is to have the pedestrian and cyclist crossing on the western approach of Station Street operating at a separate time to turning vehicles from Station Street. It is regarded that this arrangement would reduce the risk of conflict between motorised vehicles and cyclists and pedestrians.

The details of each phase time for each peak period are shown in Appendix B.

Intersection analysis

SIDRA version 7 software has been used to assess the operation of the intersections. This produces individual summaries for each intersection even though they are modelled as a single site due to their proximity. The distance between Nepean Highway and Station Street is approximately 15 metres.

To optimise the traffic signals, modifications were made manually to the proposed signal phasing instead of allowing the software to determine the phase splits and cycle times.

The outputs of SIDRA modelling are summarised in Table 17 and Table 18. Full results are provided in Appendix B. Definitions of the terms used in the summary table and how they relate to intersection performance are provided in the Glossary.

Table 17 SIDRA results at Nepean Highway and Station Street

Approach Lane	AM peak period				PM peak period			
	Degree of Saturation (DoS)	Average delay (s/veh)	95% queue (m)	Level of Service (LOS)	Degree of Saturation (DOS)	Average delay (s/veh)	95% queue (m)	Level of Service (LOS)
Nepean Highway (south)	0.568	28	145	C	0.341	26	71	C
Connection to Station Street (east)	0.250	47	25	D	0.245	49	25	D
Nepean Highway (north)	0.395	25	94	C	0.821	35	247	D
All vehicles	**0.568**	**28**	**145**	**C**	**0.821**	**34**	**247**	**C**

Table 18 SIDRA results at Station Street and Bondi Road

Approach Lane	AM peak period				PM peak period			
	Degree of Saturation (DOS)	Average delay (s/veh)	95% queue (m)	Level of Service (LOS)	Degree of Saturation (DOS)	Average delay (s/veh)	95% queue (m)	Level of Service (LOS)
Station Street (south)	0.466	31	93	C	0.551	38	90	D
Bondi Road (east)	0.396	56	31	E	0.317	53	24	D
Station Street (north)	0.387	36	51	D	0.490	36	84	D
Connection to Nepean Highway (west)	0.045	21	9	C	0.060	25	14	C
All vehicles	**0.466**	**35**	**93**	**C**	**0.551**	**37**	**90**	**D**

Discussion

The current intersections work reasonably well under current traffic conditions with the exception of cross-rail corridor movements, which can be subject to substantial delays due to the operation of the boom gates and traffic signal phasing. Removal of the level crossing will allow the traffic signal cycle time that is currently taken up by train phases to be reallocated to different movements as required depending on demand and priority. This is expected to result in reduced delays and enhanced reliability for cross-rail corridor trips.

North-south bicycle and pedestrian movements on Station Street will also be a beneficiary of the proposed intersection upgrades as the proposed pedestrian and cyclist crossing is able to operate every signal cycle without the risk of conflict with turning vehicles.

The provision of on-street parking in the vicinity of the works will be resolved in consultation with Kingston City Council and VicRoads as part of the final design.

As shown from Table 17 and Table 18, the proposed Nepean Highway, Station Street and Bondi Road signalised intersections are predicted to operate within capacity (DOS below 0.9) in both the AM and PM peak periods with estimated opening year volumes. The intersection Level of Service is expected to be C or D, indicating that average delay is within acceptable limits. Based on the analysis the performance of the intersections is estimated to be acceptable.

Management and mitigation

The project would be designed and constructed to provide for safe vehicle movements and acceptable intersection performance to the satisfaction of the responsible road management authority **(EPR_T4)**, including road safety audits at appropriate times during design, construction and post-opening. This would reduce the likelihood of unacceptable impacts to travel time, travel time reliability and road safety. Adopting these controls would result in a negligible risk rating.

8.2.1.3 Pedestrian and cyclist connectivity

The configuration of the path network during operation could have the following impacts:

- Connectivity for pedestrians and cyclists is negatively impacted by level crossing removal, resulting in increases to travel distance and/or time resulting in social and business impacts **(risk T27).**

The project design generally maintains current pedestrian and cyclist connectivity with the following changes:

- Cross-corridor connectivity would be provided by two DDA compliant pedestrian bridges over the trench. The locations of the pedestrian bridges are to be confirmed in consultation with Council and incorporate community feedback. Pedestrians and cyclists would also be able to use the road bridge over the rail corridor.
- A new Shared Use Path provided on the western side of Station Street in the vicinity of the station
- A pedestrian and cyclist signalised crossing provided on the western side of the intersection of Station Street and Bondi Road to enable pedestrians and cyclists to travel north-south along Station Street.

While pedestrians would potentially have to walk further where there is a pedestrian overpass (rail at or close to current grade), the reliability of travel time would be improved through the removal of the level crossing.

Management and mitigation

The project would be designed and constructed to provide suitable routes for pedestrians and cyclists to maintain connectivity post-construction. These measures would be developed in consultation with relevant road authorities, local councils and transport authorities where appropriate **(EPR_T3)**. This would reduce the likelihood of unacceptable impacts to pedestrian and cyclist connectivity resulting in increases to travel distance and/or time resulting in social and business impacts. Adopting these controls would maintain the risk at a negligible rating.

9 Environmental Performance Requirements

The EPRs required for the projects to achieve acceptable environmental outcomes are summarised in Table 19. The EPRs are applicable to the final design and construction approach and provide certainty regarding the environmental performance of the projects.

Table 19 Edithvale and Bonbeach environmental performance requirements

EPR ID	Environmental Performance Requirement	Stage
EPR_T1	**Transport Management Plan** Prior to the commencement of construction (excluding preparatory works), develop and implement a Transport Management Plan(s) to minimise disruption (to the extent practicable) to affected local land uses, traffic, car parking, on-road public transport, pedestrian and bicycle movements and existing public facilities during all stages of construction. The plan(s) must be developed in consultation with the relevant road management authorities and be informed and supported by an appropriate level of transport analysis. The plan(s) must include: a. a monitoring program to monitor impacts of construction activities to all modes of active and passive transport. Where monitoring identifies adverse impacts, practicable mitigation measures must be developed and implemented b. consideration of cumulative impacts of other major projects operating concurrently in the local area c. identify the route options for construction vehicles (including haulage of spoil and other heavy materials to and from site) travelling to and from the project construction site, recognising sensitive receptors and minimising the use of local streets where practicable d. be prepared in consultation with emergency services, develop suitable measures to ensure emergency service access is not inhibited as a result of project construction activities e. allow for the provision of alternative parking where practicable to replace public and commuter parking lost as a result of project construction activities and to prevent construction-related parking on local roads or use of public carparks f. allow for the provision of car parking or park and ride facilities for construction workers g. provisions for the minimisation of impacts on existing connectivity for pedestrians, cyclists, public transport and road vehicles as a result of construction (including laydown areas) including the identification of alternative routes for pedestrians and cyclists and other measures to maintain connectivity and safety for pedestrians and cyclists h. management of any temporary or partial closure of roads and traffic lanes, including provision for suitable routes for vehicles, cyclists and pedestrians to maintain connectivity for road and footpath users i. an approach for maximising the current road capacity on Nepean Highway and Edithvale Road during peak periods j. restrictions to the number of local roads to be used for construction-related transportation to minimise impacts on amenity, in consultation with the relevant road authorities k. reinstatement of access to open space, community facilities,	Construction

EPR ID	Environmental Performance Requirement	Stage
	commercial premises and dwellings if disrupted, as soon as practicable and to an equivalent standard l. provision for safe access points to laydown areas and site compounds m. a communications strategy to advise affected users, potentially affected users, relevant stakeholders and the relevant road authorities of any changes to transport conditions in accordance with the Community and Stakeholder Engagement Management Plan (EPR reference SC1). The plan may include specific measures for discrete components or stages of the works having the potential to impact on roads, shared use paths, bicycle paths, footpaths or public transport infrastructure.	
EPR_T2	**Public Transport Disruption Management Plan** Prior to commencement of works significantly affecting public transport services, develop and implement a plan for minimising disruption to public transport services (rail, bus) resulting from project construction activities. The plan must be developed in consultation with VicTrack, V/Line, Public Transport Victoria, the Department of Economic Development, Jobs, Transport and Resources (Transport) and Metro Trains Melbourne, as relevant.	Construction
EPR_T3	**Pedestrian and cyclist connectivity** Optimise the design in accordance with the principles and objectives of LXRA's Urban Design Guidelines to maintain and enhance pedestrian and cyclists connectivity in consultation with relevant road authorities, Kingston City Council and Public Transport Victoria where appropriate.	Construction Operation
EPR_T4	**Intersection design and performance** Intersections must be designed and constructed to provide safe vehicle movements to the satisfaction of the responsible road management authority. Undertake an intersection analysis to ensure acceptable intersection performance.	Operation
EPR_T5	**Car parking** Where practicable, ensure no net loss in station car parking for rail users upon completion and car parking must be replaced or reinstated at the earliest opportunity.	Operation
EPR_T6	**Vehicle and pedestrian access** Where vehicle and pedestrian access are altered during construction, ensure that vehicle and pedestrian access is replaced, in accordance with relevant road design standards.	Construction Operation
EPR_T7	**Debris on roads** Minimise dirt and debris on the roads from construction activities by measures including: n. street sweeping o. covering all truck loads that have the potential to result in debris on public roads p. cleaning vehicles and tyres when leaving construction sites.	Construction
EPR_T8	**Emergency services** Maintain vehicular and pedestrian access to hospital emergency departments at all times during construction and to other key health and medical facilities, where practicable.	Construction

10 Conclusion

Existing conditions

The existing traffic conditions for Bonbeach and Edithvale have been discussed and traffic surveys used to determine future volumes in the impact assessment.

Construction impact assessment

Work during the construction phase of the level crossing removal projects has the potential to impact traffic operations and road safety. Aspects of construction that have been identified as having the greatest potential to result in impacts include:

- lane closures (vehicle and bicycle lanes) and parking removal
- road closures
- rail line closures
- pedestrian crossing and footpath closures
- construction traffic.

These activities could have the following impacts:

- Construction (including rail shutdowns) reduces road capacity and/or increases traffic volumes resulting in delays and increased travel time during the piling and main rail occupation.
- Construction (including rail shutdowns) reduces road capacity and/or increases traffic volumes resulting in delays and increased travel time outside of the piling and main rail occupation.
- Plant and spoil trucks deposit construction debris on public roads leading to dust generation, perceived loss of amenity and public health and safety issues.
- Construction results in disruption to the transport network and/or increases in traffic volumes leading to increased crashes or the perception that the area is less safe.

Traffic impacts are expected to be most pronounced during the piling and main rail occupation periods when lanes may be closed on Nepean Highway and Station Street and Edithvale Road and Station Street (Bondi Road) will be subject to periodic closure. Construction traffic volumes are also expected to be greatest during the main rail occupation. The extent of traffic impacts will depend on the design of the works and construction methodology adopted. Different combinations of lane closures, road closures, changes to intersection signalling, rail line closures and construction traffic volumes and routing will result in different impacts to traffic operations during construction. Careful consideration will therefore be required of the cumulative impacts.

The works affecting the transport network have the potential to result in a range of economic and social impacts, which are discussed in Technical report K *Business* and Technical report L *Social*.

The projects would develop and implement a range of management and mitigation measures to minimise the impacts as described above (EPRs). The primary management measures would be development of a transport management plan and public transport disruption management plan in consultation with, and to the satisfaction of, relevant road management and transport authorities. Other EPRs include optimising the works for pedestrian and cyclist connectivity, no debris on roads, reinstating vehicle and pedestrian access and maintaining emergency vehicle access. Implementing these measures would assist to provide for the efficient and safe

operation of the transport network during construction, reducing the likelihood of unacceptable impacts to travel time, reliability and road safety. Adopting these controls would result in a moderate risk rating for traffic delay during the main works (piling and main rail occupation), a minor risk rating for traffic delay outside the main works, a negligible risk rating for dirt on roads and a minor risk rating for road safety during construction.

Operational impact assessment

Removal of the level crossings and modifying the adjacent road network has potential to result in the following key operational impacts:

- New road network layout and signalling cannot safely and efficiently cater for traffic volumes following level crossing removal, resulting in unacceptable intersection performance and/or increased crashes.
- Connectivity for pedestrians and cyclists is negatively impacted by level crossing removal, resulting in increases to travel distance and/or time resulting in social and business impacts.

