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**LEVEL  
CROSSING  
REMOVAL**  
PROJECT

# Program Business Case

May 2017



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## Executive Summary

**The Level Crossing Removal Project (LXRP) will remove 50 of Victoria's dangerous and congested level crossings.**

**The project will also deliver a Metropolitan Network Modernisation Program, which includes new train stations, improved public transport access, and improved pedestrian and cycling links.**

**The project uses high quality urban design to enhance the attractiveness and amenity of communities around level crossings. The project also has a strong focus on improving integrated land use along rail corridors, to create vibrant hubs for local communities.**

**The project also plays a critical role in enabling other major rail upgrades to occur. On corridors where level crossing removals will separate the road and rail networks, additional rail services can be run without exacerbating road congestion, which allows the benefits of these other major rail upgrades to be achieved.**

Melbourne is Australia's fastest growing city, heading towards a population of six million by 2031 and more than 7.8 million by 2051. As the city grows, reliable and highly efficient transport networks are essential to moving more and more people and goods around the city, attracting new businesses, residents and jobs, and maintaining Melbourne's liveability and amenity.

Victorian Government policies and plans recognise that without an immediate and major change in the capacity and efficiency of the city's transport system, Melbourne's liveability, accessibility and productivity cannot be sustained. To this end, the Government is investing in road and rail projects designed to ensure the transport system keeps pace with the city's growth into the future.

There are 178 level crossings on Melbourne's metropolitan (electrified) rail network – more than any other Australian city. Each of these crossings represents a major conflict point between rail, road and pedestrian traffic. All of them contribute to some extent to congestion, safety and amenity problems on the city's transport system and many inhibit improvements to the capacity of both the road and rail networks. Level crossings also limit opportunities for urban renewal and development.

It is clear that without some intervention, a significant number of roads across Melbourne, many of which are important commuter and freight routes, will effectively be closed for considerable periods of time if there is an increase in the frequency of train services – causing even longer delays, higher costs, greater frustration and increased safety risks.

Until now, level crossings have been removed one at a time or in pairs, and over a number of years. While this incremental approach goes some way towards addressing the issues associated with level crossings, the scale of the problem is so big that it calls for a corresponding change in the scale of investment and in the overall strategic response.

For the first time, the Victorian Government has a long-term, strategic plan for removing level crossings to systematically address the problems associated with this outdated feature of Melbourne's transport system. The Level Crossing Removal Project (LXRP) is a coordinated program of unprecedented scale and ambition that will deliver significant change to the transport system, take advantage of economies of scale, positively transform local communities and boost productivity and the broader economy.

The LXRP is a critical enabler of other major rail projects, which includes the Cranbourne-Pakenham line upgrade and the Metro Tunnel. These major projects will transform Melbourne's transport network and are expected to have a significant impact on Melbourne's city structure, by encouraging households and businesses to locate along high capacity rail corridors, due to the significant accessibility improvements these projects provide. This will deliver economic and social outcomes that will benefit the Victorian economy.

The LXR will remove 50 level crossings across Melbourne. This enables additional rail services to occur under the Metro Tunnel project and Cranbourne-Pakenham line upgrade, as shown below.



**ALTONA LOOP**

- 30 Kororoit Creek Road, Williamstown North

**BELGRAVE**

- 38 Mountain Highway, Bayswater
- 42 Scoresby Road, Bayswater

**CRAIGIEBURN**

- 7 Buckley Street, Essendon
- 22 Glenroy Road, Glenroy

**CRANBOURNE**

- 1 Abbots Road, Dandenong South
- 10 Thompsons Road, Lyndhurst

**FRANKSTON**

- 40 North Road, Ormond
- 3 Balcombe Road, Mentone
- 10 Centre Road, Bentleigh
- 15 Charman Road, Cheltenham
- 18 Edithvale Road, Edithvale
- 17 Eel Race Road, Carrum
- 5 McKinnon Road, McKinnon
- 45 Seaford Road, Seaford
- 44 Skye Road, Frankston
- 44 Station Street, Bonbeach
- 17 Station Street, Carrum

**GLEN WAVERLEY**

- 1 Burke Road, Glen Iris
- 17 Toorak Road, Kooyong

**HURSTBRIDGE**

- 23 Grange Road, Alphington
- 31 Lower Plenty Road, Rosanna

**LILYDALE**

- 4 Blackburn Road, Blackburn
- 26 Heatherdale Road, Ringwood
- 33 Manchester Road, Mooroolbark
- 34 Maroondah Highway, Lilydale

**PAKENHAM**

- 11 Centre Road, Clayton
- 15 Clayton Road, Clayton
- 27 Koornang Road, Carnegie
- 29 Murrumbeena Road, Murrumbeena
- 12 Chandler Road, Noble Park
- 17 Corrigan Road, Noble Park
- 24 Grange Road, Carnegie
- 27 Heatherton Road, Noble Park
- 41 Poath Road, Hughesdale
- 16 Clyde Road, Berwick
- 15 Hallam Road South, Hallam
- 45 South Gippsland Highway, Dandenong

**SOUTH MORANG**

- 5 Bell Street, Preston
- 26 High Street, Reservoir

**SUNBURY**

- 22 Main Road, St Albans
- 21 Furlong Road, St Albans
- 35 Melton Highway, Sydenham

**UPFIELD**

- 4 Bell Street, Coburg
- 7 Camp Road, Campbellfield
- 37 Moreland Road, Brunswick

**WERRIBEE**

- 2 Aviation Road, Laverton
- 14 Cherry Street, Werribee
- 16 Werribee Street, Werribee

**WILLIAMSTOWN**

- 20 Ferguson Street, Williamstown

\* Includes capacity uplift for both Metro Tunnel and Cranbourne/Pakenham corridor upgrade



## Problem

The problems and benefits identified naturally take on varying degrees of importance at different sites. For example, congestion is likely to be the major problem caused by crossings on key arterial roads, while safety and amenity consequences may be important for crossings bisecting busy shopping precincts.

The LXP seeks to address three key problems.

### **PROBLEM 1: Conflicting demands of rail, road and pedestrian traffic at level crossings constrain one or more modes, reducing transport efficiency and economic productivity**

- *More train services means more and longer boom gate closures* – At more than half of the 50 level crossings, the boom gates are closing at least 20 times or more in the 2 hour morning peak each weekday and some crossings are closed, on average, for more than 60 per cent of this period. Boom gate closures at many of these sites are expected to increase substantially and a significant number of roads across Melbourne will effectively be closed for considerable periods of time. If level crossings remain in place on key rail corridors with major rail upgrades, such as the Cranbourne-Pakenham Line upgrade and Metro Tunnel, then a significant number of roads across Melbourne will be effectively closed for considerable periods of time due to increased train services.
- *Longer boom gate closures mean more delays* – On an average weekday, approximately 1 million vehicles cross the 50 level crossings that are part of the Level Crossing Removal Project (LXP); each one of these vehicles has the potential to be delayed at a crossing. Boom gates closing more often and for longer periods creates significant delays and congestion on the road network. As traffic and train volumes continue to increase, travel speeds around level crossings will decrease, delays will increase and trips will take longer.
- *Travel time variability causes inconvenience and higher costs* – Variability in boom gate closures features on most rail lines across the metropolitan rail network. Variable and unpredictable closures make travel time on the road network less reliable, causing frustration and inconvenience for road users experiencing unexpected delays, as well as creating additional personal and business costs. This variability is expected to increase as patronage, dwell time at stations (the time taken for passengers to board or alight trains) and the frequency of rail services increases.
- *Transport interchanges are a critical component of Melbourne's public transport network* – Of the 50 crossings to be removed as part of the LXP, 34 have adjacent train stations. Thirty two of these stations have interchanges with buses and two have interchanges with trams. Issues associated with level crossings and poor station design can compromise the effective operation of train stations as transport interchanges, undermining the efficiency of the public transport network.
- *Less reliable and less punctual bus services* – Of the 50 crossings that make up the LXP, 44 sites have bus routes that either approach or travel over the crossing. Variable speeds through and around level crossings cause delays to bus services. In addition, a significant number of bus routes terminate at level crossings to avoid unreliable travel times. This creates inefficient bus routes and acts as a deterrent to using buses due to passengers having to terminate or change buses at the level crossing.
- *Level crossing constraints are impacting Melbourne's freight networks* – Variability in travel times due to level crossings located on key freight routes limits the efficiency of freight movements. Reliable and efficient connections to key freight hubs are critical to sustaining the productivity and competitiveness of a number of industries, especially those engaged in exporting.
- *Greater vulnerability to faults and incidents, causing further delays* – Level crossings make the rail and road networks more vulnerable to incidents and signal and hardware faults. When these occur, they can cause unexpected and sometimes lengthy boom gate closures, delaying rail and road traffic even further, generating additional costs and contributing to risk-taking behaviour by drivers, pedestrians and cyclists.

**PROBLEM 2: Rail corridors and excessive boom gate closures reinforce community severance and reduce local amenity**

- *Greater community severance and dislocation* – Level crossings can exacerbate the community severance caused by rail corridors, dividing communities and limiting their ability to access goods and services, jobs, education and housing. Crossings can have a significant impact on local communities through traffic congestion, poor land use, limitations on development and missed opportunities for urban renewal.
- *Reduced neighbourhood amenity* – Level crossings can reduce neighbourhood amenity and have a significant impact on local communities through noise, poor visual amenity, reduced access to local shops, limited business diversity and rundown and unappealing precincts adjacent to the crossing.
- *Reduced walking and cycling connectivity* – As the duration of walking and cycling trips tends to be shorter than car trips, the delay to a pedestrian or cyclist caused by a level crossing has a greater impact; the delay they experience is often a greater proportion of their overall trip. Level crossings on Strategic Cycling Corridors limit cycling connectivity to and around major activity centres and discourage people from using active transport.

**PROBLEM 3: Motor vehicle driver, cyclist and pedestrian frustration at level crossing delays invites risk-taking behaviour, causing serious incidents**

- *Risk-taking behaviour, causing serious incidents* – Collisions at level crossings in Victoria account for around one third of level crossing collisions between trains and road vehicles, and over half of all collisions between trains and pedestrians, across Australia. In the ten year period between 2005 and 2014, there were 149 collisions between a train and road vehicle or pedestrian along rail corridors across metropolitan Melbourne. Of these incidents, 38 resulted in fatalities and 22 resulted in serious injuries.

Over the same period, across the 50 level crossings in this program there were over 60 collisions between a train and a road vehicle or pedestrian, 20 of which resulted in fatalities.

- *Potential risk at level crossings* –The risk of a serious incident is present at all level crossings to varying degrees. As delays and traffic, pedestrian and train volumes increase at these locations, the risk is likely to escalate unless there is appropriate intervention.

A well-connected and efficient transport network is critical to Melbourne’s liveability, but also to its economic activity, productivity and competitiveness. Without action being taken to remove level crossings, the transport network’s connectivity and accessibility will be compromised and the problems associated with level crossings will be exacerbated even further.

If we do not remove level crossings:

- journey times and the variability of journey times for private, business and freight vehicles across Melbourne’s road network will increase
- vehicle operating costs will increase
- collision costs will increase
- we will be unable to operate higher rail service frequencies in peak periods without extending boom gate closures even further and creating more delays for road users. This will impact on planned rail capacity upgrades, including the Cranbourne-Pakenham Line Upgrade (CPLU) and the Metro Tunnel
- public transport users will experience longer travel times on road-based public transport (buses and trams), overcrowded trains, reduced station amenity and delays to train services
- public transport becomes a less attractive travel option (especially for commuting), with flow-on impacts for the city’s road network
- community amenity and local accessibility will not improve
- the connectivity and accessibility of Melbourne’s transport network will reduce, eroding the city’s liveability
- opportunities for economic development, higher productivity and jobs growth will be limited.

## Benefits

The Level Crossing Removal Project has three core objectives.

### To provide:

- 1. Improved productivity from more reliable and efficient transport networks**
- 2. Better connected, liveable and thriving communities**
- 3. Safer communities.**

In meeting these objectives, the LXR will deliver significant city-wide and local benefits, including:

- Improved travel around Melbourne – for train users, pedestrians, buses, trams, cyclists and drivers
- More reliable roads across Melbourne, enabling people to better predict their travel times
- Significant safety improvements for drivers and pedestrians
- Enabling more trains to run more often and on time
- Improved bus-train interchanges and the creation of better connected, more efficient bus routes
- Stimulating economic growth by creating thousands of jobs during construction
- Improved access to activity centres and National Employment Clusters
- Revitalised local communities, with many areas benefiting from improved station precincts that are more attractive areas in which to live, work, shop and invest.

A Benefit Management Plan has been prepared for the LXR that outlines the key performance indicators that will be used to measure and monitor achievement of the identified benefits.

The LXR is not a stand-alone road project with transport network benefits existing independently of other projects. There are key interdependencies between the LXR and other major rail projects, which make the benefits of each contingent on the others. For example, the LXR is a critical *enabling* project, in that it enables additional rail services to be run without exacerbating existing road congestion.

If level crossings are not removed, more frequent rail services delivered by the Cranbourne Pakenham Line upgrade (CPLU) and Metro Tunnel would result in substantial increases in boom gate closure times and worsening congestion at level crossings, particularly on the Caulfield-Dandenong corridor.

The LXR makes feasible the Cranbourne Pakenham Line Upgrade (CPLU) Project, and without level crossing removals providing space for increased rail services, the rationale for investing in the Metro Tunnel infrastructure is also diminished.

## The program

The removal of each of the level crossings nominated in the LXRP will contribute to addressing the identified problems. However, achieving the full range of potential benefits from the program will require a number of complementary activities that go beyond providing the basic infrastructure required level crossing removals. The LXRP supports four broad strategic interventions:

- **Separating road and rail networks at critical junctions** – using infrastructure solutions (including removal of the level crossing) designed for each level crossing site
- **Implementing a Metropolitan Network Modernisation Program** – which includes new train stations, improved public transport access, and better pedestrian and cycling facilities
- **Improving the urban amenity and physical integration of activity precincts and communities along rail corridors** – using high quality urban design to make public areas around train stations and level crossings more attractive, accessible and secure
- **Improving integrated land use along rail corridors, to create vibrant community hubs**– exploring opportunities to undertake property development around stations to improve local amenity, make better use of currently under-used land, encourage residential and commercial development around public transport networks and contribute to more efficient patterns of development across the wider city.