The projects would develop and implement a range of management and mitigation measures to minimise the impacts as described above (EPRs). The primary management measures would be optimising the works for pedestrian and cyclist connectivity and optimising the intersection design and construction for performance and safety. Other EPRs include the replacement of station car parking to ensure no net loss and reinstating vehicle and pedestrian access. Implementing these measures would assist to provide for the safe and efficient operation of the transport network during the operational phase of the projects, reducing the likelihood of unacceptable impacts to travel time, reliability and road safety. Adopting these controls would result in a negligible risk rating.

11 References

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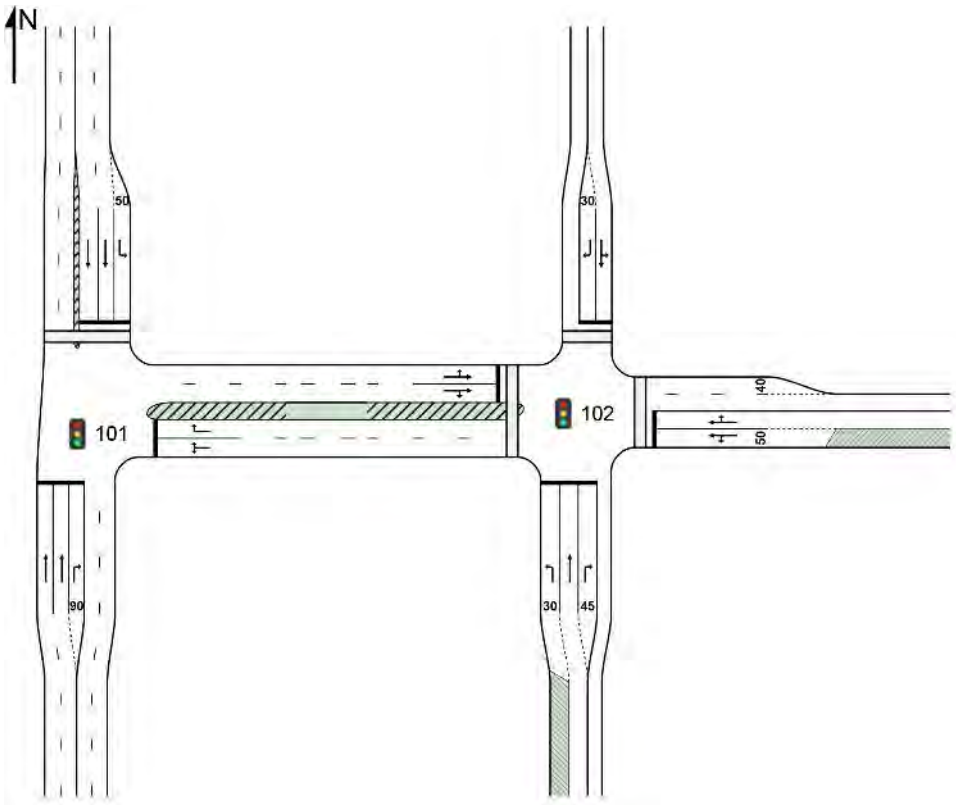
Appendix A – SIDRA Results, Edithvale

NETWORK LAYOUT

Network: 1 [AM Peak - Nepean Highway prioritised - Station Street early start]

New Network



SITES IN NETWORK		
Site ID	**CCG ID**	**Site Name**
101	CCG1	AM Peak Nepean Highway & Edithvale Road- Nepean Highway prioritised - Station Street early start
102	CCG1	AM Peak Station Street & Edithvale Road - Nepean Highway prioritised - Station Street early start

MOVEMENT SUMMARY

Site: 101 [AM Peak Nepean Highway & Edithvale Road-Nepean Highway prioritised - Station Street early start]

Network: 1 [AM Peak - Nepean Highway prioritised - Station Street early start]

AM Peak - Nepean Highway & Edithvale Road
Signals - Fixed Time Isolated Cycle Time = 140 seconds (User-Given Phase Times)
Common Control Group: CCG1 [CCGName]

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Nepean Highway													
2	T1	1293	1.3	1293	1.3	0.825	36.7	LOS D	42.2	298.5	0.91	0.84	37.5
3	R2	169	13.7	169	13.7	0.724	70.8	LOS E	11.6	90.8	1.00	0.85	18.2
Approach		1462	2.7	1462	2.7	0.825	40.6	LOS D	42.2	298.5	0.92	0.85	35.2
East: Edithvale Road													
4	L2	92	8.0	92	8.0	0.337	14.4	LOS B	2.9	21.2	0.29	0.59	39.5
6	R2	213	5.0	213	5.0	0.337	11.5	LOS B	2.9	21.2	0.22	0.57	42.2
Approach		304	5.9	304	5.9	0.337	12.4	LOS B	2.9	21.2	0.24	0.58	41.4
North: Nepean Highway													
7	L2	129	8.9	129	8.9	0.232	12.7	LOS B	2.9	21.8	0.43	0.69	42.6
8	T1	491	2.6	491	2.6	0.288	25.7	LOS C	10.5	75.3	0.67	0.58	42.2
Approach		620	3.9	620	3.9	0.288	23.0	LOS C	10.5	75.3	0.62	0.60	42.3
All Vehicles		2386	3.4	2386	3.4	0.825	32.4	LOS C	42.2	298.5	0.76	0.75	37.2

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 1.0 %
Number of Iterations: 20 (maximum specified: 30)

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P3	North Full Crossing	25	57.7	LOS E	0.1	0.1	0.91	0.91
All Pedestrians		25	57.7	LOS E			0.91	0.91

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 102 [AM Peak Station Street & Edithvale Road - Nepean Highway prioritised - Station Street early start]

Network: 1 [AM Peak - Nepean Highway prioritised - Station Street early start]

AM Peak - Station Street & Edithvale Road
Signals - Fixed Time Isolated Cycle Time = 140 seconds (User-Given Phase Times)
Common Control Group: CCG1 [CCGName]

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Station Street													
1	L2	37	0.0	37	0.0	0.292	67.1	LOS E	2.4	16.7	0.94	0.75	18.9
2	T1	548	1.7	548	1.7	0.817	38.7	LOS D	31.8	225.7	0.88	0.82	36.7
3	R2	82	7.7	82	7.7	0.312	54.7	LOS D	4.7	35.4	0.87	0.78	30.9
Approach		667	2.4	667	2.4	0.817	42.2	LOS D	31.8	225.7	0.88	0.81	34.9
East: Edithvale Road													
4	L2	31	20.7	31	20.7	0.869	80.5	LOS F	13.9	105.0	1.00	1.03	26.3
5	T1	255	6.6	255	6.6	0.869	71.5	LOS E	17.6	126.8	0.99	1.01	17.8
6	R2	137	0.8	137	0.8	0.869	72.7	LOS E	17.6	126.8	0.97	0.97	27.4
Approach		422	5.7	422	5.7	0.869	72.5	LOS E	17.6	126.8	0.99	1.00	22.1
North: Station Street													
7	L2	225	1.4	225	1.4	0.642	43.9	LOS D	23.0	165.0	0.88	0.81	35.1
8	T1	191	4.4	191	4.4	0.642	38.4	LOS D	23.0	165.0	0.88	0.81	35.7
9	R2	13	8.3	13	8.3	0.086	67.8	LOS E	0.8	6.0	0.93	0.70	18.7
Approach		428	2.9	428	2.9	0.642	42.2	LOS D	23.0	165.0	0.88	0.81	34.9
West: Edithvale Road													
10	L2	73	14.5	73	14.5	0.173	3.6	LOS A	0.1	0.9	0.03	0.50	50.4
11	T1	136	9.3	136	9.3	0.508	34.7	LOS C	2.8	21.2	0.74	0.68	28.3
12	R2	91	12.8	91	12.8	0.508	37.2	LOS D	2.8	21.2	0.74	0.68	27.4
Approach		299	11.6	299	11.6	0.508	27.9	LOS C	2.8	21.2	0.57	0.64	31.3
All Vehicles		1817	4.8	1817	4.8	0.869	46.9	LOS D	31.8	225.7	0.85	0.82	31.1

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 1.0 %
Number of Iterations: 20 (maximum specified: 30)

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P2	East Full Crossing	117	48.3	LOS E	0.4	0.4	0.83	0.83
P3	North Full Crossing	225	52.8	LOS E	0.8	0.8	0.87	0.87
P4	West Full Crossing	53	51.5	LOS E	0.2	0.2	0.86	0.86
All Pedestrians		395	51.3	LOS E			0.86	0.86

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.

PHASING SUMMARY (CCG)

Common Control Group: CCG1 [CCGName]

Network: 1 [AM Peak - Nepean Highway prioritised - Station Street early start]

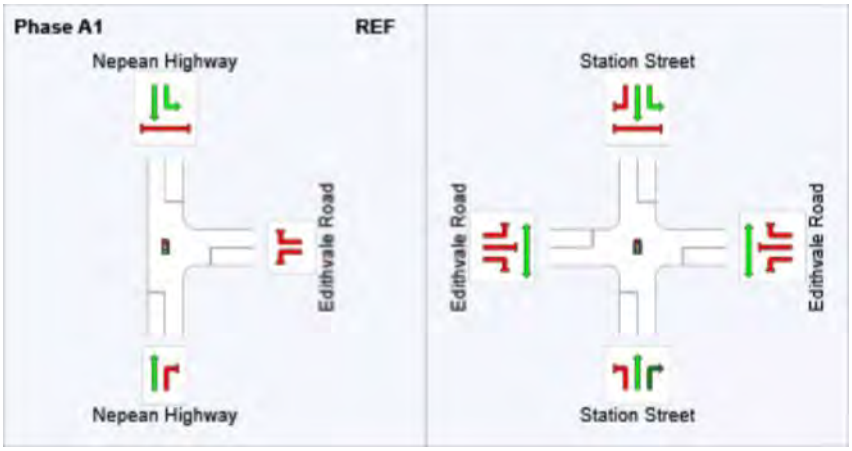
Fixed Time Isolated Cycle Time = 140 seconds (User-Given Phase Times)

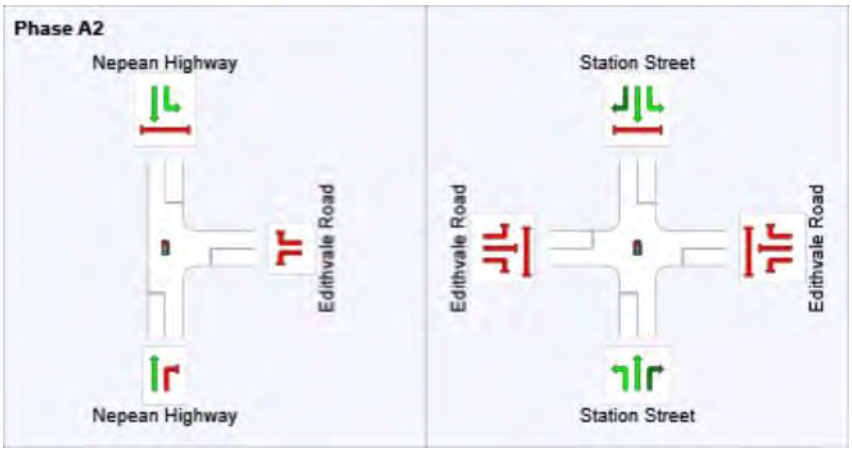
Phase Times specified by the user
Phase Sequence: CCG Phasing - 2P
Reference Phase: Phase A1
Input Phase Sequence: A1, A2, B, C, D1, D2
Output Phase Sequence: A1, A2, B, C, D1, D2

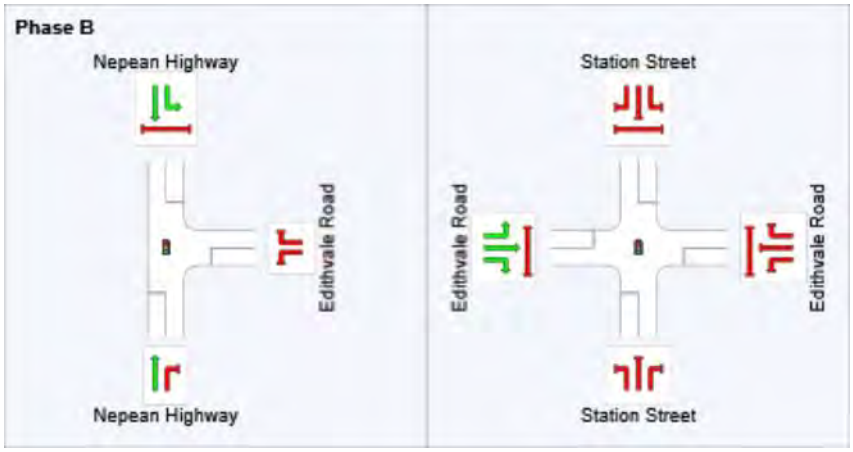
Phase Timing Results

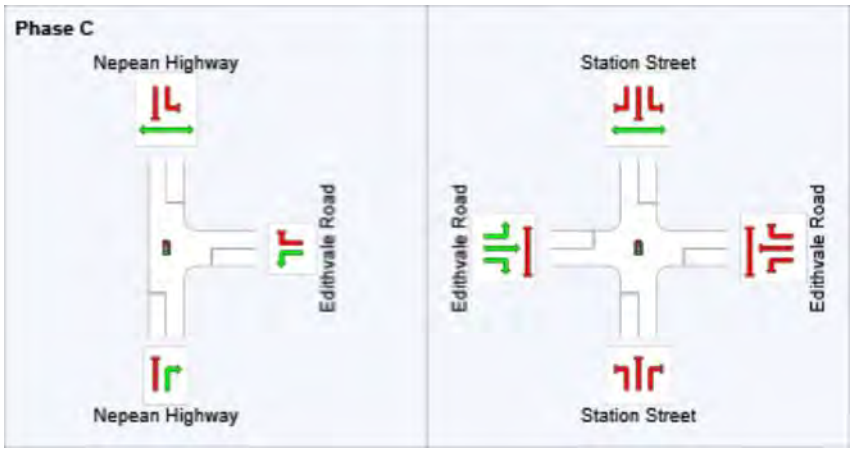
Phase	A1	A2	B	C	D1	D2
Phase Change Time (sec)	0	34	59	69	100	135
Green Time (sec)	28	19	4	25	29	***
Phase Time (sec)	34	25	10	31	35	5
Phase Split	24 %	18 %	7 %	22 %	25 %	4 %

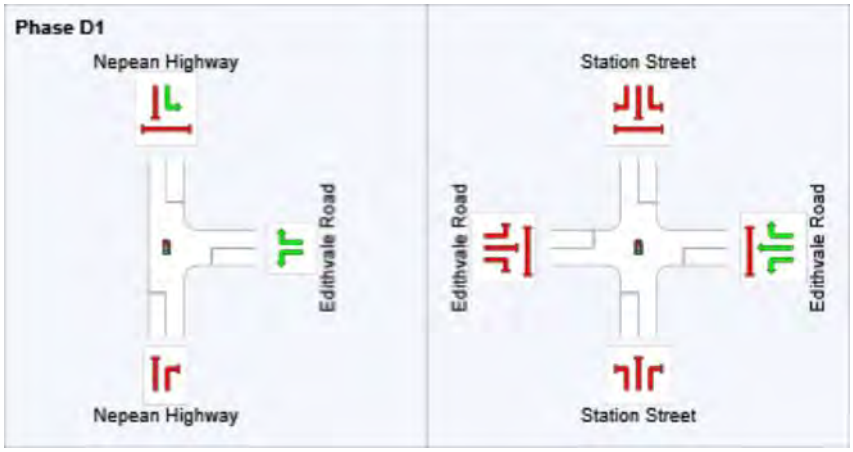
See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

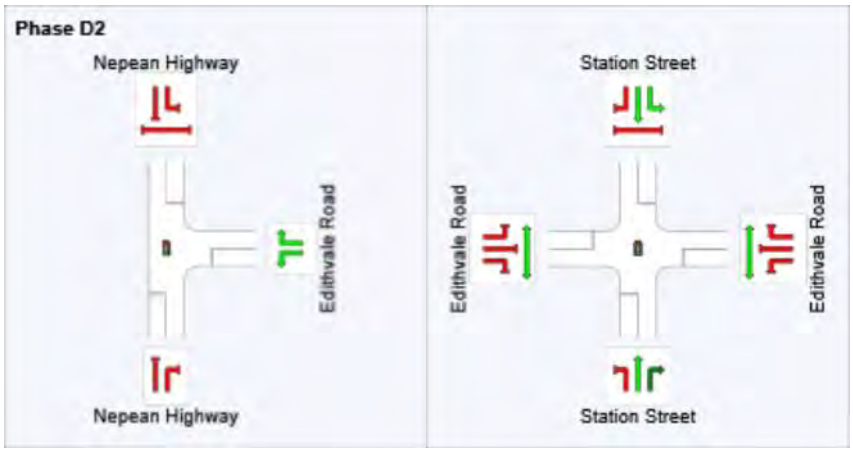






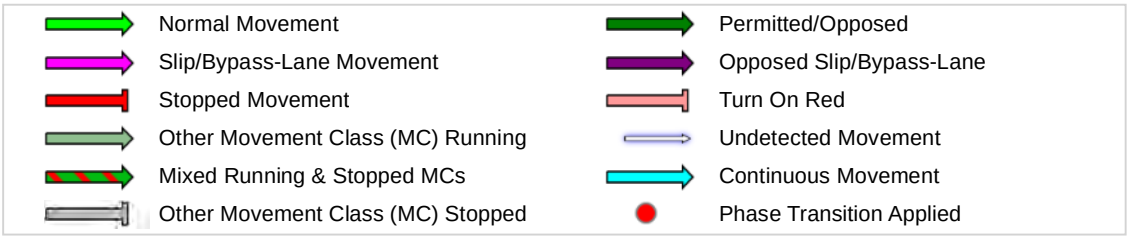






REF: Reference Phase

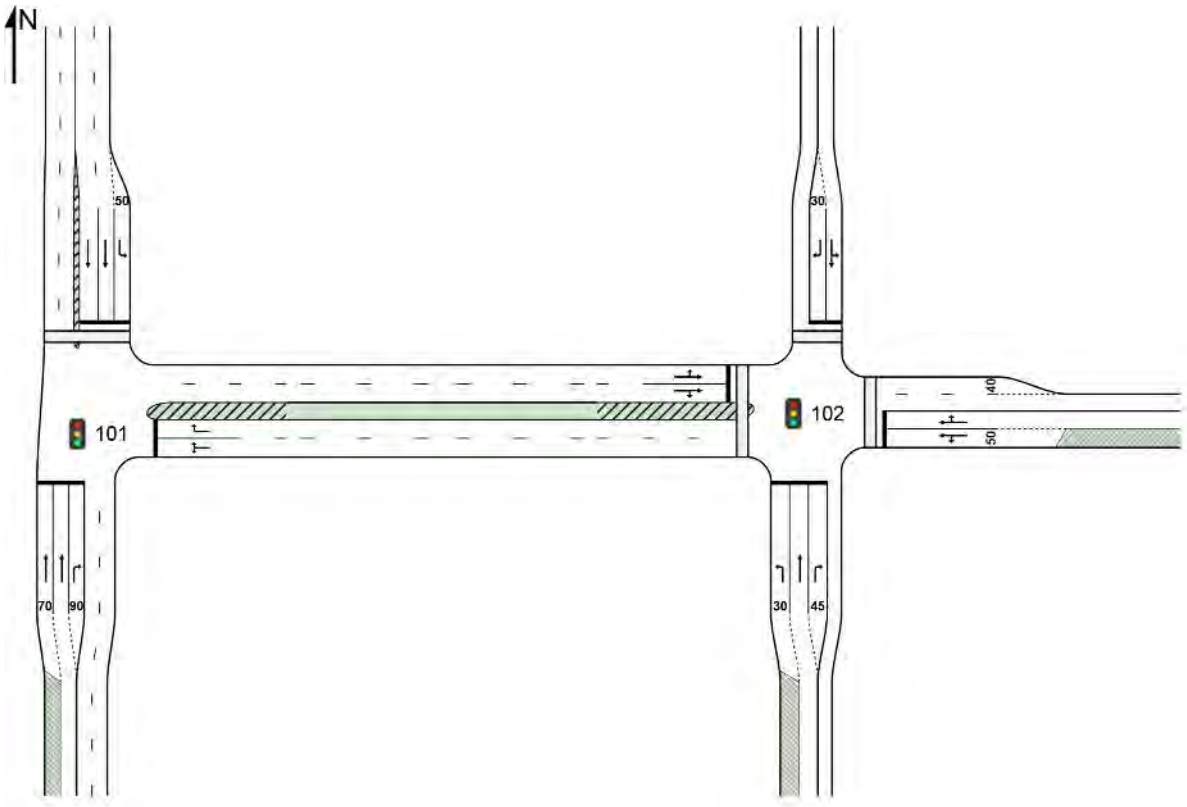
VAR: Variable Phase



NETWORK LAYOUT

Network: 1 [PM Peak - Nepean Highway prioritised - Station Street early start]

New Network



SITES IN NETWORK		
Site ID	**CCG ID**	**Site Name**
101	CCG1	PM Peak Nepean Highway & Edithvale Road- Nepean Highway prioritised - Station Street early start
102	CCG1	PM Peak Station Street & Edithvale Road- Nepean Highway prioritised - Station Street early start

MOVEMENT SUMMARY

Site: 101 [PM Peak Nepean Highway & Edithvale Road-Nepean Highway prioritised - Station Street early start]

Network: 1 [PM Peak - Nepean Highway prioritised - Station Street early start]

PM Peak - Nepean Highway & Edithvale Road
Signals - Fixed Time Isolated Cycle Time = 146 seconds (User-Given Phase Times)
Common Control Group: CCG1 [CCGName]

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Nepean Highway													
2	T1	508	1.0	508	1.0	0.266	21.6	LOS C	10.1	71.3	0.61	0.52	44.3
3	R2	181	10.5	181	10.5	0.877	85.6	LOS F	14.3	109.4	1.00	0.94	15.9
Approach		689	3.5	689	3.5	0.877	38.4	LOS D	14.3	109.4	0.71	0.63	34.8
East: Edithvale Road													
4	L2	116	0.0	116	0.0	0.381	9.1	LOS A	1.9	13.2	0.16	0.56	44.8
6	R2	201	2.6	201	2.6	0.381	12.9	LOS B	2.7	19.2	0.24	0.58	41.1
Approach		317	1.7	317	1.7	0.381	11.5	LOS B	2.7	19.2	0.21	0.57	42.4
North: Nepean Highway													
7	L2	187	6.7	187	6.7	0.459	33.7	LOS C	9.1	67.1	0.72	0.79	28.7
8	T1	1398	0.8	1398	0.8	0.857	35.3	LOS D	53.0	373.2	0.87	0.83	38.0
Approach		1585	1.5	1585	1.5	0.857	35.1	LOS D	53.0	373.2	0.85	0.83	37.2
All Vehicles		2592	2.0	2592	2.0	0.877	33.1	LOS C	53.0	373.2	0.74	0.74	36.9

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 0.9 %
Number of Iterations: 17 (maximum specified: 30)

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P3	North Full Crossing	65	62.6	LOS F	0.3	0.3	0.93	0.93
All Pedestrians		65	62.6	LOS F			0.93	0.93

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 102 [PM Peak Station Street & Edithvale Road- Nepean Highway prioritised - Station Street early start]

Network: 1 [PM Peak - Nepean Highway prioritised - Station Street early start]

PM Peak - Station Street & Edithvale Road
Signals - Fixed Time Isolated Cycle Time = 146 seconds (User-Given Phase Times)
Common Control Group: CCG1 [CCGName]