### Advantages of a coordinated program

Bundling level crossing removals as a coordinated program has advantages over a site-by-site approach, including:

- Delivers better value for money
- Provides the ability to have a well-developed assessment framework that encourages optimising project outcomes and avoids the risks of ad-hoc implementation
- Offers greater flexibility to sequence level crossing removals to match rail capacity investments, road projects or other works, leveraging benefits from coordinated infrastructure delivery
- Provides a better understanding of the information gaps that will de-risk procurement
- Enables costs savings from packaging or bundling sites and from providing a predictable pipeline of work for industry
- Realises benefits that are not possible when removals occur site-by-site – such as greater travel time and other savings generated from augmenting the metropolitan rail network; wider economic benefits from increasing effective density through improved accessibility; and increasing corridor attractiveness for urban renewal
- Enables other major rail upgrades to occur on corridors where level crossing removals will separate the road and rail networks

## Project options

A wide range of potential options for removal level crossings are available. These have been reviewed, assessed and refined to establish a realistic budget for delivering a credible range of options at each level crossing removal site. An Options Assessment Framework has been developed to assess and shortlist a range of options at each site in a consistent manner. This approach will ensure that the assessment of options is cost-effective, defensible, comprehensive, transparent and consistent across all sites.

For the purpose of describing and providing a cost estimate for the LXRP in this Business Case, a Reference Option has been identified for each level crossing removal site. Each Reference Option represents a feasible solution for removal of the level crossing (such as Rail over Road or Road over Rail). Each Reference Option also identifies Metropolitan Network Modernisation Program improvements, (such as new train stations, improved public transport access, new pedestrian and cycling links), and amenity improvements to landscaping and streetscape. Opportunities to integrate property development of state-owned land within and nearby existing rail and road corridors have also been considered.

The Reference Options represent a point-in-time view developed in February 2016 of how the LXRP could be delivered. Further detailed investigation and public consultation will be undertaken and will inform the recommended solutions. Individual Project Proposals or Works Package Proposals, outlining the recommended solutions, have been and will be prepared for each level crossing removal site (or package).

## Financial analysis

The first 20 level crossings to be removed have been grouped into five packages for delivery and the remaining 30 sites have been grouped into Reference Works Packages, for the purposes of describing and costing the LXR in this Business Case. The development of the packaged costs for the remaining 30 sites is based on the Reference Option selected by LXRA for each of the sites.

The estimated net capital cost for the project (P50 escalated cost), comprises of:

- Removal of 50 Level Crossings: **\$6.6 Billion**
- Metropolitan Network Modernisation Program: **\$1.0 Billion**

The total estimated savings from the packaging of individual projects is approximately \$400 million.

## Program appraisal

The LXR is expected to deliver significant economic benefits to transport users and communities across Melbourne.

Typically, transport projects require a rate of return of 7 per cent, while social projects require a rate of return of 4 per cent. In recognition of the current levels of market rates, and practice in other jurisdictions around the choice of an appropriate discount rate for similar large projects, there are good reasons to consider that a real discount rate of approximately 4 per cent is appropriate for the LXR.

However, to keep in step with the approach adopted by other major transport investments being undertaken by the Victorian Government, the appraisal results for the LXR are shown using the standard discount rate of 7 per cent (real), and also present a sensitivity impact using a lower discount rate of 4 per cent (real).

The core benefits anticipated as a result of the program include travel time savings, reduced vehicle operating costs, road travel reliability benefits, public transport user benefits and avoided collisions. As a standalone program, the LXR is expected to deliver a Benefit Cost Ratio (BCR) of 0.78 using a 7 per cent discount rate. Using a discount rate of 4%, the BCR is 1.34.

The BCR has been calculated using a standard appraisal methodology. This excludes other significant benefits that the LXR can be expected to deliver, including:

- Wider economic benefits (WEBs), such as agglomeration benefits and additional tax revenue from increased labour supply, which are expected to be \$555 million using a 7 per cent discount rate
- Additional Benefits – such as improved network resilience to incidents, reduced perceived congestion benefits and the related benefits and costs of land use changes occurring as a result of the project – are expected to be \$175 million using a 7 per cent discount rate
- Local amenity benefits, increased activity centre connectivity/ consolidation, and benefits for emergency services.
- Avoidance of wider social impacts (ie. to families and communities) caused by accidents at level crossings

The LXR plays a critical role in enabling the full benefits of major rail projects such as the Cranbourne Pakenham Line Upgrade (CPLU) and the Metro Tunnel to be achieved. This business case also includes a combined appraisal of these three critically interdependent transport projects. The combined effect of these projects can be expected to deliver large transport benefits and have a significant impact on Melbourne's city structure, by encouraging households and businesses to locate in areas that will benefit from the significant accessibility improvements that these projects will provide, driving significant employment growth along rail corridors in the south-east, north and west, of Melbourne.

The combined program of LXR, CPLU and Metro Tunnel is expected to deliver a net benefit of \$5.1 billion and BCR of **1.2** using a discount rate of 7 per cent. When using a 4 per cent discount rate, the net benefit is \$21 billion and the BCR is 2.2.

Program	7% Discount Rate	4% Discount Rate
Benefit Cost Ratio: LXR	<b>0.78</b>	<b>1.34</b>
Benefit Cost Ratio: Combined program of LXR, Metro Tunnel & CPLU	<b>1.2</b>	<b>2.2</b>

The LXR is also expected to make a significant contribution to supporting economic growth and employment in the construction industry and more broadly across the Victorian economy. Through the construction period, the short-term stimulus effect of construction is expected to add moderate amounts to Victorian Gross State Product (GSP). In each year between 2015-16 and 2019-20, the size of the Victorian economy will be around \$200-300 million (up to 0.08 per cent) larger than in the absence of the project. In the short-term, the LXR will drive job growth through the stimulus effects of additional construction expenditure. During the first three construction years, up to 1,750 more people are expected to be employed (across the economy as a whole) than would have been in the absence of the project. By the later construction years (2017-18 to 2021-22), average real wages are expected to grow to levels around 0.15 per cent higher (over the whole economy, not just the road transport industry) due to the project.

In the longer term, the LXR will create additional ongoing incremental benefits to the Victorian economy via improved productivity. By the end of the evaluation period in 2065, real GSP is expected to be around \$275 million (or 0.02 per cent) higher than it would otherwise have been.

The program appraisal includes an overview of the multi-criteria assessment (MCA) of the local amenity and project impacts for the Reference Options selected for the 30 level crossing sites, noting that the other 20 sites had been subject to previous assessments and funding submissions at the time the Reference Options were chosen and the program appraisal conducted in February 2016.

## Program delivery

The Victorian Government has committed to delivering the program of 50 level crossing removals by 2022, with the first 20 level crossing removal projects to be delivered within its first term in office, or by 2018. A number of level crossings are currently in progress for removal, with construction either well underway or contracts for delivery having been awarded.

Detailed Works Package/Project Proposals are required to secure the release of funding for further packages of works. These will be developed to align with the LXR Program Business Case, and submitted progressively to suit the funding requirements of the program.

Governance of the LXR will be provided through the Major Transport Infrastructure Program Governance Framework.

Procurement objectives and an initial procurement options analysis have been developed for the program, and suitable delivery models have been shortlisted. A Program Packaging and Procurement Strategy has been developed for the North Eastern, North Western and Western rail corridors to further develop the packaging solutions, to consider program-level delivery issues, and recommend delivery models for the rail corridors.

Level crossing removals are often high value, high risk projects that involve substantial rail, road, tram and bus disruptions, as well as impacts on busy commercial centres. Each site will require significant management of a number of stakeholders and affected persons, as well as access to different transport networks managed by different parties. An overarching Communications and Stakeholder Engagement Strategy has been developed for the LXR and will be further refined throughout the program's development and delivery.

A Risk Management Plan has been developed by LXRA and is being used to guide the assessment of risk for the LXR.

The LXRA has developed an Urban Design Framework, which sets benchmarks and measures for high quality design outcomes and place making approaches, and a consistent consideration of urban design principles and objectives across the program. The UDF establishes the expectations of the Victorian Government and local governments for high quality, context sensitive urban design outcomes from the LXR. It aims to achieve a high quality urban design response that enhances urban amenity and minimises any adverse impacts resulting from the proposed project and its associated structures and development.

One of the key objectives of the *Transport Integration Act* is environmental sustainability in developing and managing the Victorian transport system. As part of its Sustainability Policy the LXRA has adopted four guiding principles:

- Deliver urban design solutions which connect and enhance local communities;
- Manage resources efficiently through embedding energy, water and material saving initiatives into the design and construction of the assets;
- Protect and enhance natural assets by minimising the LXR's environmental footprints; and
- Future-proof the infrastructure so it is resilient to projected effects from changes in climate.

# Chapter 1

## Background



## **CHAPTER 1: BACKGROUND - SUMMARY**

Melbourne is Australia's fastest growing city, heading towards a population of six million by 2031 and more than 7.8 million by 2051. As the city grows, reliable and highly efficient transport networks are essential to moving more and more people and goods around the city, attracting new businesses, residents and jobs, and maintaining Melbourne's liveability and amenity.

Victorian Government policies and plans recognise that without an immediate and major change in the capacity and efficiency of the city's transport system, Melbourne's liveability, accessibility and productivity cannot be sustained. To this end, the Government is investing in road and rail projects designed to ensure the transport system keeps pace with the city's growth into the future.

There are 178 level crossings on Melbourne's metropolitan (electrified) rail network – more than any other Australian city. Each of these crossings represents a major conflict point between rail, road and pedestrian traffic. All of them contribute to some extent to congestion, safety and amenity problems on the city's transport system and many inhibit improvements to the capacity of both the road and rail networks. Level crossings also limit opportunities for urban renewal and development.

It is clear that without some intervention, a significant number of roads across Melbourne, many of which are important commuter and freight routes, will effectively be closed for considerable periods of time if there is an increase in the frequency of train services – causing even longer delays, higher costs, greater frustration and increased safety risks.

The Level Crossing Removal Project (LXRP) will remove 50 of Victoria's dangerous and congested level crossings. The project will also deliver the Metropolitan Network Modernisation Program (which includes new train stations, improved public transport access, and improved pedestrian and cycling links) and use high quality urban design to enhance the attractiveness and amenity of communities around level crossings. The project also has a strong focus on facilitating integrated land use along rail corridors.

Many of the level crossing removals are critical components of the Victorian Government's program of major rail network upgrades. In particular, the removal of nine level crossings on the Caulfield-Dandenong corridor and three level crossings on the Sunbury corridor, allow for the rail service increases planned under both the Cranbourne Pakenham Line Upgrade (CPLU) and the Metro Tunnel.

The relationship between the LXRP and other major projects such as the CPLU and Metro Tunnel is critical for Melbourne's future development and prosperity. These major projects in combination can be expected to transform Melbourne's transport network and have a significant impact on Melbourne's city structure, by encouraging households and businesses to locate along high capacity rail corridors that will benefit from the significant accessibility improvements that these projects will provide. This will result in better economic and social outcomes in those areas, and drive additional productivity gains that will be felt across the Victorian economy.

This business case describes and assesses the full program of 50 level crossing removals and will enable budget provisions to be made over the forward program and beyond.

Works Package Proposals or Project Proposals will be prepared to explain in detail the options considered and the Recommended Solution for each level crossing removal or package of level crossing removals.



# 1 Background

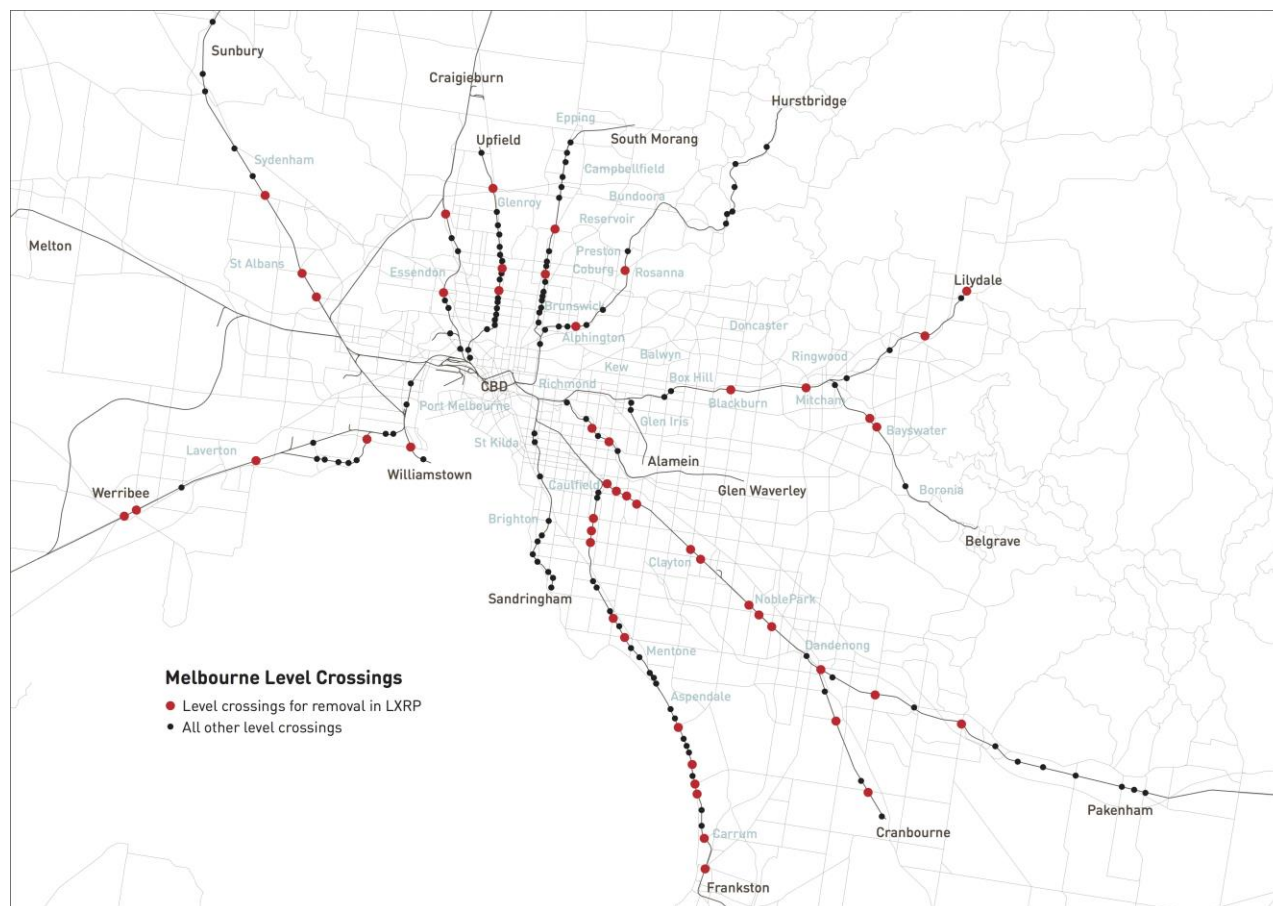
## 1.1 Introduction

Melbourne is Australia's fastest growing city, and is expected to grow from 4.3 million to 7.8 million people by 2051. Reliable and highly efficient transport networks are essential to moving more and more people and goods around the city, to attracting new businesses and jobs, and to maintaining Melbourne's liveability and amenity.