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Station Street													
1	L2	21	0.0	21	0.0	0.038	42.1	LOS D	1.0	7.1	0.72	0.69	25.4
2	T1	237	0.0	237	0.0	0.264	24.3	LOS C	9.9	69.4	0.64	0.55	42.9
3	R2	52	8.2	52	8.2	0.448	72.4	LOS E	3.6	26.9	0.97	0.78	26.8
Approach		309	1.4	309	1.4	0.448	33.6	LOS C	9.9	69.4	0.70	0.59	38.0
East: Edithvale Road													
4	L2	36	17.6	36	17.6	0.882	80.2	LOS F	17.2	125.0	1.00	1.01	26.3
5	T1	274	1.5	274	1.5	0.882	75.3	LOS E	17.2	125.0	1.00	1.01	17.2
6	R2	119	0.0	119	0.0	0.882	82.5	LOS F	16.2	114.1	1.00	1.01	25.5
Approach		428	2.5	428	2.5	0.882	77.7	LOS E	17.2	125.0	1.00	1.01	20.8
North: Station Street													
7	L2	199	3.7	199	3.7	0.893	52.6	LOS D	50.5	361.8	0.95	0.95	32.8
8	T1	518	2.4	518	2.4	0.893	47.1	LOS D	50.5	361.8	0.95	0.95	33.4
9	R2	22	4.8	22	4.8	0.086	44.5	LOS D	1.1	8.2	0.74	0.71	24.5
Approach		739	2.8	739	2.8	0.893	48.5	LOS D	50.5	361.8	0.95	0.94	33.1
West: Edithvale Road													
10	L2	71	16.4	71	16.4	0.295	3.8	LOS A	0.1	1.1	0.03	0.50	49.9
11	T1	174	4.8	174	4.8	0.722	44.9	LOS D	2.9	21.2	0.90	0.80	24.5
12	R2	124	9.3	124	9.3	0.722	47.4	LOS D	2.9	21.2	0.90	0.80	23.9
Approach		368	8.6	368	8.6	0.722	37.9	LOS D	2.9	21.2	0.74	0.74	26.9
All Vehicles		1845	3.7	1845	3.7	0.893	50.7	LOS D	50.5	361.8	0.88	0.86	29.6

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 0.9 %
Number of Iterations: 17 (maximum specified: 30)

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P2	East Full Crossing	84	65.4	LOS F	0.3	0.3	0.95	0.95
P3	North Full Crossing	158	48.8	LOS E	0.5	0.5	0.82	0.82
P4	West Full Crossing	53	67.3	LOS F	0.2	0.2	0.96	0.96
All Pedestrians		295	56.9	LOS E			0.88	0.88

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.

PHASING SUMMARY (CCG)

Common Control Group: CCG1 [CCGName]

Network: 1 [PM Peak - Nepean Highway prioritised - Station Street early start]

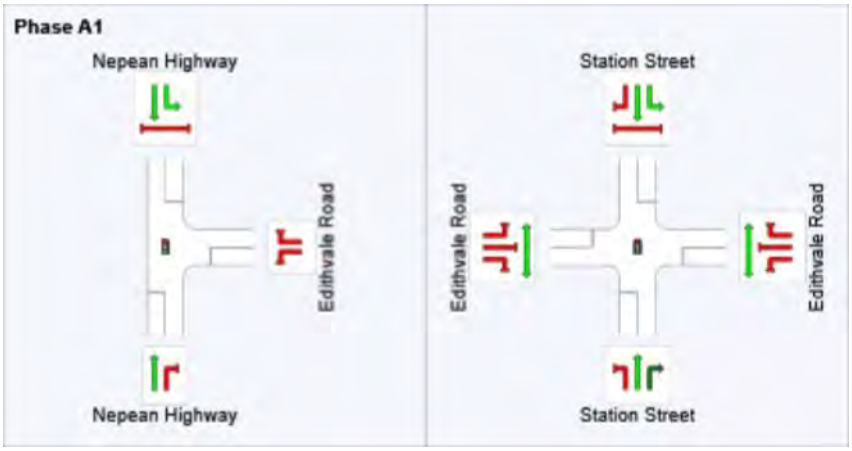
Fixed Time Isolated Cycle Time = 146 seconds (User-Given Phase Times)

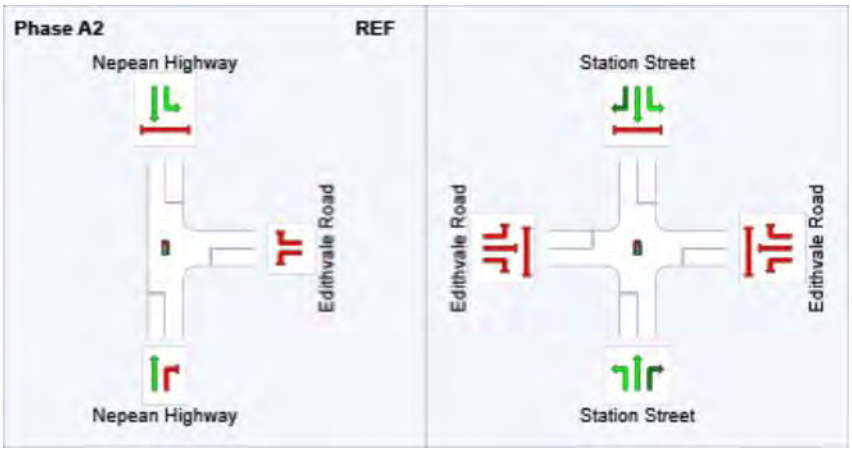
Phase Times specified by the user
Phase Sequence: CCG Phasing
Reference Phase: Phase A2
Input Phase Sequence: A1, A2, B, C, D1, D2
Output Phase Sequence: A1, A2, B, C, D1, D2

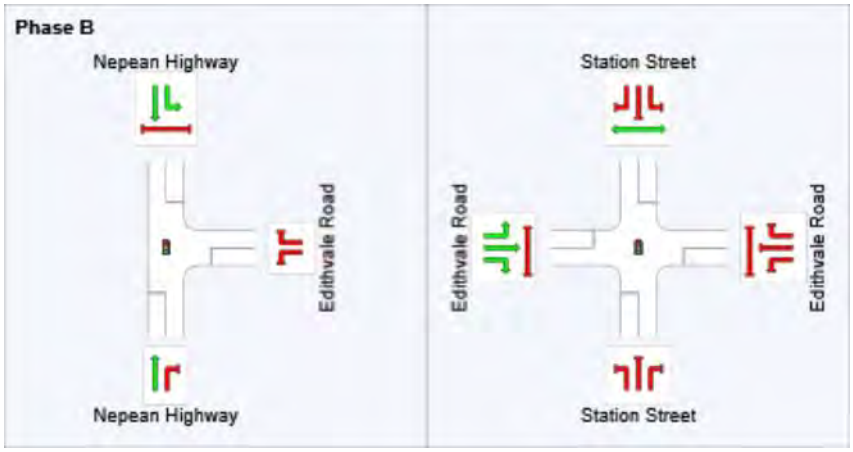
Phase Timing Results

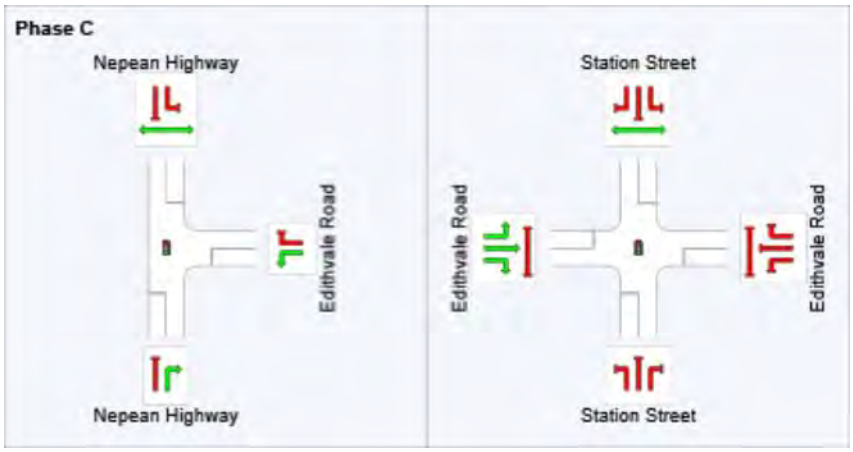
Phase	A1	A2	B	C	D1	D2
Phase Change Time (sec)	128	0	52	62	91	123
Green Time (sec)	12	46	4	23	26	***
Phase Time (sec)	18	52	10	29	32	5
Phase Split	12 %	36 %	7 %	20 %	22 %	3 %

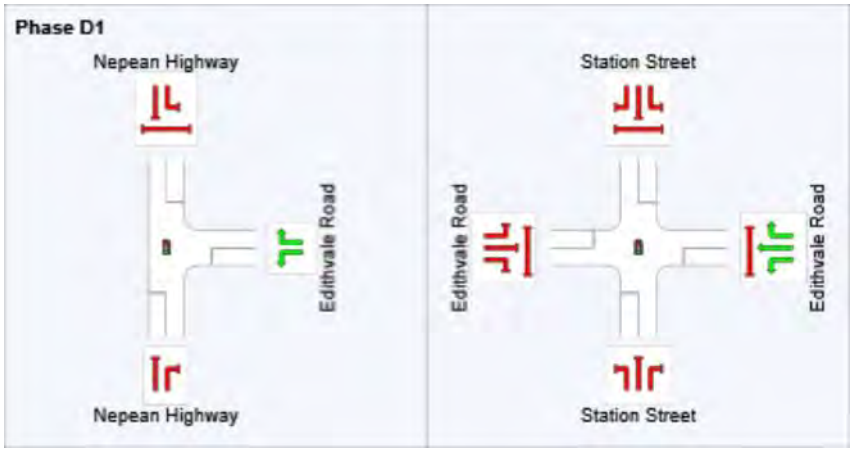
See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