***Transport underpins the liveability, economic prosperity, efficiency and success of large cities.<sup>1</sup>***

As Melbourne's population grows and travel demand increases, Victorian Government policies and plans recognise that without an immediate and major change in the capacity and efficiency of the city's transport system, Melbourne's liveability, productivity and accessibility cannot be sustained. There are 178 level crossings on Melbourne's metropolitan rail network<sup>2</sup>, each representing a conflict point between trains and road traffic, such as cars, trucks, buses, trams, cyclists and pedestrians. This conflict is managed by giving absolute priority to trains and interrupting the flow of road and pedestrian traffic.

Figure 1-1: Level Crossings on Melbourne's electrified rail network



Melbourne's transport network consists of roads, railways, cycle paths and footpaths. These various components of the transport network work together as an integrated transport system to ensure that people and goods can move in and around Melbourne.

The Government's review of the *Plan Melbourne* metropolitan planning strategy acknowledges the 'big challenges' facing the city as a result of projected population growth and the need to upgrade the transport system to respond to

<sup>1</sup> Plan Melbourne, page 82

<sup>2</sup> Melbourne's electrified rail network has 178 level crossings. There are 245 level crossings across Melbourne's entire network.

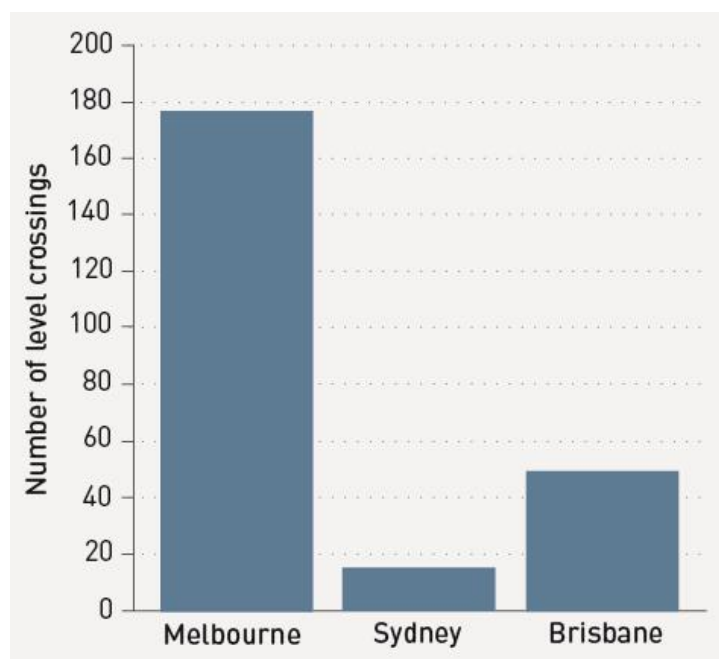
growth pressures. The *Plan Melbourne Refresh* discussion paper (released in October 2015) notes “as the city grows, Melbourne’s transport network will be under increasing pressure which will impact on productivity and the city’s liveability. Building new transport infrastructure will be a key part of responding to increased demand, particularly in the fast growing parts of the city”.<sup>3</sup> This is why the Victorian Government is investing in major transport projects such as the Western Distributor, Cranbourne-Pakenham Line Upgrade, Metro Tunnel, and the Mernda Rail Extension.

***Changes and improvements on one part of the system have a flow-on effect on other parts of the system.***<sup>4</sup>

The road network is a critical element of the transport system and supports on road public transport, cycling, walking and freight movements. As Melbourne grows, there will be continued road network improvements, particularly in the middle suburbs, with a focus on improved access to jobs and services across the suburbs. Improvements are also being made to the city’s rail network to match the growing demand for train services, with the aim of providing a 130 per cent increase in rail capacity within 20 years. These changes are interdependent and need to be integrated and managed across the respective networks to ensure that road improvements are not compromised by rail improvements, and vice versa.

***Intersections between Melbourne’s road and rail networks are becoming a major constraint.***

Figure 1-2: Level crossings comparison by city<sup>5</sup>



Across Melbourne, the conflicting demands of rail, road and pedestrian traffic at level crossings are a major constraint on one or more of these transport modes, preventing the efficient operation of the city’s transport networks and eroding economic productivity. These intersections are particularly significant for Melbourne, as the city has more level crossings (178) than any other Australian city.

Already the city’s level crossings are a major congestion, safety and amenity problem, and on several corridors they are a significant constraint to improving the efficiency of the road and rail networks.

Note: The level crossings shown for Melbourne are those on the *electrified* metropolitan network. There are in total 245 level crossings on the metropolitan rail network in Melbourne.<sup>6</sup>

At the 178 crossing on the metropolitan (electrified) network in Melbourne, in the period 2003-2012, there have been more than 97 collisions between a train and a vehicle or pedestrian at level crossings, including 40 resulting in fatalities and serious injuries. In addition, there have been more than 921 near misses, demonstrating the risk-taking behaviour prevalent at these sites and the potential for catastrophic outcomes.

Across the 178 sites, boom gate closure times vary significantly. At many sites, the boom gates can be closed for over half of the morning peak period, extending to over 70 per cent of the morning peak at some locations. Estimated traffic volumes across the sites also vary, with some sites carrying as little as 200 vehicles in the morning peak while

<sup>3</sup> *Plan Melbourne Refresh* discussion paper, 2015

<sup>4</sup> *Plan Melbourne*, page 85

<sup>5</sup> Source: <http://www.tmr.qld.gov.au/~media/Safety/railsafety/QldLevelCrossingSafetyStrategy20122021AnnualReport201314.pdf>  
Manual count using: <http://www.transport.nsw.gov.au/customers/trains/levelcrossings/level-crossing-finder>

<sup>6</sup> VicRoads Strategic Framework for the Prioritisation of Level Crossings in Metropolitan Melbourne, 17 June 2014

others carry in excess of 8,000 vehicles in the morning peak, as well as being major freight routes. Congestion across these sites varies with many roads carrying traffic volumes well in excess of their capacity. At these already congested locations, extended boom gate closures can cause long queues of road traffic at the crossings and across adjacent intersections, which can persist for the entire peak period.

Melbourne without level crossings would be a very different city, but removing them one by one, as has been done in the past, would take decades. Now, for the first time, the State Government has a long-term, strategic plan for removing level crossings to systematically address the problems associated with this feature of Melbourne's transport network. The Level Crossing Removal Project (LXRP) has been conceived as a coherent program to deliver significant change to the transport system, take advantage of economies of scale, create opportunities for local communities and boost productivity and the broader economy.

The LXRP will remove 50 of Melbourne's dangerous and congested level crossings (refer Figure1-3) while also seeking to capture value from this investment by pursuing development and commercial opportunities at level crossing removal locations.

The problems associated with each of the 50 level crossings take on varying degrees of importance at different sites. The opportunities to address safety, improve traffic flow on arterial routes, improve economic productivity and access along major freight routes, as well as opportunities for urban renewal as part of the program were all important criteria for the targeted removal of the 50 level crossings, for example:

- Four of the seven level crossings that are on key freight routes are being removed, helping to ensure that domestic goods can move around the city and Victoria in a safe and timely manner to improve the State's economic productivity.
- 36 of the level crossings being removed are on arterial roads, helping to improve the efficiency of the transport network
- 32 of the level crossings are located at, or in close proximity (within one kilometre) to, an activity centre - urban renewal precincts and sites, particularly around stations, that will be a major source of housing to meet Melbourne's growth needs.
- Collisions and near misses between road users and rail have the potential for catastrophic outcomes. Removal of these 50 level crossings will eliminate these conflict points, delivering significant safety outcomes.

### ***The Level Crossing Removal Program and interdependent rail upgrades will transform the transport system and shape the future of Melbourne.***

Many of the level crossing removals are critical components of the Victorian Government's program of major rail network upgrades.

In particular, the removal of nine level crossings on the Caulfield-Dandenong corridor and three level crossings on the Sunbury corridor, allow for the rail service increases planned under both the Cranbourne Pakenham Line Upgrade (CPLU) and Metro Tunnel.

The relationship between the LXRP and other major projects such as the CPLU and Metro Tunnel is critical for Melbourne's future development and prosperity. These major projects in combination can be expected to transform Melbourne's transport network and have a significant impact on Melbourne's city structure, by encouraging households and businesses to locate along high capacity rail corridors that will benefit from the significant accessibility improvements that these projects will provide. This will result in better economic and social outcomes in those areas, and drive additional productivity gains that will be felt across the Victorian economy.

The LXRP is a key initiative in the Government's 'Getting On With It' transport policy and its 'Project 10,000' election platform. Delivery will be overseen by the Level Crossing Removal Authority, with the Government committing to removing the first 20 crossings by the end of its first term in office and the remaining 30 by 2022.

This business case is an important step both in the state's formal investment approval process and in the provision of information about the project to the Victorian public. It represents the outcome of a thorough investigation into the what, when, why and how of the proposed LXRP. It covers the problems to be addressed, the case for the investment, the design of the program, costs and delivery issues.

Figure 1-3: LXR – 50 level crossings to be removed by 2022, and interdependent rail service increases under CPLU and Metro Tunnel



**ALTONA LOOP**

- 30 Kororoit Creek Road, Williamstown North

**BELGRAVE**

- 38 Mountain Highway, Bayswater
- 42 Scoresby Road, Bayswater

**CRAIGIEBURN**

- 7 Buckley Street, Essendon
- 27 Glenroy Road, Glenroy

**CRANBOURNE**

- 1 Abbots Road, Dandenong South
- 10 Thompsons Road, Lyndhurst

**FRANKSTON**

- 10 North Road, Ormond
- 3 Balcombe Road, Mentone
- 10 Centre Road, Bentleigh
- 15 Charman Road, Cheltenham
- 10 Edithvale Road, Edithvale
- 17 Eel Race Road, Carrum
- 55 McKinnon Road, McKinnon
- 45 Seaford Road, Seaford
- 24 Skye Road, Frankston
- 48 Station Street, Bonbeach
- 47 Station Street, Carrum

**GLEN WAVERLEY**

- 5 Burke Road, Glen Iris
- 7 Toorak Road, Kooyong

**HURSTBRIDGE**

- 25 Grange Road, Alphington
- 31 Lower Plenty Road, Rosanna

**LILYDALE**

- 4 Blackburn Road, Blackburn
- 25 Heatherdale Road, Ringwood
- 35 Manchester Road, Mooroolbark
- 24 Maroondah Highway, Lilydale

**PAKENHAM**

- 11 Centre Road, Clayton
- 15 Clayton Road, Clayton
- 20 Koornang Road, Carnegie
- 29 Murrumbeena Road, Murrumbeena
- 12 Chandler Road, Noble Park
- 17 Corrigan Road, Noble Park
- 24 Grange Road, Carnegie
- 27 Heatherton Road, Noble Park
- 41 Poath Road, Hughesdale
- 18 Clyde Road, Berwick
- 25 Hallam Road South, Hallam
- 45 South Gippsland Highway, Dandenong

**SOUTH MORANG**

- 6 Bell Street, Preston
- 20 High Street, Reservoir

**SUNBURY**

- 11 Main Road, St Albans
- 21 Furlong Road, St Albans
- 35 Melton Highway, Sydenham

**UPFIELD**

- 4 Bell Street, Coburg
- 7 Camp Road, Campbellfield
- 37 Moreland Road, Brunswick

**WERRIBEE**

- 2 Aviation Road, Laverton
- 14 Cherry Street, Werribee
- 30 Werribee Street, Werribee

**WILLIAMSTOWN**

- 20 Ferguson Street, Williamstown

\* Includes capacity uplift for both Metro Tunnel and Cranbourne/Pakenham corridor upgrade

## 1.2 Status of the Level Crossing Removal Project

Since 2000, 16 level crossings have been removed in Metropolitan Melbourne,<sup>7</sup> but 178 level crossings remain on Melbourne's electrified rail network of which 65 are on arterial roads and four are on roads with trams. All of these level crossings contribute to congestion, safety and amenity problems on the city's transport network and many of these level crossings inhibit improvements to the capacity of both the road and rail networks.

Until now, level crossings have been removed one at a time or in pairs. Starting with 50 level crossing removals by 2022, the Government is committed to addressing the problems associated with level crossings by removing them from Melbourne's transport network.

Work has already begun, with procurement and construction of a number of level crossing removals occurring as shown in the table below.

Table 1-1: Current Procurement Status (as at April 2017)

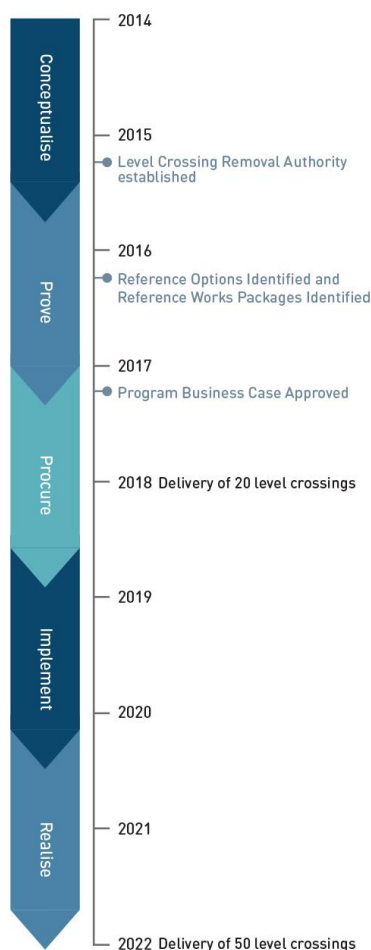
Procurement	Level crossings	Expected Completion	Procurement status
Package 1	Burke Road, Glen Iris	2016 <sup>1</sup>	Contract Awarded
	Centre Road, Bentleigh	2016 <sup>1</sup>	
	McKinnon Road, McKinnon	2016 <sup>1</sup>	
	North Road, Ormond	2016 <sup>1</sup>	
Package 2	Main Road, St Albans	2017 <sup>1</sup>	Contract Awarded
	Furlong Road, St Albans	2017 <sup>1</sup>	
	Heatherdale Road, Mitcham	2017 <sup>1</sup>	
	Blackburn Road, Blackburn	2017 <sup>1</sup>	
Caulfield-Dandenong	Koornang Road, Carnegie	2018	Contract Awarded
	Murrumbeena Road, Murrumbeena	2018	
	Poath Road, Hughesdale	2018	
	Grange Road, Carnegie	2018	
	Centre Road, Clayton	2018	
	Clayton Road, Clayton	2018	
	Corrigan Road, Noble Park	2018	
	Heatherton Road, Noble Park	2018	
Chandler Road, Noble Park	2018		
Package 4	Mountain Highway, Bayswater	2017 <sup>1</sup>	Contract Awarded
	Scoresby Road, Bayswater	2017 <sup>1</sup>	
Thompsons Road Duplication	Thompsons Road, Lyndhurst	2018	Contract Awarded
Melton Highway	Melton Highway, Sydenham	2018	Contract Awarded
North East Program Alliance	Grange Road, Alphington	2019	Contract Awarded
	Lower Plenty Road, Rosanna		
	Bell Street, Preston	2019	Additional Works Packages
	High Street, Reservoir		
North Western Program Alliance	Camp Road, Campbellfield	2019	Bidders Shortlisted
	Skye Road, Frankston		
	Buckley Street, Essendon	To be Confirmed	Additional Works Packages
	Glenroy Road, Glenroy		
	Moreland Road, Brunswick		
	Bell Street, Coburg		
Western Program Alliance	Kororoit Creek Road, Williamstown North	2019	Bidders Shortlisted
	Aviation Road, Laverton	To be Confirmed	Additional Works Packages
	Werribee Street, Werribee		
	Cherry Street, Werribee		
	Ferguson Street, Williamstown		

NOTE 1 - Actual Date of Level Crossing Removal

<sup>7</sup> VicRoads Strategic Framework for the Prioritisation of Level Crossings in Metropolitan Melbourne, 17 June 2014

## 1.3 Planning and delivery pathway

Figure 1-4: Investment Lifecycle



This full Program Business Case is the key document supporting this investment to remove all 50 level crossings. It demonstrates the benefits of the LXR as a whole, provides a cost envelope for the program and includes a delivery strategy that outlines the sequencing and packaging proposed to enable delivery of the 50 projects.

The program will follow the Department of Treasury and Finance’s investment lifecycle framework, which ensures that projects and programs are aligned with Victorian Government priorities and policies and that maximum benefits are extracted from the investment of public money.

The timing of the LXR and its progress through the investment lifecycle framework are depicted in Figure 1-4.

Collectively, the 50 level crossing removals constitute a major investment that has a strong ‘place-making’ dimension as well as seeking to meet core transport objectives.

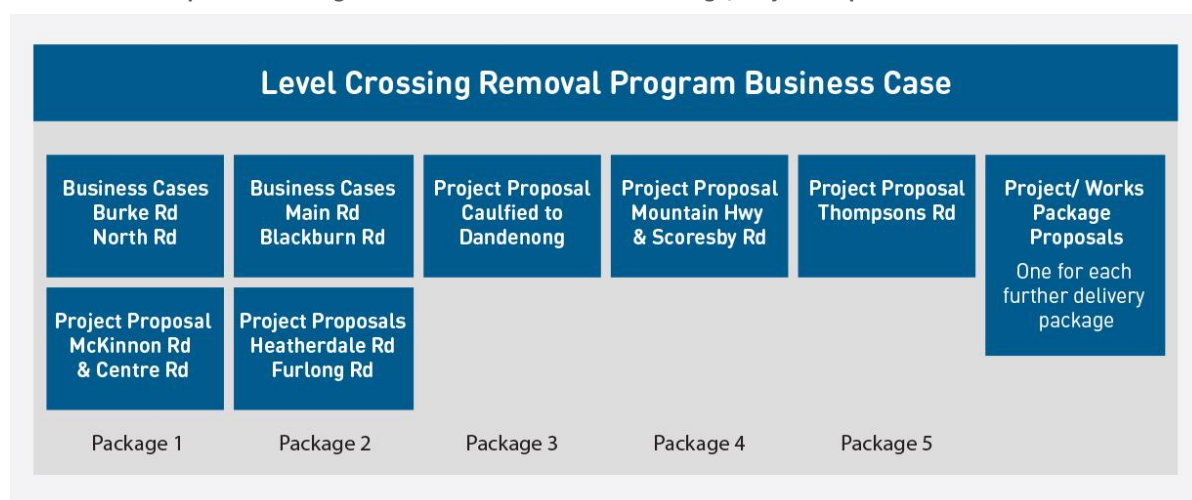
Accordingly, and given also that the program has commenced, the examination of the LXR and its constituent parts along the pathway from planning to delivery differs from the normal process applied to more typical single investments.

The Program Business Case is an overarching document that supports the Business Cases and Project/ Works Package Proposals prepared to date. It will also be the overarching document for all Project Proposals or Works Package Proposals prepared in future.

Separate Works Package/Project Proposals will be prepared for each delivery package. These will explain in detail the options considered and the recommended solution for each level crossing removal, or package of level crossing removals.

The Works Package/Project Proposals are required to secure the release of funding from Central Contingency. The scope of the Works Package/Project Proposals is further described in Section 9.4.

Figure 1-5: Relationship between Program Business Case and Works Package/Project Proposals



The LXR is a High Value High Risk project.<sup>8</sup> A HVHR compliant program review process will be undertaken in collaboration with DTF.

Currently, the program business case is at the 'Prove' stage of the framework, but some of the delivery packages have already passed through the 'procure' stage and are into implementation. These delivery packages have been through the relevant gateway reviews.

## 1.4 Objectives and scope of the business case

The objectives of this business case include:

- Defining and presenting evidence for the problems associated with level crossings in the Melbourne metropolitan area
- Defining the expected benefits to be delivered by responding to the problems, including associated key performance indicators
- Describing the project at a strategic level – in terms of its aims and basic form, as well as in terms of site-specific technical solutions and the process for identifying site solutions
- Undertaking an economic analysis to assess the expected benefits and costs associated with the project
- Presenting complementary information about the impacts of the project on accessibility, urban form and amenity, different groups of transport users and the macro economy
- Defining the approach to delivery for the project, including commercial considerations, the approach to value capture and a suggested procurement strategy
- Presenting the approach to delivering land use improvements and development opportunities that are integrated with level crossing removals and station rebuilding works, creating a benefit compared to conventional level crossing removal projects.

The business case describes and assesses the full program of 50 level crossing removals, not just those yet to go to market. This approach has been adopted for the following reasons:

- The LXR has been developed, and should be assessed, as a coherent, systematic program of works.
- The assessment of works already committed should be visible.
- There are significant benefits to adopting a programmatic approach for planning and delivery of level crossing removals.
- As an assessment of a cornerstone election commitment by the Victorian Government, and to communicate information about the program's impacts to the public and stakeholders.

<sup>8</sup> The Government has in place well established processes for identifying and delivering projects to meet the service needs of the Victorian community. These process are detailed in the Investment Lifecycle and High Value, High Risk Guidelines (HVHR) (Investment Lifecycle Guidelines)

The solutions for each site ('Reference Options'), estimated cost, and program appraisal presented in this business case are based on an assessment conducted in February 2016. These elements of the business case thus represent a point-in-time view of how the program might be delivered, but do not reflect decisions taken or information received since that time. The Reference Options and cost estimates presented in this Business Case may differ from the recommended solutions and costs ultimately presented in Works Package/Project Proposals.

The Program Business Case will enable DTF to make budget provisions over the forward program and beyond. Once funding is released into Central Contingency, Works Package/Project Proposals are required to secure the release of funding from Central Contingency for delivery.

## 1.5 Business case structure

The business case is structured as shown below.

Table 1-2: Business Case Structure

Chapter	Content
<b>Chapter 2</b>	Presents evidence of the problems to be addressed by the LXR
<b>Chapter 3</b>	Outlines the broader strategic context in which the LXR is being delivered
<b>Chapter 4</b>	Discusses the benefits expected to arise from addressing these problems and presents the Benefit Management Plan
<b>Chapter 5</b>	Describes the project as a strategic response to the problems identified
<b>Chapter 6</b>	Describes the reference options for each element of the project and the processes involved in project options selection
<b>Chapter 7</b>	Presents the financial analysis and phasing of project costs/revenues
<b>Chapter 8</b>	Presents an appraisal of the project, including cost-benefit analysis results
<b>Chapter 9</b>	Describes project deliverability issues, including governance, project management, procurement strategy and risk management and the content of Works Package/Project Proposals



# Chapter 2

## Problem



## CHAPTER 2: PROBLEM - SUMMARY

Level crossings represent a major conflict point between road and rail and are a major constraint to the viability of Melbourne's road and rail network. On an average weekday, approximately one million vehicles cross the 50 level crossings that are part of the LXR; each one of these vehicles has the potential to be delayed at a crossing.

An Investment Logic Map has been developed for the Level Crossing Removal Project which seeks to address three key problems.

**PROBLEM 1:** Conflicting demands of rail, road and pedestrian traffic at level crossings constrain one or more modes, reducing transport efficiency and economic productivity:

- More train services mean more and longer boom gate closures
- Longer boom gate closures mean more delays
- Travel time variability causes inconvenience and higher costs
- Transport interchanges are a critical component of Melbourne's public transport network
- Less reliable and less punctual bus services
- Level crossing constraints are impacting Melbourne's transport gateways
- Greater vulnerability to faults and incidents, causing further delays

**PROBLEM 2:** Rail corridors and excessive boom gate closures reinforce community severance and reduce local amenity:

- Greater community severance and dislocation
- Reduced neighbourhood amenity
- Reduced walking and cycling connectivity

**PROBLEM 3:** Motor vehicle driver, cyclist and pedestrian frustration at level crossing delays invites risk-taking behaviour, causing serious incidents:

- Risk-taking behaviour, causing serious incidents
- Potential risk at level crossings

It is clear that level crossings are a major constraint to the viability of Melbourne's road and rail networks and to delivering the upgrades in rail capacity needed to support a growing city. Level crossings also present a safety risk, contribute to reduced local amenity and limit opportunities for urban renewal and residential and commercial development. These problems generate significant costs for individuals and businesses and erode Melbourne's liveability, accessibility and productivity.

## 2 Problem

### 2.1 Intersections between Melbourne's road and rail networks are a major constraint

Level crossings, like other signalised road network junctions, provide a means of managing conflicts between the competing demands of rail passengers, on road public transport, motorists, pedestrians and cyclists. Currently, the rail network has 100 per cent priority although it is not without inefficiencies as trains are affected by incidents on the rail line and also must slow when passing tram lines.

Relatively busy roadways can accommodate a low level of boom gate closures before excessive conflicts and delays become a problem. As rail services increase to cater to the city's growing population, so too do the delays and conflicts between rail and road users. There has been an increase in boom gate closures in a number of locations around Melbourne, particularly in what are now well-established suburbs in Melbourne's middle and outer areas. This has a number of impacts:

- **Longer delays to road users** – Boom gates closing more often and for longer periods creates significant delays and congestion on the road network (for cars, buses, cyclists, pedestrians and trams), compounded by peak rail services coinciding with peak road traffic volumes. As traffic and train volumes continue to increase, delays to road users will increase.
- **Variability in travel times** – Boom gate closures may be highly variable and/or longer than planned for multiple reasons. Variable closures make travel time on the road network less reliable, causing frustration and inconvenience for road users experiencing unexpected delays, as well as creating additional personal and business costs as road users build in precautionary time to their journeys. Variability in boom gate closures features on most rail lines across the metropolitan rail network, and lengthy delays are a daily event at some crossing locations. This variability is expected to increase as patronage, dwell time at stations (the time taken for passengers to board or alight a train) and the frequency of rail services increases.
- **Less reliable and less punctual bus services** – Variable speeds through and around level crossings due to boom gate closures have a direct impact on buses. As well as causing delays to services, a significant number of bus routes terminate at level crossings to avoid unreliable travel times. This acts as a deterrent to using buses due to passengers having to terminate their journey or change buses at the level crossing and discourages people from shifting to public transport, as well as creating an inefficient bus route.
- **Greater vulnerability to faults and incidents** – Signal and hardware faults along the rail corridor cause unexpected and sometimes very lengthy boom gate closures, delaying rail and road traffic and contributing to risk-taking behaviour by drivers, pedestrians and cyclists.
- **Community severance and reduced amenity** – Level crossings exacerbate community severance and dislocation, impacting the amenity of neighbourhoods and limiting opportunities for urban renewal and economic development.
- **Frustration leading to risk-taking behaviour** – Delays at crossings cause some pedestrians, cyclists and motorists to undertake risky crossings of the rail line while the boom gates are down or descending.
- **Constraints on rail capacity** – Currently, the rail system cannot operate higher service frequencies in peak periods without extending boom gate closures even further and creating more delays for road users. This impacts on planned rail capacity upgrades, including the Cranbourne-Pakenham Line Upgrade (CPLU) and the Metro Tunnel, both of which aim to significantly boost rail capacity.

These issues are discussed in greater detail in the following sections.

### Wider network enhancements, network development and dependencies

The LXR is not a stand-alone road project with transport network benefits existing independently of other projects. Rather, there are interdependencies between the LXR and other concurrent and subsequent projects that make the benefits of each contingent on the others.

In particular, more frequent rail services delivered in the near term by the CPLU and later by service upgrades to utilise the Metro Tunnel infrastructure would result in substantial increases in boom gate closure times and worsening congestion at level crossings, particularly on the Caulfield-Dandenong corridor, if level crossings are not removed.

The CPLU program includes:

- The purchase of 37 next-generation, high capacity trains
- New and upgraded rail infrastructure in the corridor including track, power and signalling upgrades along the entire corridor and through the City Loop
- A new train depot and maintenance facility in Pakenham

The Metro Tunnel includes:

- Two nine-kilometre rail tunnels from South Kensington to South Yarra as part of a new Sunshine to Dandenong line
- New underground stations at Arden, Parkville, CBD North, CBD South and Domain
- A new transport interchange at Domain

The Metro Tunnel will increase the capacity, reliability and efficiency of Melbourne's busiest train lines and eventually allow for an extra 150,000 passengers to travel to and from the CBD in peak periods. It will ease congestion on the busy St Kilda Road/Swanston Street tram corridor and pave the way for further extensions to Melbourne's train network.

The scope of the project is contained almost entirely within the City of Melbourne; however, the project will interface directly with surface lines. Owing to the scale of this project, it is critical that services are run at maximum efficiency to realise its intended benefits and return positive value for money to the Victorian community. The extent to which trains on the new metro system can run efficiently is constrained by the capacity and efficiency of the existing surface network. The LXR will complement the Metro Tunnel, as additional services can be run on the Cranbourne-Dandenong Lines following the removal of nine level crossings between Caulfield and Dandenong. In addition, the scope of the nine level crossing removal projects on the Caulfield-Dandenong line includes provision for future platform extensions as part of the design in order to accommodate future works as part of the Metro Tunnel.

PTV's Network Development Plan anticipates a 130 per cent increase in rail capacity within 20 years, which would result in boom gate closures on the Pakenham-Cranbourne line rising from an average of 60 per cent of the peak hour at present, up to 95 per cent in future. It is obvious that community intolerance to the resulting delays or the need of road network managers for a level of road network efficiency would not permit this scenario to occur, and that at best only a constrained form of service upgrade (with less extreme increases in closure times) could be implemented while level crossings remain in place. A more pessimistic assessment is that the system is already stretched to 'breaking point' and that the presence of level crossings means that no increase in service frequency is practically possible on some rail lines.