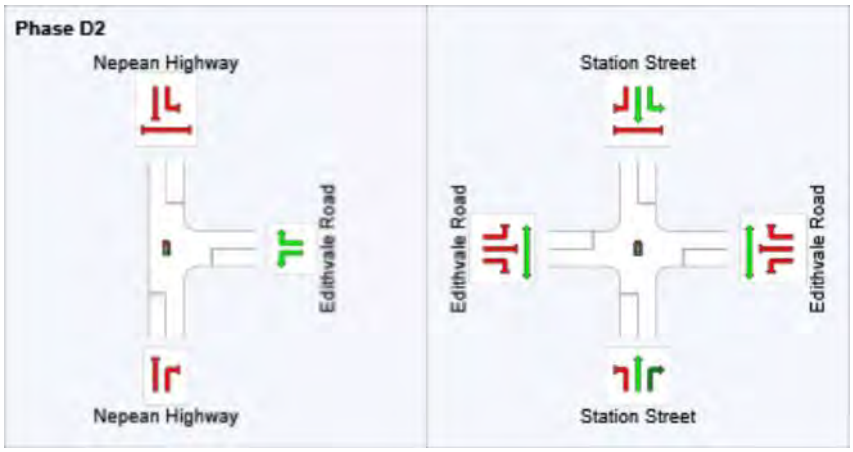






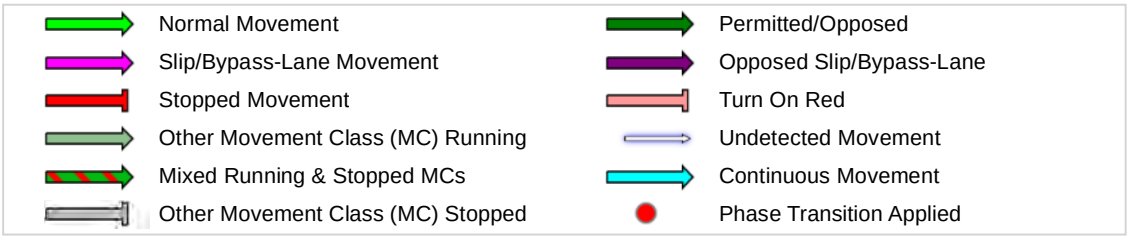






REF: Reference Phase

VAR: Variable Phase

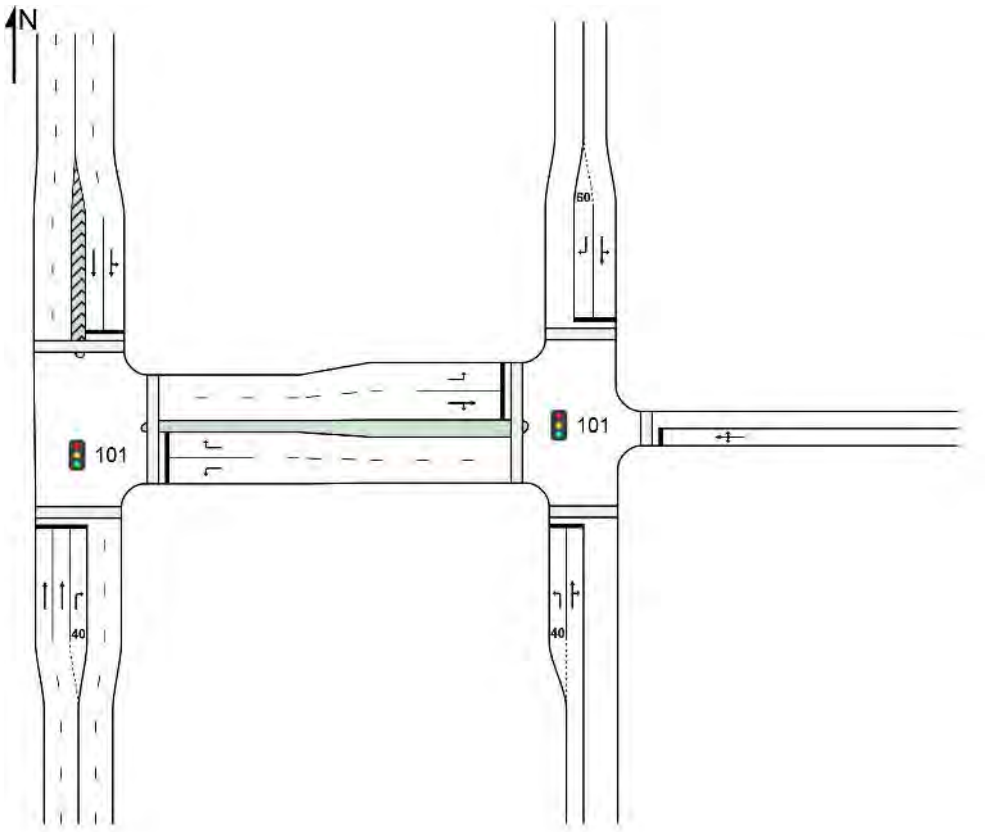


Appendix B – SIDRA Results, Bonbeach

NETWORK LAYOUT

Network: N101 [AM Peak - Predicted Volumes]

New Network



SITES IN NETWORK		
Site ID	**CCG ID**	**Site Name**
101	CCG1	Nepean Highway & Station Street - AM Peak - Predicted
101	CCG1	Station Street & Bondi Road - AM Peak - Predicted

Organisation: AECOM AUSTRALIA PTY LTD | Created: Friday, 8 December 2017 3:55:31 PM
Project: \\10.2.104.6\projects$\Project Data\LX31\37-06 Frankston Group\46 - Station Street, Bonbeach\4. Tech work area\Traffic\SIDRA Modelling\Bonbeach SIDRA Models.sip7

MOVEMENT SUMMARY

Site: 101 [Nepean Highway & Station Street - AM Peak - Predicted]

Network: N101 [AM Peak - Predicted Volumes]

Nepean Highway & New Connection
Signals - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Phase Times)
Common Control Group: CCG1 [CCGName]

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Nepean Highway													
2	T1	915	2.0	915	2.0	0.568	27.1	LOS C	20.3	144.7	0.80	0.71	41.6
3	R2	26	0.0	26	0.0	0.072	47.4	LOS D	1.2	8.7	0.84	0.71	23.7
Approach		941	1.9	941	1.9	0.568	27.7	LOS C	20.3	144.7	0.80	0.71	41.2
East: Connection to Station Street													
4	L2	86	0.0	86	0.0	0.250	42.9	LOS D	3.5	24.5	0.81	0.73	25.0
6	R2	37	0.0	37	0.0	0.107	55.9	LOS E	2.1	14.9	1.00	0.74	21.5
Approach		123	0.0	123	0.0	0.250	46.8	LOS D	3.5	24.5	0.87	0.73	23.8
North: Nepean Highway													
7	L2	24	0.0	24	0.0	0.395	30.3	LOS C	13.2	93.9	0.73	0.64	33.2
8	T1	638	2.0	638	2.0	0.395	24.7	LOS C	13.2	93.9	0.73	0.64	42.6
Approach		662	1.9	662	1.9	0.395	24.9	LOS C	13.2	93.9	0.73	0.64	42.4
All Vehicles		1726	1.8	1726	1.8	0.568	28.0	LOS C	20.3	144.7	0.78	0.68	40.5

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 3.8 %
Number of Iterations: 10 (maximum specified: 10)

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	53	51.5	LOS E	0.2	0.2	0.93	0.93
P2	East Full Crossing	53	51.5	LOS E	0.2	0.2	0.93	0.93
P3	North Full Crossing	53	44.3	LOS E	0.2	0.2	0.86	0.86
All Pedestrians		158	49.1	LOS E			0.90	0.90

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 101 [Station Street & Bondi Road - AM Peak - Predicted]

Network: N101 [AM Peak - Predicted Volumes]

Station Street & Bondi Road
Signals - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Phase Times)
Common Control Group: CCG1 [CCGName]

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Station Street													
1	L2	22	0.0	22	0.0	0.161	55.7	LOS E	1.2	8.3	0.90	0.73	21.4
2	T1	283	2.0	283	2.0	0.466	29.3	LOS C	13.1	93.2	0.79	0.69	40.4
3	R2	21	0.0	21	0.0	0.466	34.8	LOS C	13.1	93.2	0.79	0.69	39.6
Approach		326	1.7	326	1.7	0.466	31.4	LOS C	13.1	93.2	0.80	0.69	39.1
East: Bondi Road													
4	L2	44	0.0	44	0.0	0.396	57.8	LOS E	4.4	30.9	0.95	0.77	30.8
5	T1	24	0.0	24	0.0	0.396	52.2	LOS D	4.4	30.9	0.95	0.77	21.3
6	R2	12	0.0	12	0.0	0.396	57.8	LOS E	4.4	30.9	0.95	0.77	30.8
Approach		80	0.0	80	0.0	0.396	56.1	LOS E	4.4	30.9	0.95	0.77	28.5
North: Station Street													
7	L2	7	0.0	7	0.0	0.237	31.5	LOS C	7.2	51.1	0.71	0.60	41.2
8	T1	178	2.0	178	2.0	0.237	26.0	LOS C	7.2	51.1	0.71	0.60	42.0
9	R2	77	0.0	77	0.0	0.387	58.6	LOS E	4.3	29.8	0.96	0.77	20.8
Approach		262	1.4	262	1.4	0.387	35.7	LOS D	7.2	51.1	0.78	0.65	35.7
West: Connection to Nepean Highway													
10	L2	29	0.0	29	0.0	0.045	33.1	LOS C	1.3	9.1	0.80	0.70	28.6
11	T1	4	0.0	4	0.0	0.032	0.9	LOS A	0.0	0.2	0.02	0.42	54.9
12	R2	17	0.0	17	0.0	0.032	3.5	LOS A	0.0	0.2	0.02	0.42	52.9
Approach		51	0.0	51	0.0	0.045	20.6	LOS C	1.3	9.1	0.48	0.58	35.5
All Vehicles		719	1.3	719	1.3	0.466	35.0	LOS C	13.1	93.2	0.79	0.68	36.3

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 3.8 %
Number of Iterations: 10 (maximum specified: 10)

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	53	51.5	LOS E	0.2	0.2	0.93	0.93
P2	East Full Crossing	53	47.8	LOS E	0.2	0.2	0.89	0.89
P3	North Full Crossing	53	51.5	LOS E	0.2	0.2	0.93	0.93
P4	West Full Crossing	53	51.5	LOS E	0.2	0.2	0.93	0.93
All Pedestrians		211	50.5	LOS E			0.92	0.92

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.

PHASING SUMMARY (CCG)

Common Control Group: CCG1 [CCGName]

Network: N101 [AM Peak - Predicted Volumes]

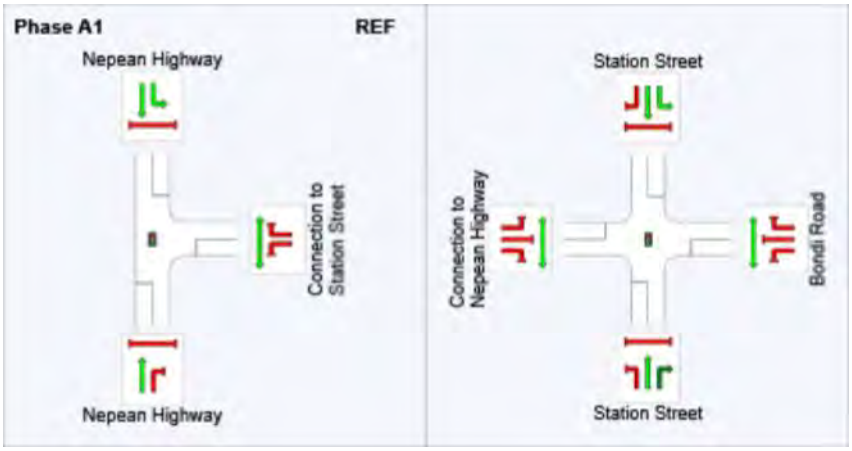
Fixed Time Isolated Cycle Time = 120 seconds (User-Given Phase Times)

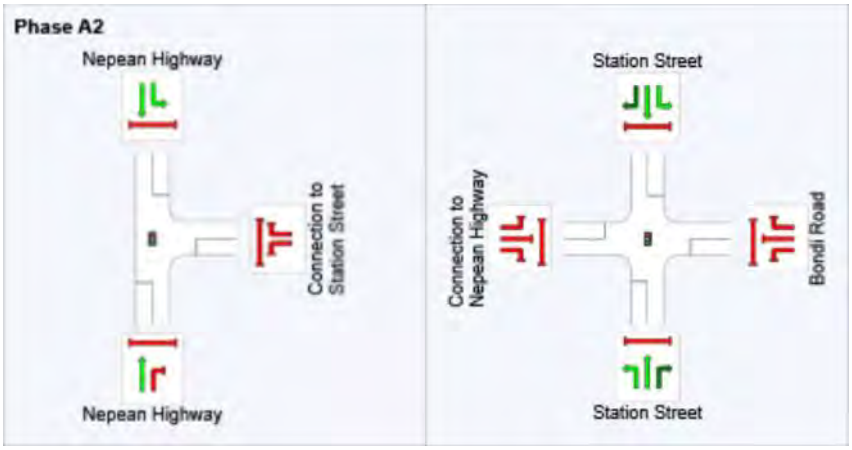
Phase Times specified by the user
Phase Sequence: CCG Phasing
Reference Phase: Phase A1
Input Phase Sequence: A1, A2, B, C, D1, D2
Output Phase Sequence: A1, A2, B, C, D1, D2

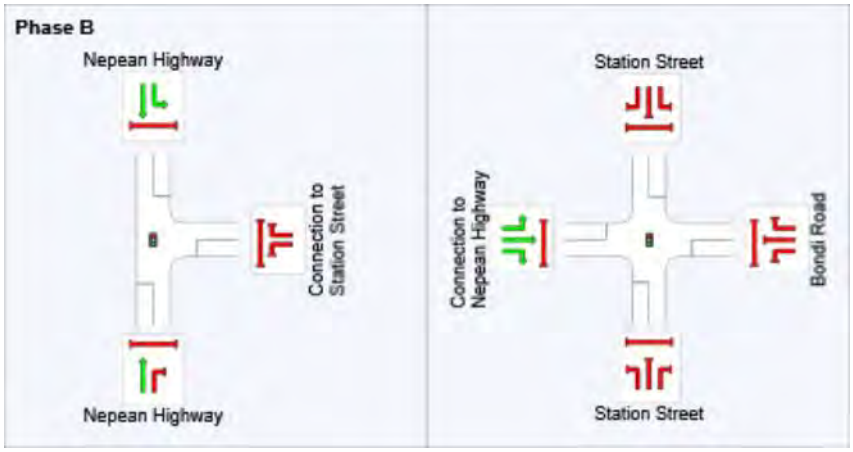
Phase Timing Results

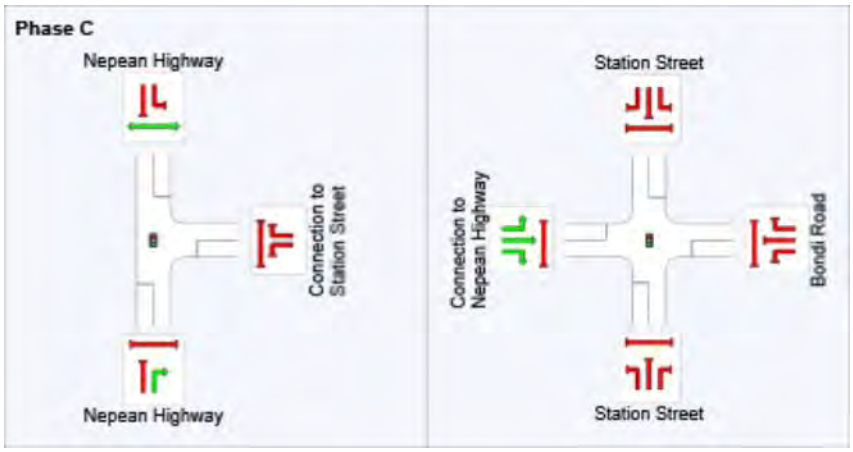
Phase	A1	A2	B	C	D1	D2
Phase Change Time (sec)	0	26	48	58	93	116
Green Time (sec)	20	18	4	29	17	***
Phase Time (sec)	24	24	10	35	22	5
Phase Split	20 %	20 %	8 %	29 %	18 %	4 %

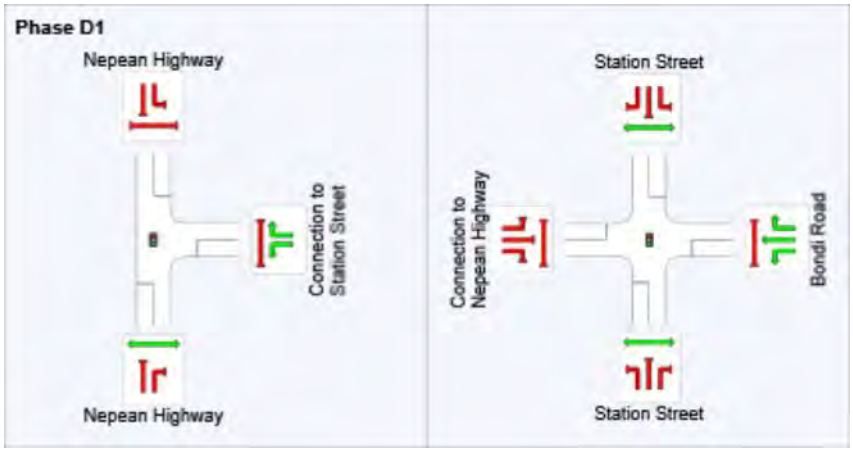
See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

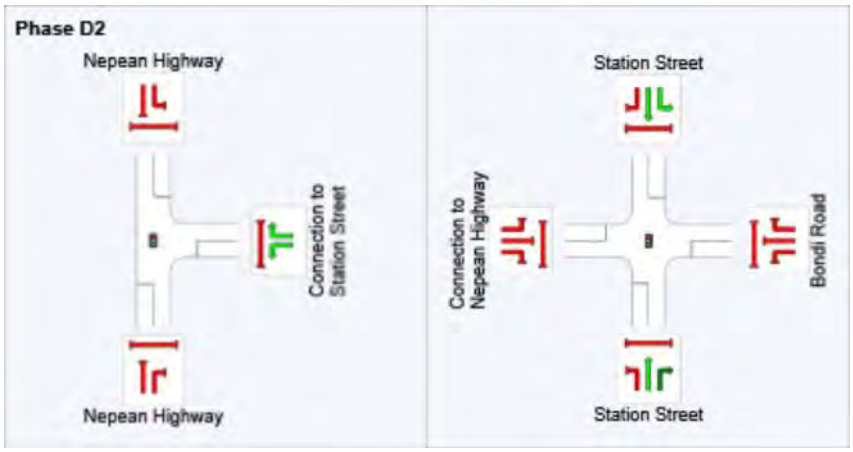






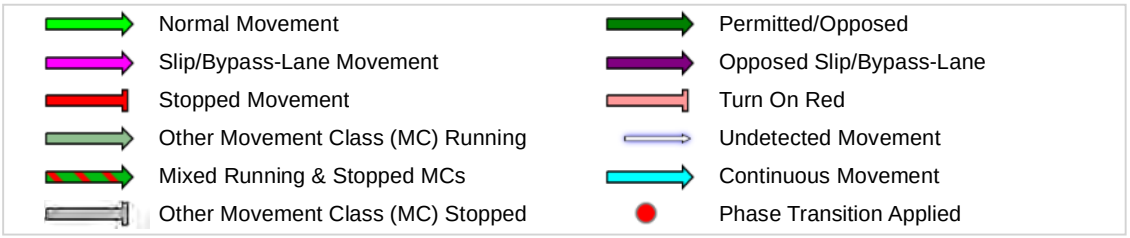






REF: Reference Phase

VAR: Variable Phase



MOVEMENT SUMMARY

Site: 101 [Nepean Highway & Station Street - PM Peak - Predicted]

Network: N101 [PM Peak - Predicted Volumes]

Nepean Highway & New Connection
Signals - Fixed Time Isolated Cycle Time = 116 seconds (User-Given Phase Times)
Common Control Group: CCG1 [CCGName]

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Nepean Highway													
2	T1	523	2.0	523	2.0	0.341	24.6	LOS C	10.0	71.0	0.72	0.62	42.8
3	R2	29	0.0	29	0.0	0.078	45.5	LOS D	1.3	9.4	0.84	0.71	24.4
Approach		553	1.9	553	1.9	0.341	25.7	LOS C	10.0	71.0	0.73	0.62	41.9
East: Connection to Station Street													
4	L2	87	0.0	87	0.0	0.245	46.7	LOS D	3.5	24.5	0.85	0.74	23.8
6	R2	37	0.0	37	0.0	0.103	53.7	LOS D	2.1	14.4	1.00	0.74	22.0
Approach		124	0.0	124	0.0	0.245	48.8	LOS D	3.5	24.5	0.89	0.74	23.2
North: Nepean Highway													
7	L2	39	0.0	39	0.0	0.821	40.6	LOS D	34.7	247.1	0.96	0.90	28.1
8	T1	1274	2.0	1274	2.0	0.821	35.2	LOS D	34.7	247.1	0.96	0.90	38.0
Approach		1313	1.9	1313	1.9	0.821	35.3	LOS D	34.7	247.1	0.96	0.90	37.8
All Vehicles		1989	1.8	1989	1.8	0.821	33.5	LOS C	34.7	247.1	0.89	0.81	38.1

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 3.8 %
Number of Iterations: 10 (maximum specified: 10)

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	53	49.5	LOS E	0.2	0.2	0.92	0.92
P2	East Full Crossing	53	49.5	LOS E	0.2	0.2	0.92	0.92
P3	North Full Crossing	53	42.3	LOS E	0.1	0.1	0.86	0.86
All Pedestrians		158	47.1	LOS E			0.90	0.90

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 101 [Station Street & Bondi Road - PM Peak - Predicted]

Network: N101 [PM Peak - Predicted Volumes]

Station Street & Bondi Road
Signals - Fixed Time Isolated Cycle Time = 116 seconds (User-Given Phase Times)
Common Control Group: CCG1 [CCGName]

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Station Street													
1	L2	22	0.0	22	0.0	0.200	58.2	LOS E	1.2	8.4	0.94	0.73	20.8
2	T1	220	2.0	220	2.0	0.551	34.8	LOS C	12.7	90.3	0.87	0.76	37.8
3	R2	55	0.0	55	0.0	0.551	40.3	LOS D	12.7	90.3	0.87	0.76	37.1
Approach		297	1.5	297	1.5	0.551	37.6	LOS D	12.7	90.3	0.87	0.75	36.5
East: Bondi Road													
4	L2	38	0.0	38	0.0	0.317	54.9	LOS D	3.4	24.0	0.94	0.75	31.6
5	T1	21	0.0	21	0.0	0.317	49.4	LOS D	3.4	24.0	0.94	0.75	22.1
6	R2	6	0.0	6	0.0	0.317	54.9	LOS D	3.4	24.0	0.94	0.75	31.6
Approach		65	0.0	65	0.0	0.317	53.1	LOS D	3.4	24.0	0.94	0.75	29.1
North: Station Street													
7	L2	17	0.0	17	0.0	0.389	34.2	LOS C	11.9	84.4	0.78	0.68	40.0
8	T1	271	2.0	271	2.0	0.389	28.7	LOS C	11.9	84.4	0.78	0.68	40.7
9	R2	81	0.0	81	0.0	0.490	61.0	LOS E	4.5	31.8	0.99	0.78	20.3
Approach		368	1.5	368	1.5	0.490	36.0	LOS D	11.9	84.4	0.83	0.70	36.1
West: Connection to Nepean Highway													
10	L2	41	0.0	41	0.0	0.060	38.9	LOS D	2.0	14.1	0.92	0.74	26.4
11	T1	3	0.0	3	0.0	0.040	0.8	LOS A	0.0	0.2	0.02	0.46	54.7
12	R2	24	0.0	24	0.0	0.040	3.4	LOS A	0.0	0.2	0.02	0.46	52.7
Approach		68	0.0	68	0.0	0.060	24.6	LOS C	2.0	14.1	0.56	0.63	33.0
All Vehicles		799	1.2	799	1.2	0.551	37.0	LOS D	12.7	90.3	0.83	0.72	35.5

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 3.8 %
Number of Iterations: 10 (maximum specified: 10)

Movement Performance - Pedestrians

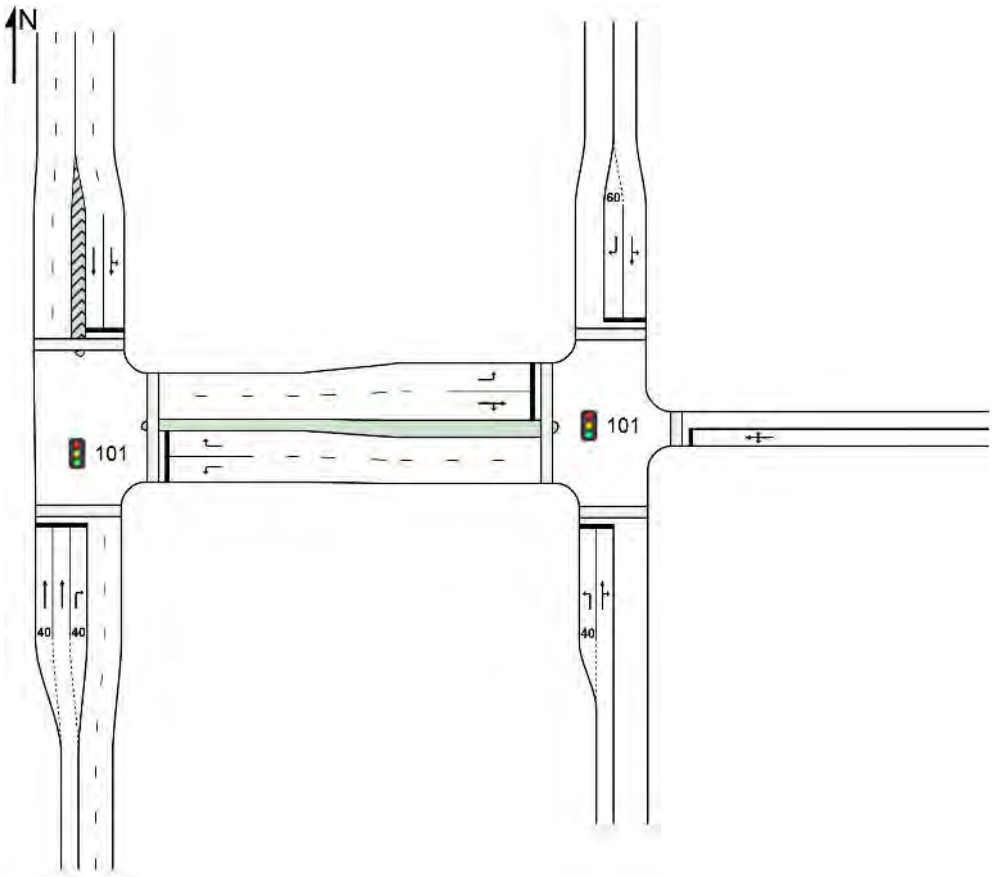
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	53	49.5	LOS E	0.2	0.2	0.92	0.92
P2	East Full Crossing	53	45.8	LOS E	0.2	0.2	0.89	0.89
P3	North Full Crossing	53	49.5	LOS E	0.2	0.2	0.92	0.92
P4	West Full Crossing	53	49.5	LOS E	0.2	0.2	0.92	0.92
All Pedestrians		211	48.6	LOS E			0.92	0.92

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.