By enabling additional services to be run without exacerbating existing road delays, the LXR effectively enables the benefits of rail upgrades – additional passenger movements, de-crowding and faster trips, and de-congestion of roads via mode shift – to be achieved. It makes feasible rolling stock procurement programs such as the CPLU, which are necessarily 'lumpy' in order to exploit economies of scale in production and realise value for money for the state. Without level crossing removals providing space for service frequency upgrades, the rationale for investing in the Metro Tunnel infrastructure is also diminished.

While interdependencies are to some extent common to every transport project, the LXR's importance makes this aspect of project benefits far more significant than is typical.

## 2.2 Investment Logic Map

To improve the transparency of decision-making in relation to the LXR, a Program Investment Logic Map (ILM), shown below, and a Benefit Management Plan (BMP), shown in Appendix B, were developed in accordance with the Victorian Department of Treasury and Finance guidelines.

An important class of inter-related problems and benefits is associated with taking a programmatic approach to level crossing removals. As the LXR is a network-wide program, it addresses network-level issues and provides network-wide benefits. For instance, separating Melbourne's busiest rail lines from the road network will reduce the risk of disruption for many rail commuters while also allowing more services to be run without exacerbating road congestion.

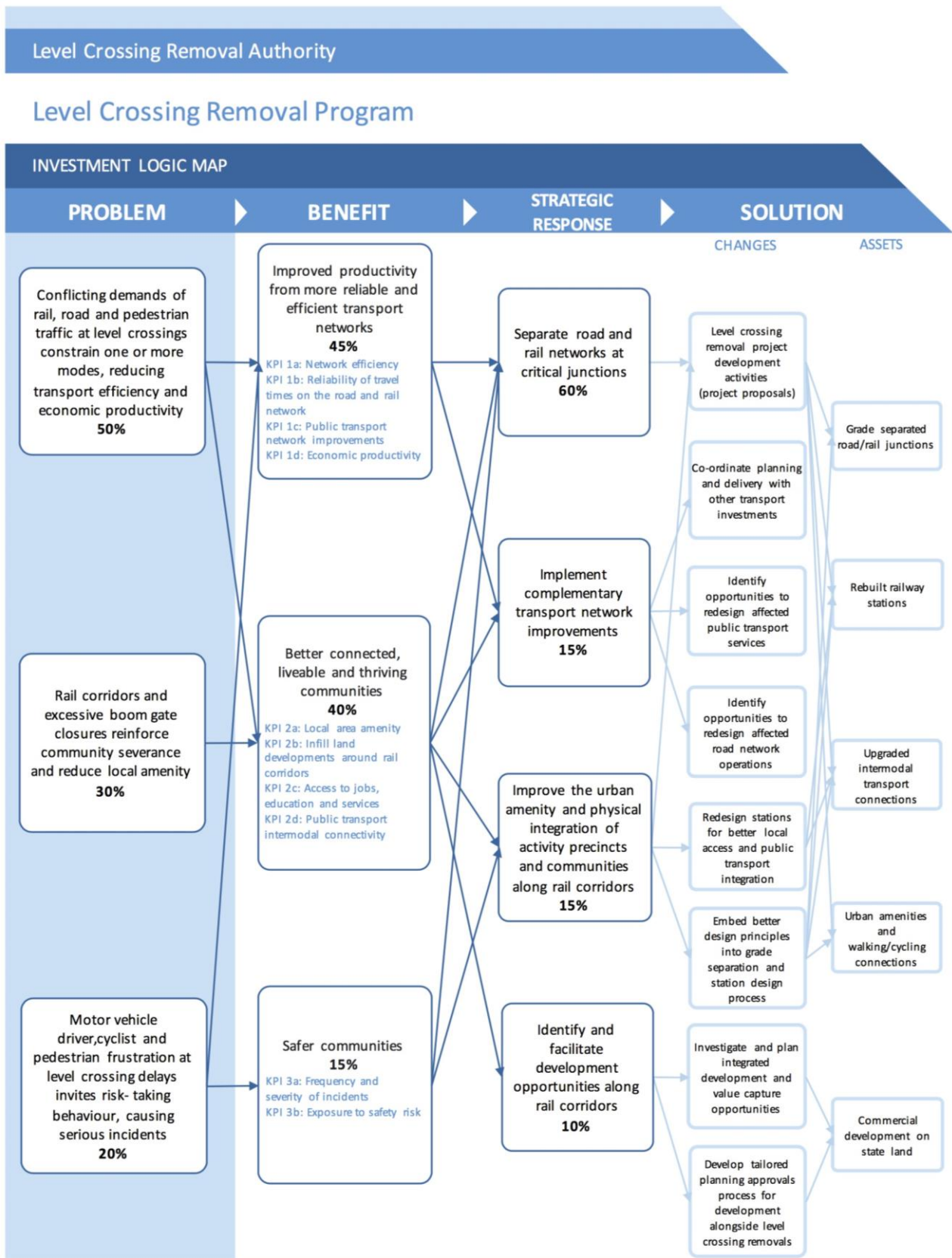
It should also be noted that the problems and benefits identified in the ILM naturally take on varying degrees of importance at different sites. For example, congestion is likely to be the major problem caused by crossings on key arterial roads, while safety and amenity consequences may be more important for crossings bisecting busy shopping precincts.

The problem descriptions in this chapter describe the issues in aggregate across the program, but it should be borne in mind that the emphasis on each issue varies from site to site.

The ILM was developed following a series of workshops, which included consideration of the problem and benefits statements from previous ILM's for level crossing removal projects and other programs; these were reviewed in detail to accommodate the program level issues. The ILM was also circulated to stakeholders from various Government departments for comment.

The ILM for the LXR nominates and weights three high level problems the LXR seeks to address (described in Section 2.3), along with the key benefits that will be realised from tackling these problems successfully (described in Chapter 4). It identifies the strategic responses required to achieve the benefits and potential solutions to deliver these responses (Chapters 5 and 6).

Figure 2-1: LXRP Investment Logic Map (ILM)



Investor: LXRA  
Facilitator: David Cochrane  
Accredited Facilitator: Yes

Version no: 3.0  
Initial Workshop: 9/7/15  
Last modified by: Stuart McCully 29/9/15  
Template version: 5.0

## 2.3 Key problems

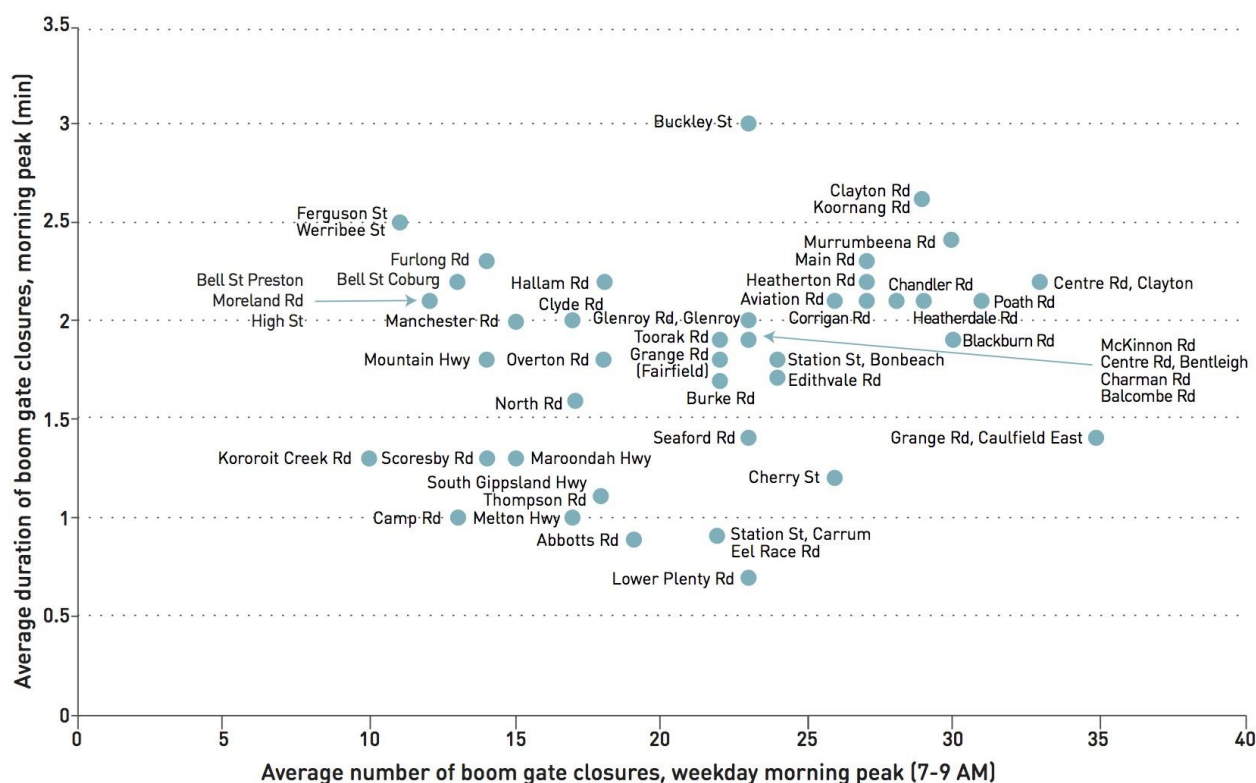
### 2.3.1 PROBLEM 1: Conflicting demands of rail, road and pedestrian traffic at level crossings constrain one or more modes, reducing transport efficiency and economic productivity

#### More train services mean longer boom gate closures

The frequency and duration of boom gate closures at any level crossing is governed by a range of factors, including signalling, the proximity of the crossing to a station and by the number of trains passing through the junction (which on many lines can include not only scheduled Metro Trains Melbourne (MTM) services but V-Line, freight and trains being moved for maintenance).

An assessment of boom gate closures at the 50 level crossings in the LXP indicates that there is some variance in the nature and extent of the boom gate closure problem across the sites.<sup>9</sup> Figure 2-2 shows the average number and duration of closures in the morning peak; sites in the top-right quadrant are those with the longest closure during the morning peak. At more than half of the level crossings, the boom gates are closing at least 20 times, or more, in the morning peak each weekday.

Figure 2-2: 50 level crossings – average number and average duration of boom gate closures in the morning peak



Source: VicRoads assessments of boom gate closures, Oct 2015

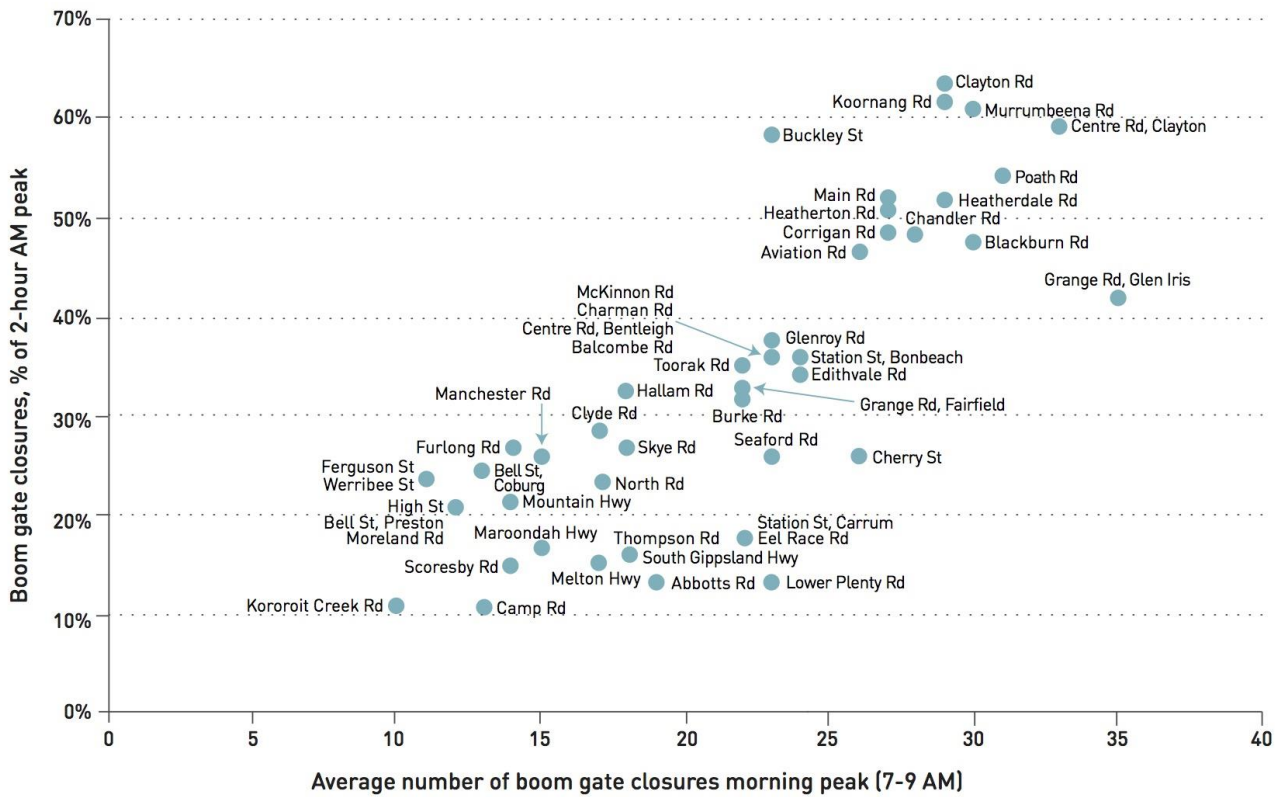
<sup>9</sup> An assessment of delays at boom gate closures was carried out by VicRoads in 2015. The full report is included in Appendix C.

**More train services mean more boom gate closures**

VicRoads data on train frequencies and boom gate closure rates for the 50 crossings identified for removal is presented in Figure 2-3. During the morning peak some crossings on the busy Caulfield-Dandenong corridor are closed, on average, for over 60 per cent of the two-hour period. On the Frankston line, where train frequencies are relatively lower, closure rates vary between 18 and 36 per cent.

As additional rail services are added via the CPLU rolling stock investment and associated cascading of fleet to other lines (and then following commencement of the Metro Tunnel, boom gate closures at many of these sites will increase significantly. Without some intervention, a significant number of roads across Melbourne (many of which are important commuter and freight routes) will effectively be closed for considerable periods of time to accommodate an increase in the frequency of train services.

Figure 2-3: Relationship between percentage of boom gate closures and average number of boom gate closures – 2 hour morning peak



Source: VicRoads assessments of boom gate closures, Oct 2015



Descriptions of the consequences of escalating boom gate closures for road capacity and road performance are shown in Table 2-1.