NETWORK LAYOUT

Network: N101 [PM Peak - Predicted Volumes]

New Network



SITES IN NETWORK		
Site ID	**CCG ID**	**Site Name**
101	CCG1	Nepean Highway & Station Street - PM Peak - Predicted
101	CCG1	Station Street & Bondi Road - PM Peak - Predicted

Organisation: AECOM AUSTRALIA PTY LTD | Created: Friday, 8 December 2017 3:56:17 PM
Project: \\10.2.104.6\projects$\Project Data\LX31\37-06 Frankston Group\46 - Station Street, Bonbeach\4. Tech work area\Traffic\SIDRA Modelling\Bonbeach SIDRA Models.sip7

PHASING SUMMARY (CCG)

Common Control Group: CCG1 [CCGName]

Network: N101 [PM Peak - Predicted Volumes]

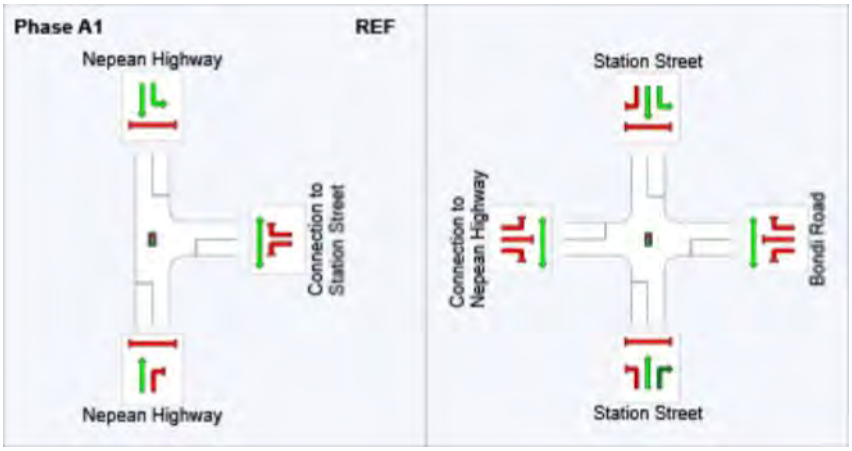
Fixed Time Isolated Cycle Time = 116 seconds (User-Given Phase Times)

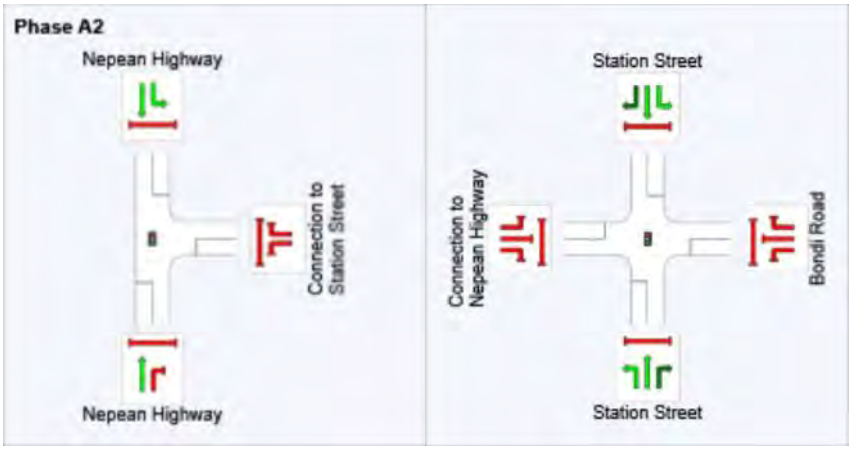
Phase Times specified by the user
Phase Sequence: CCG Phasing
Reference Phase: Phase A1
Input Phase Sequence: A1, A2, B, C, D1, D2
Output Phase Sequence: A1, A2, B, C, D1, D2

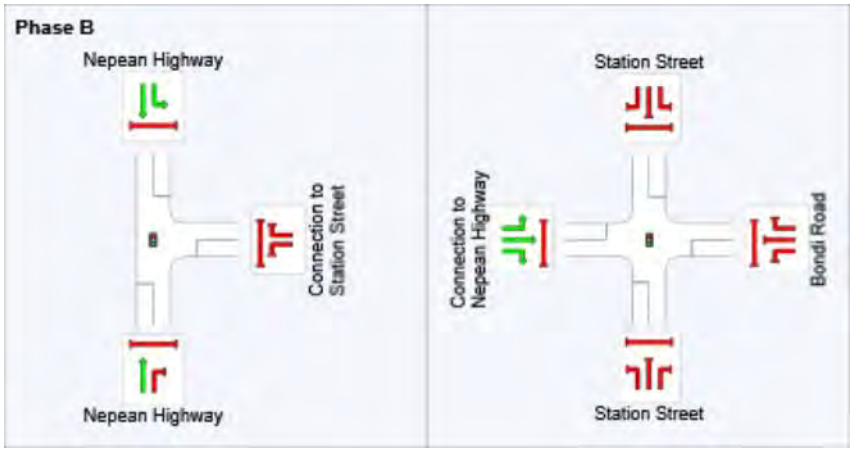
Phase Timing Results

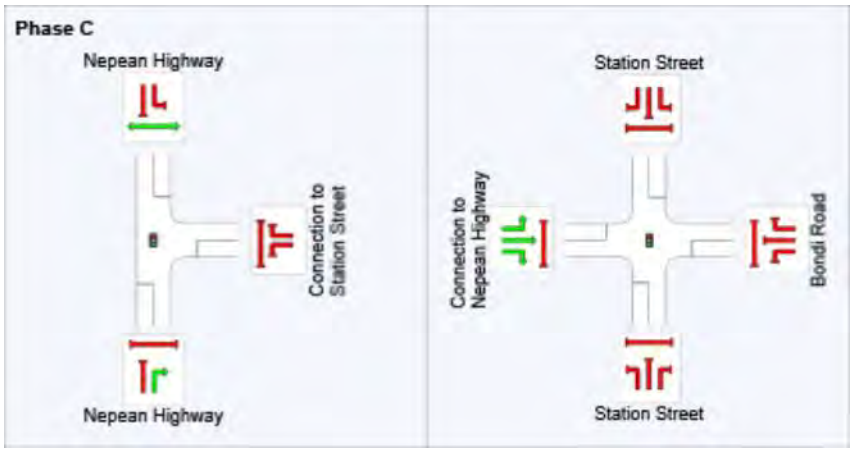
Phase	A1	A2	B	C	D1	D2
Phase Change Time (sec)	0	26	44	54	89	112
Green Time (sec)	20	14	4	29	17	***
Phase Time (sec)	24	20	10	35	22	5
Phase Split	21 %	17 %	9 %	30 %	19 %	4 %

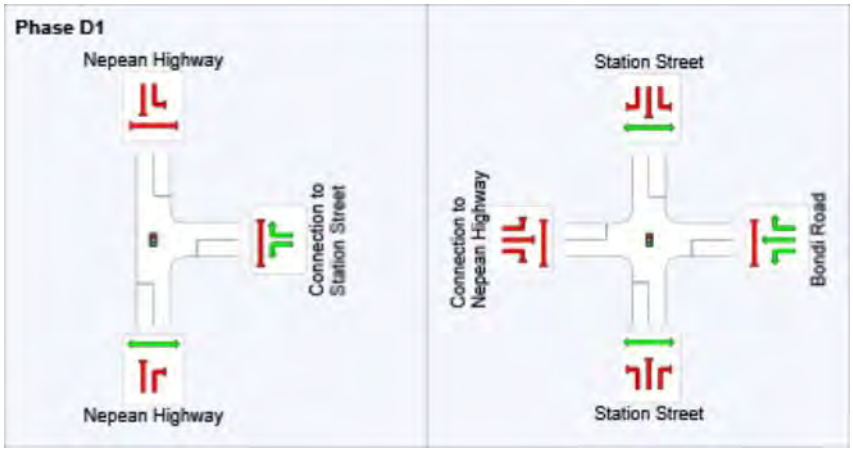
See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