**Table 2-1: Train frequency consequences for road traffic at level crossings**

Trains/hr in peak direction <sup>1</sup>	Total trains/hr <sup>2</sup>	Estimated number of boom gate closures/hr	Estimated reduction in road capacity (%) <sup>3</sup>	Consequences
7-9	9-15	9-11	25-30	The traffic capacity of signalised intersections close to level crossings will be reduced by approximately one third. Traffic signals are still able to complete full cycles; however completing consecutive cycles is becoming difficult.
10-15	13-25	13-19	35-52	The traffic capacity of signalised intersections close to level crossings will have nearly halved. These signals will become increasingly unable to complete a full cycle between successive boom closures and, as a consequence, some road user movements may not be permitted for several boom openings.
16-20	20-34	20-25	56-69	Traffic volume across level crossing will be highly restricted. Traffic signals will be becoming ineffective.
21+	36+	26+	73+	Level crossing will rarely open resulting in effective road closures. Some stations beside level crossings will become inaccessible. Risk taking by road users will increase, especially by pedestrians.

*Note 1 - Train volumes in peak direction based on PTV, Network Development Plan 2012*

*Note 2 – Total train volumes estimated at 1.7 times peak direction train volume. For a two hour period, 60 percent of services run in the first hour of the peak with 40 percent in the other hour of the peak*

*Note 3 – Estimated reduction in road capacity based on boom gate closure times*

The current (2011) and planned (2031) train frequencies (based on the PTV service plans) are shown in Figure 2-4 and Figure 2-5<sup>10</sup>.

Thirty-six of the 50 level crossings being removed as part of this program currently each have over 20 trains passing through the level crossing in the two-hour morning peak period, resulting in highly restricted traffic flow over the crossing. This is expected to increase in future.

<sup>10</sup> Note that a 2015 Victorian Integrated Transport Model (VITM) rail service plan is not available therefore 2011 VITM service plans have been used – for more information regarding VITM, refer to Section 3.2.1.

Figure 2-4: Planned 2011 hourly train frequency in the morning peak, each direction

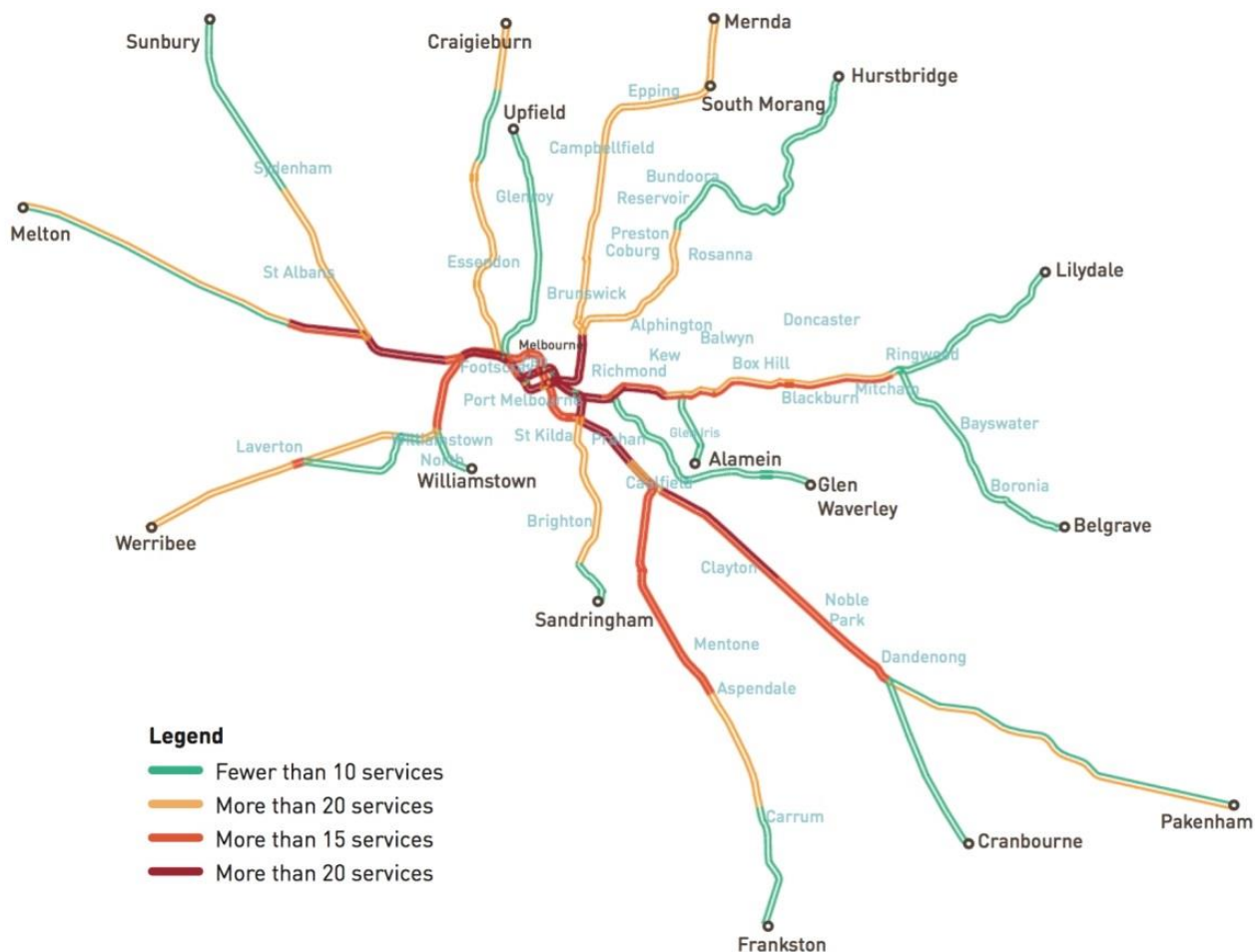


Source: DEDJTR VITM inputs<sup>11 12</sup>

<sup>11</sup> 2015 rail service plans are not available for VITM. Actual train numbers in 2015 are higher than shown in Figure 2-4. VITM has been used to assess the LXP. 2011 train volumes are presented for consistency with VITM Reference Case scenarios.

<sup>12</sup> Rail service plans assume services are evenly distributed across the morning peak period (based on 2 hour peak value divided by 2)

Figure 2-5: Modelled 2031 forecast hourly train frequency in the morning peak, each direction



Source: DEDJTR VITM inputs<sup>13</sup>

Estimated boom gate closures shown in Table 2-2 are calculated using the frequency of train services in the future, based on PTV service plans, and observed closure times based on signal timing data (Sydney Coordinated Adaptive Traffic System - SCATS) and manual surveys completed by MTM. Observed boom gate closure data is included in Appendix A.

The table shows that on the Caulfield-Dandenong corridor, the introduction of additional services may effectively shut down the roads traversing these crossings during morning peak periods, with boom gate closure rates over 90 per cent. On the Pakenham and Cranbourne lines beyond Dandenong, boom gate closures are projected to more than double, and for the Frankston line crossings, between Caulfield and Mordialloc, closures will double to more than 60 per cent of the peak period.

It is clear that without some intervention, a significant number of roads across Melbourne (many of which are important commuter and freight routes) will effectively be closed for considerable periods of time to accommodate an increase in the frequency of train services.

<sup>13</sup> Rail service plans assume services are evenly distributed across the morning peak period (based on 2 hour peak value divided by 2)

Table 2-2: Estimated future percentage boom gate closures – 2 hour morning peak

Line	Road name	2021	2031	2046
Cranbourne - Pakenham	Grange Road	95%	97%	100%
	Koornang Road	95%	97%	100%
	Murrumbeena Road	95%	97%	100%
	Poath Road	95%	97%	100%
	Clayton Road	95%	97%	91%
	Centre Road (Clayton)	95%	97%	91%
	Corrigan Road	91%	92%	90%
	Heatherton Road	91%	92%	90%
	Chandler Road	91%	92%	90%
Cranbourne	Abbotts Road	21%	21%	21%
	Thompsons Road	21%	21%	21%
Pakenham	Sth Gippsland Hwy	46%	46%	48%
	Hallam South Road	46%	46%	48%
	Clyde Road	46%	46%	48%
Frankston	North Road	63%	67%	70%
	McKinnon Road	63%	67%	70%
	Centre Road (Bentleigh)	63%	67%	70%
	Charman Road	63%	67%	70%
	Balcombe Road	63%	67%	70%
	Edithvale Road	38%	46%	50%
	Station Street (Bondi Road)	38%	46%	50%
	Station Street	38%	46%	50%
	Eel Race Road	32%	36%	40%
	Seaford Road	32%	36%	40%
	Overton Road (Skye Road)	32%	36%	40%
Glen Waverley	Toorak Road	37%	37%	39%
	Burke Road	37%	37%	39%
Belgrave	Blackburn Road	79%	79%	86%
	Heatherdale Road	79%	79%	86%
	Mountain Highway	19%	19%	19%
	Scoresby Road	19%	19%	19%
Craigieburn	Buckley Street	77%	75%	80%
	Glenroy Road	77%	65%	69%
Upfield	Moreland Road	13%	32%	39%
	Bell Street (Coburg)	13%	32%	39%
	Camp Road	13%	22%	39%
Hurstbridge	Grange Road	46%	53%	53%
	Lower Plenty Road	28%	40%	40%
South Morang	Bell Street (Preston)	38%	45%	45%
	High Street	38%	45%	45%
Sunbury	Furlong Road	52%	61%	54%
	Main Road	52%	61%	64%

Line	Road name	2021	2031	2046
	Melton Hwy	31%	35%	41%
Werribee	Aviation Road	37%	59%	59%
	Cherry Street	37%	59%	59%
	Werribee Street	2%	2%	36%
Lilydale	Manchester Road	24%	24%	40%
	Maroondah Hwy	14%	14%	40%
Laverton	Kororoit Creek Road	8%	10%	10%
Williamstown	Ferguson Street	13%	14%	14%

Source: VITM Model Input - percentage closures are calculated using closure frequency from PTV public transport service plans and closure times based on SCATS data and surveys completed by MTM.

### **Longer boom gate closures mean more delays**

On an average weekday, approximately 1 million vehicles cross the 50 level crossings that are part of the LXP. Traffic volumes are shown in Appendix A. Each one of these vehicles has the potential to be delayed at a crossing. As Melbourne's population grows, the combination of increasing road traffic volumes, more train services running on the city's rail network and longer boom gate closure times will exacerbate already severe delays around level crossings.

As traffic volumes increase and delays around level crossings also increase, road travel speeds decrease. Across Melbourne, the daily average road travel speed across the network is forecast to reduce from 44 kilometres per hour to 40.5 kilometres per hour from 2011 to 2031. As Figure 2-6 and Figure 2-7 show, current average travel speeds within one kilometre of level crossings are already relatively low and will decrease further in the morning peak from 2011 to 2031. This means that, on average, trips are taking longer, with people travelling for more time to get to the same destination. It should be emphasised that VITM is a strategic network model and the results are used to provide an indication of network-wide changes rather than expected conditions at individual level crossing sites.

Figure 2-6: Average travel speeds within one kilometre of crossings, morning peak – 2011<sup>14</sup>

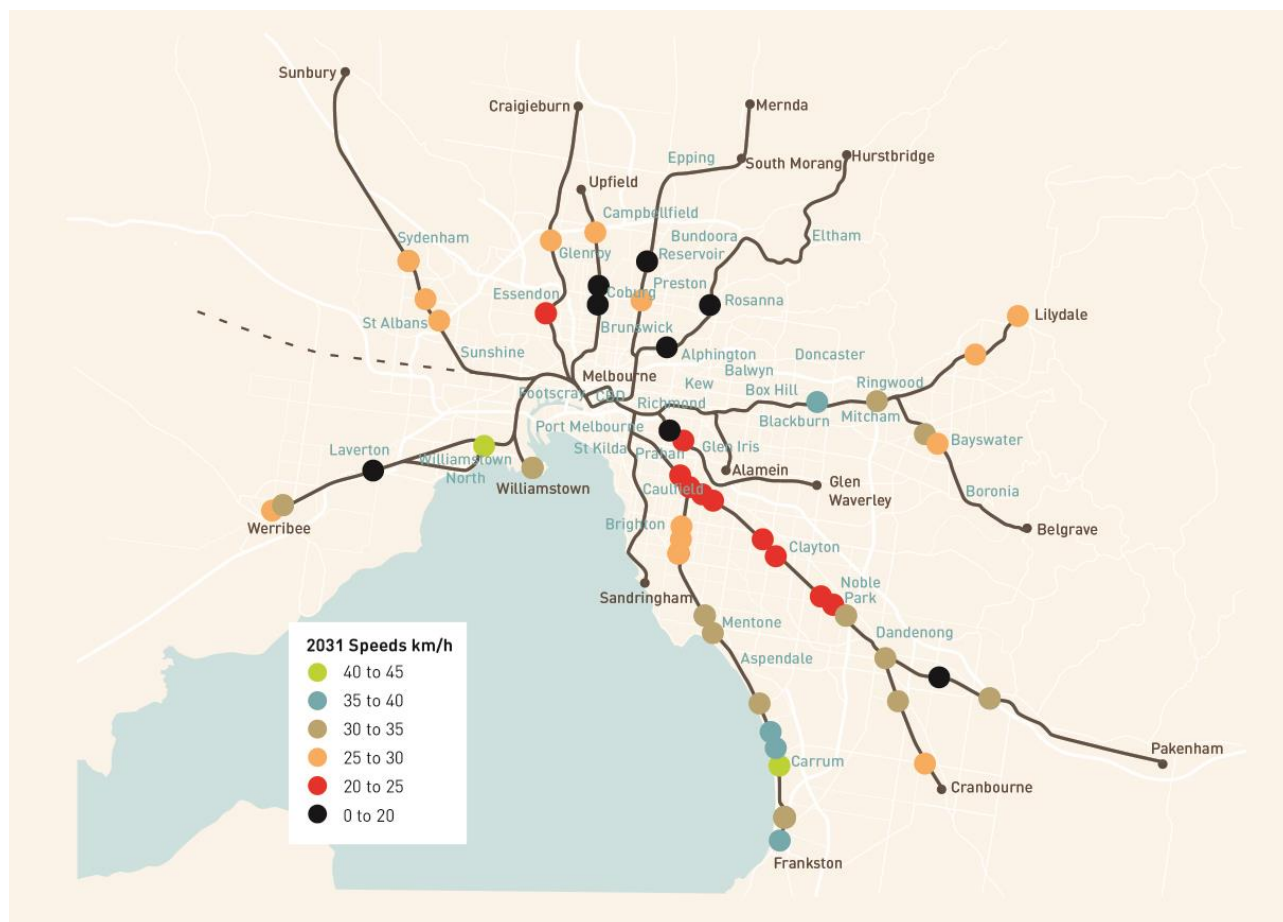


Source: VITM model projections of road speed under current transport network and public transport frequency, 50 level crossings remaining

Figure 2-6 shows that at 24 level crossings the average travel speeds are less than 30km /h in the morning peak. Figure 2-7 indicates that this is forecast to increase, with average travel speeds below 30 km/h at 32 of the 50 sites by 2031.