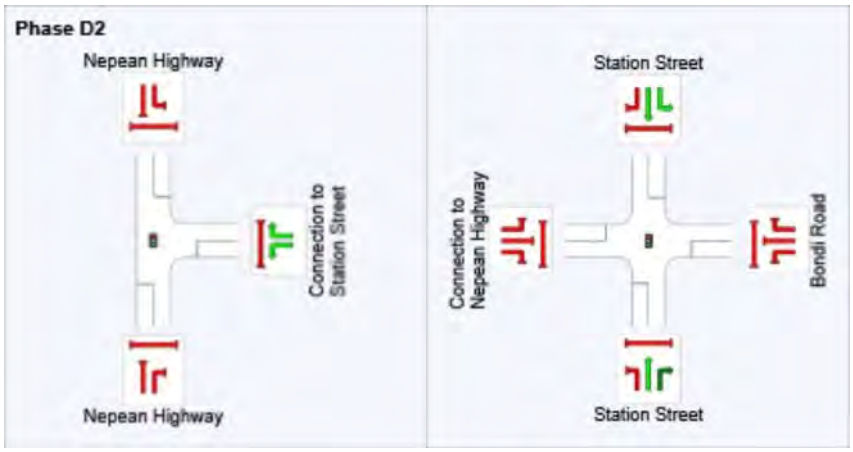






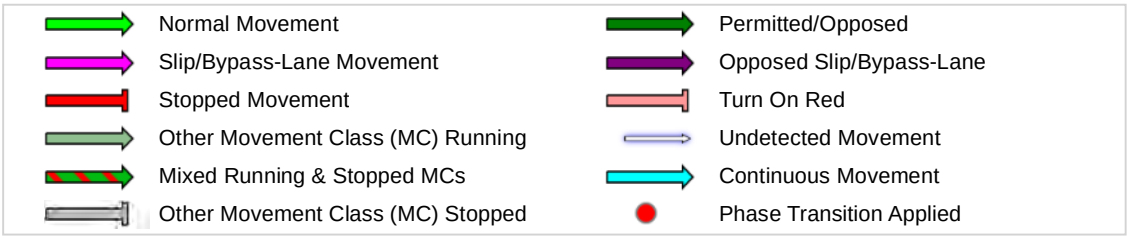




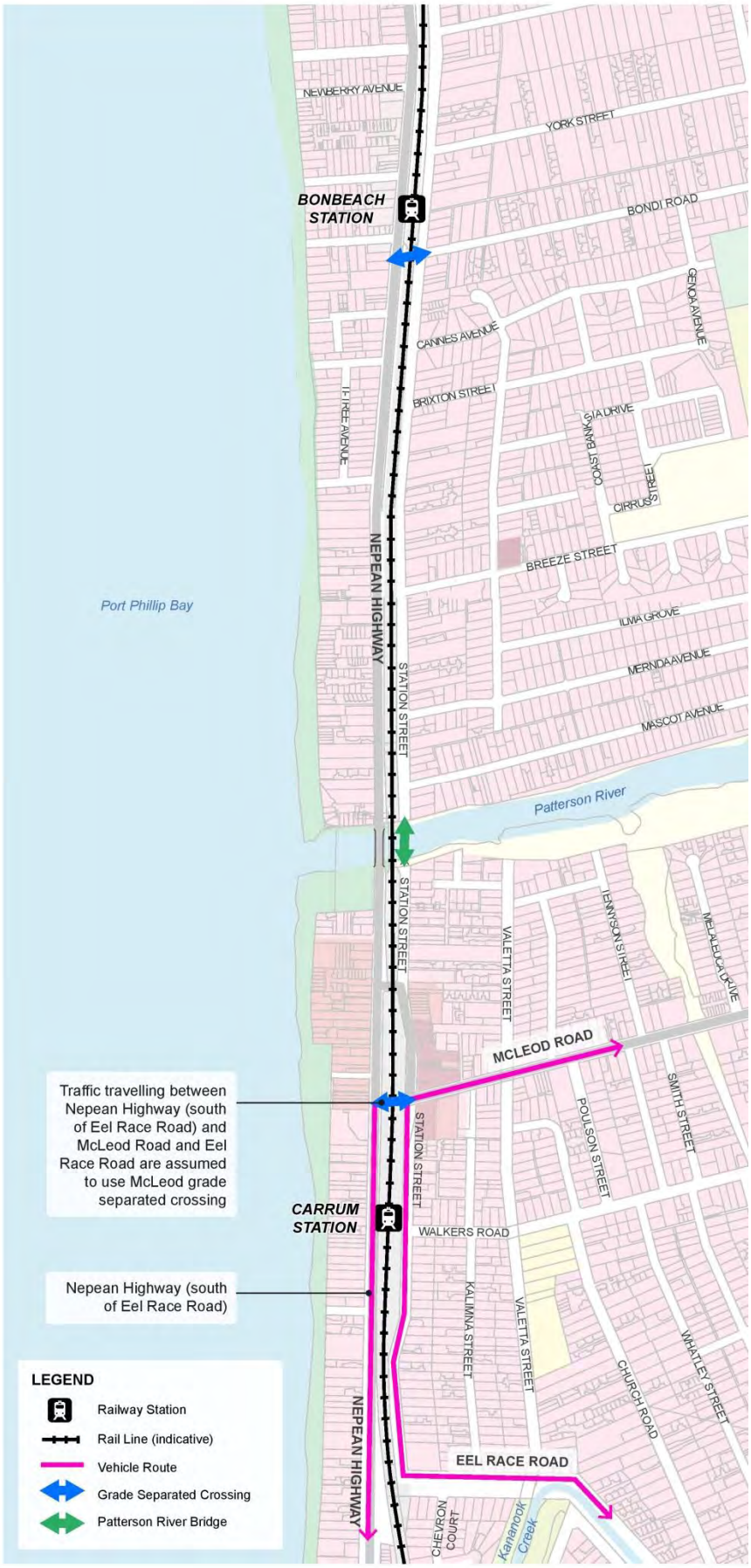


REF: Reference Phase

VAR: Variable Phase

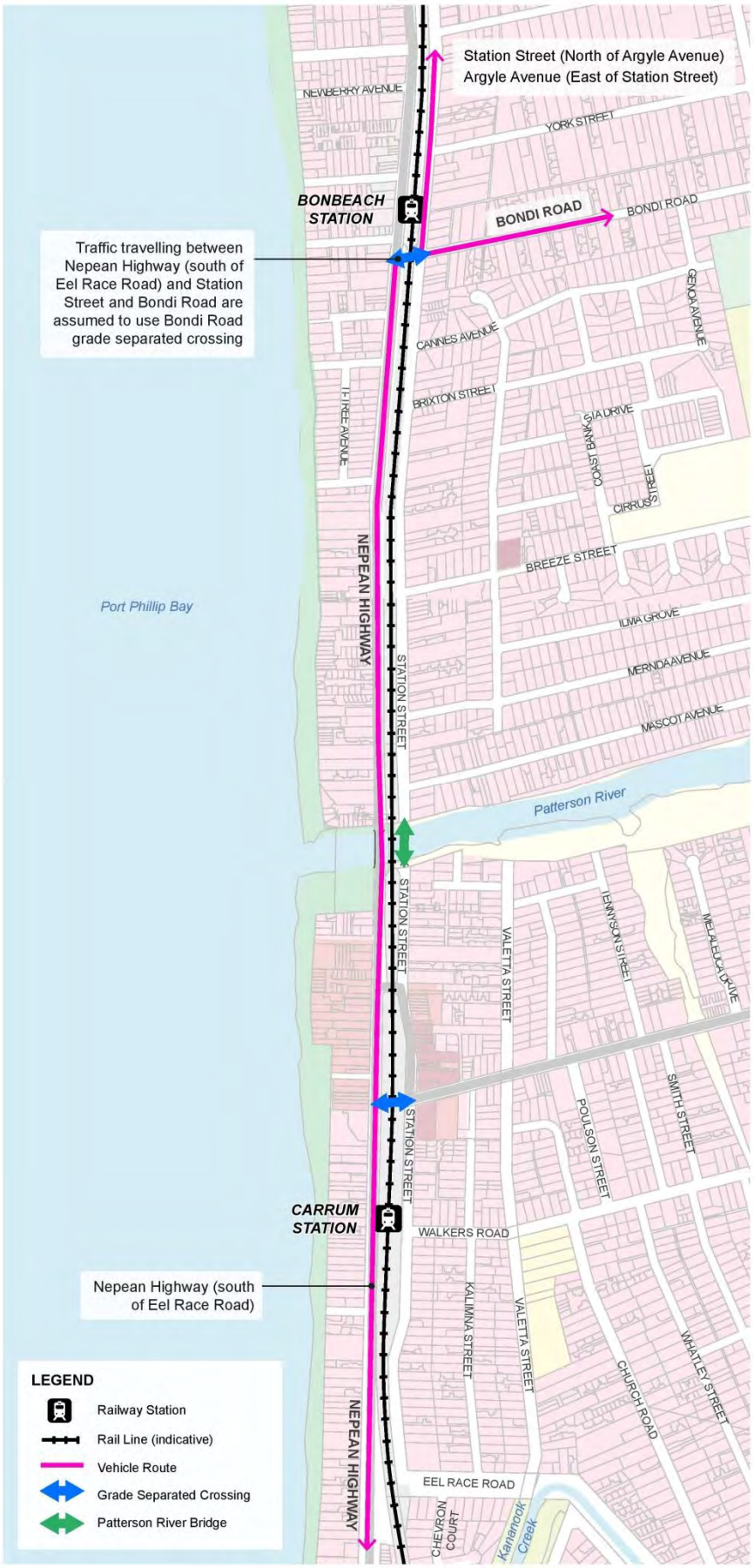


Appendix C – Bonbeach Redistribution Assumptions



Traffic redistribution for traffic travelling between McLeod Road, Eel Race Road and Nepean Highway south of Eel Race Road

Traffic redistribution for traffic travelling between McLeod Road, Eel Race Road, Bondi Road and Station Street



Traffic redistribution for traffic travelling between Station Street, Bondi Road and Nepean Highway south of Eel Race Road

Appendix D – Risk Assessment

Table F1 Guide to quantification of likelihood

Qualitative descriptions	Probability over a given time period	Basis
A. Certain	1 (or 0.999, 99.9%)	Certain, or as near to as makes no difference
B. Almost certain	0.2 – 0.9	One or more incidents of a similar nature has occurred here
C. Highly probable	0.1	A previous incident of a similar nature has occurred here
D. Possible	0.01	Could have occurred already without intervention
E. Unlikely	0.001	Recorded recently elsewhere
F. Very unlikely	1×10^{-4}	It has happened elsewhere
G. Highly improbable	1×10^{-5}	Published information exists, but in a slightly different context
H. Almost impossible	$1 X 10^{-6}$	No published information on a similar case

Source: Bowden, A.R., Lane, M.R. and Martin, J.H., 2001, Triple Bottom Line Risk Management – Enhancing Profit, Environmental Performance and Community Benefit, Wiley and Sons, New York, 314 pp.

Table F2 Consequence tables used for traffic risk assessment

Qualitative descriptor	Negligible		Minor		Moderate		Major		Extreme
Consequence description	**Minimal, if any impact for some communities. Potentially some impact for a small number (<10) of individuals**		**Low level impact for some communities, or high impact for a small number (<10) of individuals**		**High level of impact for some communities, or moderate impact for communities area-wide**		**High level of impact for communities area-wide**		**High level of impact State-wide**
	0.1	**0.3**	**1**	**3**	**10**	**30**	**100**	**300**	**1000**
ENVIRONMENT **Air quality**	Applicable air quality standards SEPP (AQM) met across the region.		Isolated, short-term exceedance of SEPP (AQM).		Minor local exceedance of SEPP (AQM).		Minor, short-term exceedance of SEPP (AQM) over a widespread area.		Major, widespread, long-term exceedance of SEPP (AQM).
SOCIAL **Amenity** **(Recreation)**	Short term interruptions in recreational use (1 to 2 days).		Activities restricted in a localised area for short-term periods (months).		Restriction on whole or parts of communities to pursue personal recreational pursuits when visiting the area during construction period. No impact post construction.		Long term inability for whole communities to pursue personal recreational pursuits when visiting the area post construction (> 2 yrs).		Long-term inability for the general community to pursue personal recreational pursuits when visiting the area post-construction (>10 yrs).
SOCIAL **Amenity** **(Traffic / air / noise / odour / visual impacts)**	Short term impacts that alter perception of area as a high amenity place to live / visit.		Short term (months) localised impacts that alter perception of area as a high amenity place to live / visit.		Medium term (1-2 years) regional impacts that alter perception of area as a high amenity place to live / visit.		Community perception that the area is significantly damaged.		Community perception that the area has experienced major damage.
	Region still seen as attractive place to live.		Region not locally seen as attractive place to live.		Region not widely seen as attractive place to live.		Area loses appeal as residential area. Recovery > 2 yrs.		Area is a place to be avoided. Recovery, if at all, >10 yrs.

Table F3 Traffic risks

Risk ID	Risk name	Risk pathway	EPR ID (initial)	Initial risk			EPR ID (final)	Residual risk		
				Likelihood	Consequence	Risk		Likelihood	Consequence	Risk
Construction risks										
T 28	Traffic (delay during main works)	Construction (including rail shutdowns) reduces road capacity and/or increases traffic volumes resulting in delays and increased travel time during the piling and main rail occupation.	EPR T1 Transport Management Plan EPR T2 Public Transport Disruption Management Plan EPR T3 Pedestrian and cyclist connectivity EPR T8 Emergency services	Certain	Moderate	Moderate	As initial EPR	Certain	Moderate	Moderate
T 29	Traffic (delay outside main works)	Construction (including rail shutdowns) reduces road capacity and/or increases traffic volumes resulting in delays and increased travel time outside of the piling and main rail occupation.	EPR T1 Transport Management Plan EPR T2 Public Transport Disruption Management Plan EPR T3 Pedestrian and cyclist connectivity EPR T8 Emergency services	Certain	Minor	Minor	As initial EPR	Certain	Minor	Minor
T 30	Traffic (dirt on roads)	Plant and spoil trucks deposit construction debris on public roads leading to dust generation and perceived loss of amenity and public health and safety issues.	EPR T7 Debris on roads	Possible	Minor	Negligible	As initial EPR	Possible	Minor	Negligible
T 31	Traffic (road safety)	Construction results in disruption to the transport network and/or increases traffic volumes leading to increased crashes or the perception that area is less safe.	EPR T1 Transport Management Plan	Unlikely	Extreme	Minor	As initial EPR	Unlikely	Extreme	Minor

Risk ID	Risk name	Risk pathway	EPR ID (initial)	Initial risk			EPR ID (final)	Residual risk		
				Likelihood	Consequence	Risk		Likelihood	Consequence	Risk
Operation risks										
T 26	Traffic (operations)	New road network layout and signalling cannot safely and efficiently cater for traffic volumes following level crossing removal, resulting in unacceptable intersection performance and/or increased crashes.	EPR T4 Intersection design and performance	Very unlikely	Major	Negligible	As initial EPR	Very unlikely	Major	Negligible
T 27	Traffic (connectivity)	Connectivity for pedestrians and cyclists is negatively impacted by level crossing removal, resulting in increases to travel distance and/or time resulting in social and business impacts.	EPR T3 Pedestrian and cyclist connectivity EPR T6 Vehicle and pedestrian access	Very unlikely	Moderate	Negligible	As initial EPR	Very unlikely	Moderate	Negligible
T 32	Traffic (change in AQ)	Changes in traffic flows at the level crossing results in air quality impacts.	EPR T4 Intersection design and performance	Highly improbable	Negligible	Negligible	As initial EPR	Highly improbable	Negligible	Negligible
T 33	Traffic (change in noise)	Changes in traffic flows at the level crossing results in noise impacts.	EPR T4 Intersection design and performance	Unlikely	Negligible	Negligible	As initial EPR	Unlikely	Negligible	Negligible