<sup>14</sup> It should be emphasised that VITM is a strategic network model and the results are used to provide an indication of network-wide changes rather than expected conditions at individual level crossing sites.

Figure 2-7: Average travel speeds within one kilometre of crossings, morning peak – 2031



Source: VITM model projections of road speed under future transport network and public transport frequency, 50 level crossings remaining, without CPLU and Metro Tunnel

There is variation across the 50 level crossings in the LXP in relation to the number of vehicles traversing the crossing and the percentage of time the gates are closed. Irrespective of these variations, travel speeds are expected to decrease (in some locations to a significant degree) or continue to remain relatively low at most of the level crossings into the future.

### ***Travel time variability causes inconvenience and higher costs***

Unpredictability in boom gate closures features on most rail lines across the metropolitan rail network, and lengthy delays are a daily event at some crossing locations.

The variability in travel times that unpredictability in boom gate closures creates can cause frustration and inconvenience for road users experiencing unexpectedly long delays. It can also generate additional personal and business costs as both commuters and business travellers are forced to build precautionary time into their journey planning. The costs to road users on time-critical trips, and the costs of accommodating these variable road delays to the businesses, schools, service providers and individuals at the trip destinations may be a substantial component of the overall social costs generated by level crossings.

Boom gate closure times vary significantly for several reasons. At some crossings, trains are scheduled to cross from opposite directions at similar times, but if one is slightly delayed this can result in a closure interval that is longer than would arise if both were crossing simultaneously. Alternatively, a train significantly behind schedule can hold up the trains behind. Stations next to level crossings can cause higher variability in boom gate closures, including when the station dwell time is extended by passengers crowding onto full services during peak times. Finally, level crossing incidents (including signal faults and crashes) can result in extremely long closures and road delays, as described below and in Section 2.3.3.

In a transport modelling exercise<sup>15</sup> to determine variability of travel time at a select number of sites, the results show that as traffic demand and rail service frequency increase, travel time and variability of travel time at level crossings also increases. For example, results for Abbots Road, Lyndhurst, show that removal of the level crossing can improve average travel time by approximately 25 per cent in the morning peak and variability of travel time by 55 per cent. Results for Bell Street show that removal of the level crossing can improve average travel time by approximately 7 per cent in the morning peak and variability of travel time by more than 10 per cent.

Extreme events (where the gates are closed for more than five minutes) occur along the Dandenong corridor about once per day, at different crossings.<sup>16</sup> Boom gate closure events cause long queues of road traffic at the crossings and across adjacent intersections, which can persist for the rest of the peak period. Extended boom gate closures lead to highly variable queue lengths.

#### **Traffic impacts of boom gate closures**

- Queues of over 500 metres are common along Murrumbeena Road, with flow-on effects extending across other adjacent roads (such as Neerim Road).
- At Koornang Road, single closure events in excess of 18 minutes have been measured and on some days boom gates can be closed for over 70 per cent of the peak period.
- Recent boom gate closure times measured at Clayton Road in the morning peak further highlight unpredictability in travel time, with boom gate closures of between 45 seconds and 5 minutes as trains pass.
- In the evening peak period at North Road, the average boom gate closure time is one and a half minutes, but the maximum time is almost five minutes. This results in queue lengths in excess of 300 metres on North Road.

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<sup>15</sup> A combined mesoscopic and microscopic transport model was used to ascertain how removal of level crossings would affect the variability of travel time

<sup>16</sup> Based on data obtained in 2011 from VicRoads SCATS data



### Clayton Road level crossing boom gate closures and delays

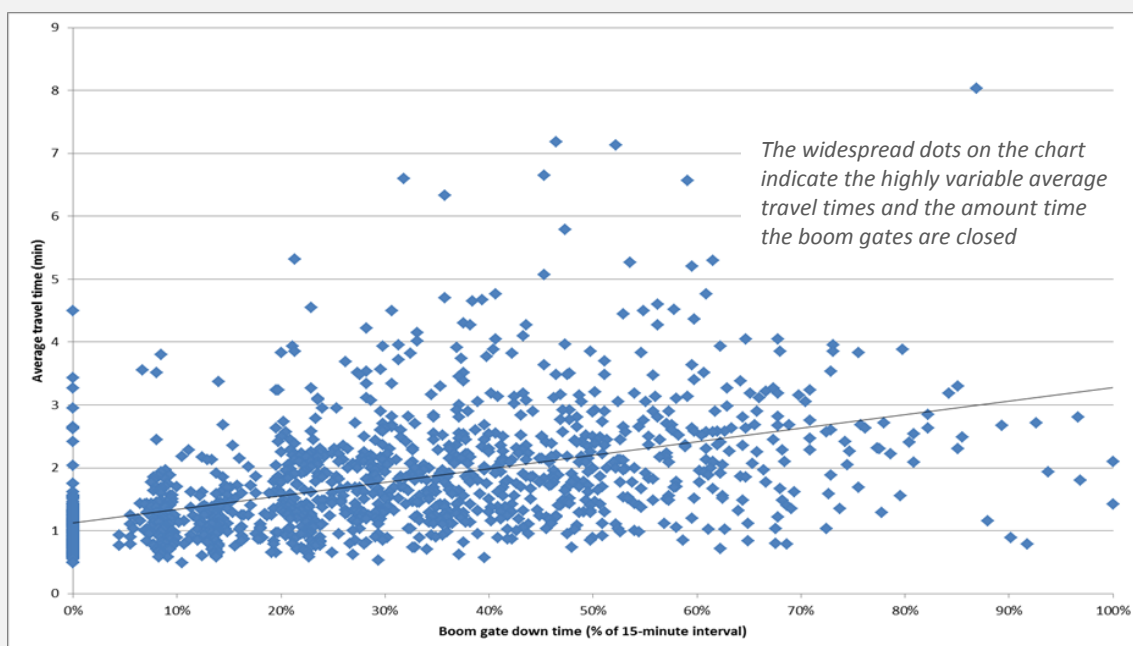


The Clayton Road crossing experiences one of Melbourne’s busiest train services, with an average of 49 services, two-way, passing through the crossing in the weekday morning peak (7am to 9am) and with average boom gate closures for over 60 per cent of this period (refer Appendix A). Figure 2-8 illustrates the wide dispersion in boom gate “down” times and the resulting wide range of travel times, which road-based transport experiences. Both boom gate closures and travel times along Clayton Road are highly variable, resulting in highly unreliable travel times for cars, freight, buses, pedestrians and cyclists.

Over a two-week observation period, measured with 15-minute intervals, boom gate closures ranged from around 5 per cent (or 45 seconds) and up to 100 per cent (of the 15-minutes). Some extreme instances were observed in peak times where boom gates were closed for more than 70 per cent of the peak period.

Travel times through the Clayton Activity Centre were generally slower during periods of extensive boom gate closures. Despite the morning peak being the generally busiest time of day on the road network, fewer vehicles traverse the Clayton crossing in each hour of the morning peak than during the inter-peak period of 10am to 3pm (1,124 per hour in the morning peak against 1,385 in the inter-peak), likely due to people accessing local services along Clayton Road. This illustrates how the crossing is constraining the potential of Clayton Road to operate efficiently.

Figure 2-8: Boom Gate Down time and travel time – northbound from Centre Rd to the Clayton Rd level crossing (500m), all days and all times



Source: VicRoads assessments of boom gate closures, Oct 2015

### ***Transport interchanges are a critical component of Melbourne's public transport network***

The sprawling nature of Melbourne's urban environment means that flexibility in how and when Melbournians travel around the city is critical and can be expected to remain a feature of the city's public transport needs in the future. Issues associated with level crossings can compromise this flexibility by limiting the effectiveness of rail stations to operate as interchanges for transport modes.

Of the 50 crossings to be removed as part of the LXP, 34 have adjacent or nearby train stations, 18 of which are premium stations that are staffed from first to last train. Thirty two of the train stations have interchanges with buses and two have interchanges with trams.

Historically, public transport has been managed as a collection of separate modes rather than as an integrated system and as a result, many public transport services are poorly coordinated.

Many existing train stations are out-dated and do not offer users a convenient transfer between travel modes, such as bicycle parking/storage, car parks and bus/coach/tram stops. At many stations, it is difficult for users to find their way around, preventing effective interchange with buses and taxis as well as walking and cycling to adjacent activity centres. Lack of reliable connections between transport modes reduces passenger mobility, choice and flexibility, which can make passenger journeys stressful and less enjoyable.

Currently, not all stations cater specifically to the various access needs of pedestrians, cyclists and less abled passengers.

Station design research<sup>17</sup> was undertaken in mid-2014 to understand community perceptions of Melbourne's rail stations and what customers expect to be provided, as a minimum, at an 'ideal' station. Across all types of stations, personal security was the most important factor to most people. Seating, shelter, toilets, disability access and level crossing removals, where possible, were also identified as important.

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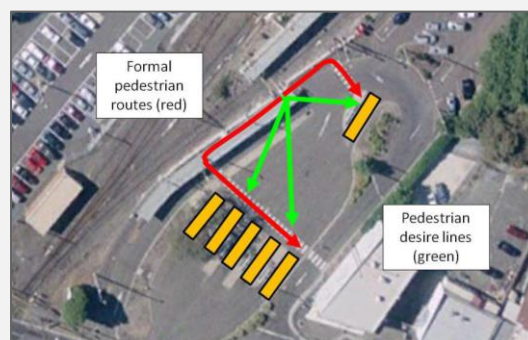
<sup>17</sup> Station Design Research, Prepared for PTV, Draft Report September 2014 – 120 discussion group participants, 1,916 online survey participants

### Maroondah Highway Level Crossing – Lilydale Station

The Maroondah Highway level crossing is adjacent to the Lilydale station and transport interchange. Being at the end of the line, the transport interchange is an important facility that incorporates a major bus interchange, servicing 11 regular bus routes plus two night-rider routes to surrounding suburbs and the Yarra Valley. It is also located close to Lilydale High School, which has a large number of students who use the bus interchange.

The transport interchange has a number of inherent safety and congestion issues, in addition to those at the level crossing:

- Although there are 11 regular bus routes, only six bus bays are provided and at times there is insufficient space to accommodate all bus services. PTV has plans to increase the frequency of bus services, which will exacerbate this problem.
- Due to the abovementioned lack of bus spaces, it is common for buses to queue up or occupy stops, which is confusing for passengers. Buses have also been observed reversing out to pass the leading bus. This can be very dangerous for pedestrians should they be walking through the interchange area, which is not uncommon.
- The existing passenger waiting areas are effectively small islands within a large expanse of asphalt used by the buses. During evening peak periods (in particular the end of the school day), these are crowded, resulting in passengers spilling out onto the carriageway (see the top left photo, below).
- Pedestrians exiting the station need to cross the bus interchange, using a long zebra crossing traversed by buses and cars. However, it has been observed that pedestrians usually spill out from the station entrance, taking the shortest route ('desire line') directly over a wide expanse of asphalt across the bus interchange, putting them in more conflict with buses and taxis (see top right and bottom centre photos below).
- In order to access the transport interchange itself, students from Lilydale high school are required to cross Maroondah Highway. However, rather than using the nearby traffic signals, they have been observed crossing the highway opposite the bus interchange, putting them in conflict with exiting cars and buses.
- To access the station itself, commuters are required to cross existing rail tracks via a controlled pedestrian level crossing near the station. This pedestrian crossing is not part of the Level Crossing Removal Project.



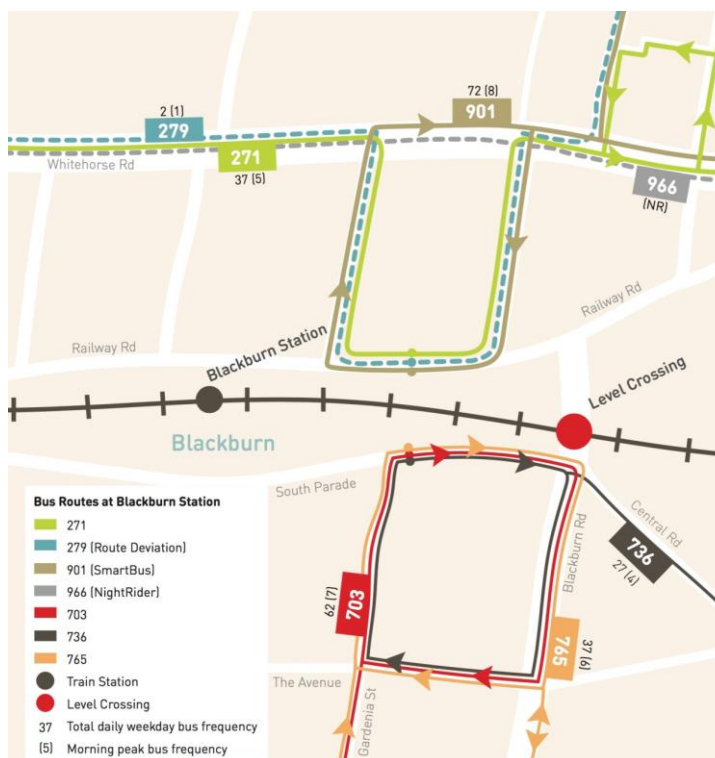
### Less reliable and less punctual bus services

Slower speeds through and around level crossings due to queues from boom gate closures have a direct impact on the city's bus network, including SmartBus routes. Delays to bus services mean they can be less punctual and less reliable, diminishing opportunities for seamless coordination with trains and trams and efficient bus timetabling and routing. Less reliable bus services make it more difficult to encourage people to shift to public transport for all or part of their journeys.

Of the 50 crossings that make up the LXR, 44 sites have bus routes that either approach or travel over the crossing.

Although there are over 60 routes that travel over crossings, there are over 70 bus routes that are disconnected, terminating or turning near level crossing locations, possibly to avoid delays. This acts as a deterrent for bus use in the local area and diminishes the effectiveness of train stations as transport interchanges. Figure 2-9 shows an example of severe disconnection in bus routing at Blackburn Road. There are seven bus routes in the vicinity of the crossing; however, none travel over the level crossing to connect the areas north and south of the rail line.

Figure 2-9: Bus routes traversing and terminating at level crossings



Source: PTV

Springvale Road is on the SmartBus route with SmartBus services running in under 10 minute frequencies during the peak periods. Travel time data is recorded for each service and actual arrival times can be compared to scheduled arrival times. An analysis (before and after the level crossing removal) of travel time data at four bus stops on either side of the (former) Springvale Road level crossing shows that the number of times bus services are late significantly decreases following removal of the level crossing. Table 2-3 summarises the before and after data, showing that prior to the level crossing removal, 86% of services were late and following the level crossing removal, 41% of services were late in the evening peak.

The SmartBus network has been designed to provide reliable bus routes that complement Melbourne's radial train and tram network by providing 'cross-town' connections to train stations, tram lines, schools, universities, hospitals and shopping centres. The network comprises nine key cross-town and orbital bus routes around Melbourne. Key aspects of the service include more frequent services, extended hours of operation to include late evening and Sunday services, improved timetable information at bus stops, road space priority along certain routes and priority at particular traffic lights. The effectiveness of these service enhancements can be undermined by the slower speeds and delays associated with level crossings.

In mid-2013, construction commenced to remove the Springvale Road level crossing that was immediately north of Springvale Station and at the northern extent of the Springvale Activity Centre. As part of this project, a new station was constructed below street level. The new station was opened in April 2014.



Springvale Road level crossing prior to removal

Table 2-3: Bus punctuality at Springvale Road, Springvale (former level crossing)

	Northbound (morning peak)		Southbound (morning peak)		Northbound (evening peak)		Southbound (evening peak)	
	Percentage late	Average delay (seconds)	Percentage late	Average delay (seconds)	Percentage late	Average delay (seconds)	Percentage late	Average delay (seconds)
Before	82%	251	67%	171	85%	254	86%	324
After	54%	130	34%	73	52%	78	41%	101

Source: PTV- Bus Operations

### Level crossing constraints are impacting Melbourne’s transport gateways

Melbourne’s sea ports and airports are the main gateways to international markets for Melbourne, regional Victoria and other states. Reliable and efficient connections to these gateways are critical to sustaining the productivity and competitiveness of a number of industries, especially those engaged in exporting.

The Principal Freight Network has been identified to secure connections between these gateways and other key destinations while ensuring that domestic goods can move around the city and Victoria in a safe and timely manner. Currently, seven level crossings on key freight routes are affecting variability in travel times along the Principal Freight Network, as shown in Figure 2-10. These crossings limit the efficiency of freight movements, which in turn has an adverse effect on productivity. As part of the LXR Project, four of the seven level crossings on the Principal Freight Network are being removed. These four crossings are Bell Street in Coburg, and Preston, Maroondah Highway, Lilydale and Kororoit Creek Road, Williamstown North.

Figure 2-10: Level crossings on the Principal Freight Network



### Greater vulnerability to faults and incidents, causing further delays

Level crossings cause rail and road networks to be more vulnerable to incidents and signal faults, which cause delays and other costs.

Signal and hardware faults along the rail corridor cause unexpected and sometimes lengthy boom gate closures. When a signal fault is detected, train drivers must stop at each signal and phone ahead to the control room for permission to proceed to the next signal. Hardware faults can result in elements of the active crossing failing. These faults can delay road traffic and contribute to risk-taking behaviour as some vehicles and pedestrians attempt to cross the closed crossings. Train drivers are also directed to reduce speed when passing boom gates.

Table 2-4 shows that over the last five years, Metro Trains has recorded approximately 1,500 incidents of signal faults at, or on the approach to, the 50 level crossings. These faults have resulted in nearly 6,000 trains being delayed and 2,500 trains being cancelled. The delays and cancelled trains have resulted in over 20 million passenger weighted minutes.<sup>18</sup> In addition, these delays represent a significant cost to road users, freight and on-road public transport users in lost productivity.

Table 2-4: Signal fault and incident data at, or on the approach to, the 50 level crossings

No. of signal faults	No. of trains delayed	Average delay (minutes)	No. of trains cancelled	Passenger weighted minutes
1,527	5,867	492,646	2,510	20,047,052

Source: Metro Trains Melbourne

Examples of incidents that caused significant delays to road traffic and had the potential to lead to risk-taking behaviour include:

- Aviation Road: pedestrian boom gate not closing properly which took over five hours to rectify
- Glenroy Road: boom gates stuck for six hours
- Charman Road: audible warning bells not working, which took over eight hours to rectify
- Grange Road: boom gate arm not lowering, which took over seven hours to rectify
- In June 2015, a water leak triggered an alarm that resulted in evacuation of the train control centre and shut down the entire rail network for 18 minutes during the morning peak. One hundred trains were stopped, directly affecting the 100,000 people on board, with further impacts and delays occurring during the four hours it took for the system to return to normal. In addition to the delays experienced by train users, approximately 180 roads with level crossings were effectively closed, resulting in gridlock at many locations.

<sup>18</sup> Every train service in the timetable is monitored every day of the week. Delays, cancellations or other service failures are recorded then measured to the nearest 60 seconds and 'weighted' according to the number of people estimated to be travelling on the train or tram in the time period, day of week and direction of travel. Delays to a heavily loaded peak train are given a greater value than delays to a lesser loaded off-peak train. This provides a measure of operational performance quality expressed in 'passenger weighted minutes of delay'.

## 2.3.2 PROBLEM 2: Rail corridors and excessive boom gate closures reinforce community severance and reduce local amenity

### Greater community severance and dislocation

Rail corridors in built-up residential areas form a physical barrier that can limit urban renewal and sever communities from facilities, businesses and services within their local areas.

Severance is commonly referred to as a problem that affects pedestrian movements, in particular. However, depending on the characteristics of local transport networks and the way they intersect residential areas and commercial centres, severance can also affect motorists, public transport users and cyclists.

Level crossings can exacerbate severance and have a significant impact on local communities through:

- Traffic congestion caused by queuing traffic at closed crossings, especially during peak periods
- Poor land use round rail corridors and missed opportunities for urban renewal
- Limitations on the development and function of open spaces and the local built environment
- Dividing communities into disparate halves, with diminished access to goods and services, jobs, education and housing
- Delays and increased journey times for road traffic increasing the cost of doing business
- Areas around and adjacent to level crossings not being conducive to pedestrian movements, with a negative impact on the 'walkability' of neighbourhoods
- Hampering investment decisions that hold back the economic development potential of activity centres.

### Reduced neighbourhood amenity

Level crossings can reduce neighbourhood amenity and have a significant impact on local communities through:

- Noise, such as warning bells, trains passing and traffic noise caused by stop-start traffic conditions
- Visual clutter, such as stanchions, overhead wires, flashing lights and a profusion of signs.

In community surveys of over 1,600 community members undertaken for eight level crossings from the list of 50 in the LXP, key themes emerged around enhancing the visual appeal and maintaining the character of neighbourhoods and communities.

For example, feedback from community surveys for the McKinnon level crossing indicated that respondents tended to avoid McKinnon Road and the shops in this strip due to the level crossing. Similarly, Centre Road in Bentleigh is seen as not having an inviting atmosphere due to the traffic queues caused by the level crossing. These responses suggest that removal of the level crossings may attract people back to these areas.

### Clayton Activity Centre

The Clayton Road level crossing sits within the Monash National Employment Cluster, which has a broad mix of commercial, educational, healthcare, research and industrial land use within two kilometres of the level crossing.

Plan Melbourne defines National Employment Clusters as "designated geographical concentrations of interconnected business and institutions that make a major contribution to the national economy and Melbourne's position as a global city".

The Clayton Road level crossing of the Dandenong rail corridor creates a physical and visual barrier to the development of Clayton Activity Centre and impedes access within the National Employment Cluster. As this precinct continues to grow and diversify, frequency and service upgrades are proposed along the Dandenong rail corridor. These upgrades are impeded by the level crossing.

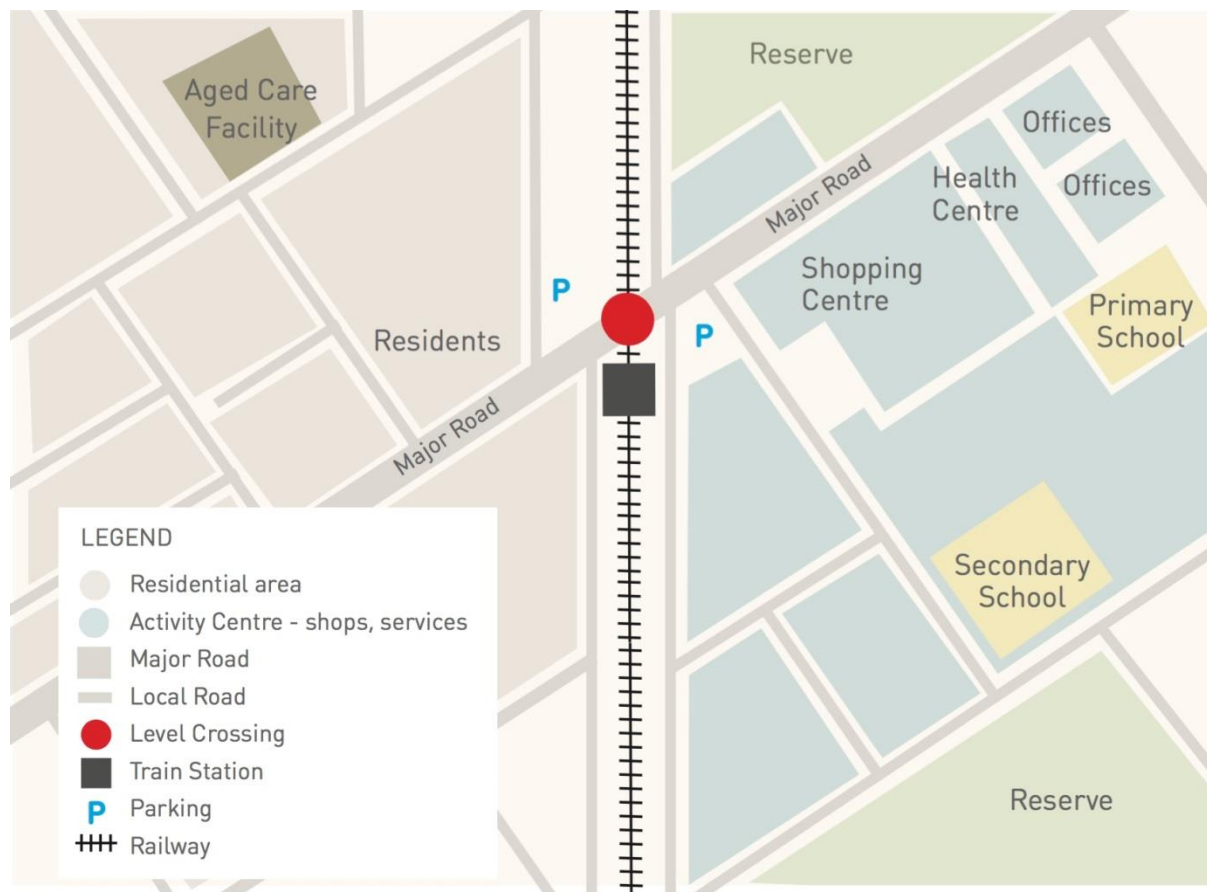
Removal of the level crossing will have a significant impact on the condition and amenity of the area and will unlock opportunities for urban regeneration, as well as mitigating existing problems. Removal of the Clayton Road level crossing will also enable improved cycling and pedestrian connections between the Clayton and Monash Medical Centre, educational facilities (Monash University) and the wider active transport network.



Congestion, community severance and poor visual amenity associated with level crossings located adjacent to activity centres can also affect the amenity, diversity and economic performance of the centre.

Railway lines act as barriers between people and activity areas. This severs communities and inhibits their access to local shops and services. The severance between residential areas and local activity areas is made worse when the only road in the area crosses the rail corridor. Instead of walking to their local shopping area, people may be tempted to drive to another shopping area that is further away but is on the same side of the railway to where they live. An example of how a railway line can sever a community is shown in Figure 2-11.

Figure 2-11: Community severance



Across Melbourne, there are 32 level crossings located within one kilometre of an activity centre, as shown in Figure 2-12. Delays within one kilometre of all level crossings are predicted to significantly increase into the future if no action is taken. These delays could reduce the accessibility of a number of activity centres, making them less attractive destinations for commercial and residential development.



Figure 2-12: Level crossings and activity centres



Source: Plan Melbourne

### Reduced walking and cycling connectivity

Twenty five level crossings being removed as part of the LXP are on Strategic Cycling Corridors (SCC). Cyclists using the SCCs are delayed as often as vehicle traffic at level crossings.

As the duration of walking and cycling trips tends to be shorter than car trips, the same delay to a pedestrian or cyclist tends to have a greater impact – that is, the delay they experience is often a greater proportion of their overall trip.

It has been identified that 32 level crossings are located within one kilometre of an activity centre and 34 level crossings are adjacent to railway stations. Activity centres and train stations are usually areas where there are higher numbers of people walking and cycling. Active forms of transport are strongly encouraged and there are many stations around Melbourne where cycling and park and ride facilities are provided.

**Strategic Cycling Corridors**

SCCs are a recent addition to bicycle network planning in metropolitan Melbourne. Identification of SCCs is part of the initiative in Plan Melbourne to ‘Support Walking and Cycling in Central Melbourne’.

These corridors are developed to improve cycling to and around major Activity Centres in metropolitan Melbourne. SCCs are a subset of the Principal Bicycle Network (PBN). They will typically be selected on the basis of providing links to a National Employment Cluster or a major Activity Centre and are routes that cater for the highest, or potentially highest, cycling volumes.

People accessing train stations by active forms of transport often have to cross the level crossing to get to them. Significant delays to those who have to cross while boom gates are down can be frustrating, particularly if they miss their train.

### Level crossings limiting urban renewal and dislocating communities

With the exception of a residential strip along one side of Station Street, Bayswater, there is limited diversity in economic activity in the **Bayswater Activity Centre**, particularly in the Bayswater Triangle, constraining its role as an important activity area. The shopping strip has relatively poor visual amenity. The lack of upgrading of buildings, shop displays, signage and the public realm has resulted in shopfronts that are cluttered, lacking in legibility and run down in many cases. The major constraint to the development of the Triangle is that the railway line and a Train Maintenance Facility (TMF) form a significant barrier separating it from the Bayswater Activity Area. The TMF also prevents access to Bayswater Station from the Triangle, limiting its development potential. The only connection between the Activity Area and the Triangle is via the rail crossings on Mountain Highway and Scoresby Road.

The level crossing at Main Road, **St Albans**, is at the centre of the activity area, at the confluence of the rail line and six roads. Congestion at this central focal point results in St Albans not performing efficiently or effectively as an Activity Centre. Community severance created by the rail line leads to traffic congestion, pedestrian congestion and poor bus terminal connections. This affects the economic viability and vibrancy of the town centre. The difficulty in transferring between transport modes means that people will be more attracted to use other stations or private vehicles to commute rather than public transport. This takes potential trade away from the Activity Centre, impacting its viability.

The **Monash Employment Cluster** has 58,500 jobs and is Melbourne's largest concentration of employment outside of the central city. The Employment Cluster has leading educational, health, research and commercialisation facilities that contribute significantly to Melbourne's economy. The full critical mass of the Cluster cannot be achieved without transient-oriented development to co-locate employment, population and public transport.

The Craigieburn railway line runs through the heart of the **Essendon Junction Activity Centre** creating barriers to pedestrian and cyclist movement and causing significant delays to traffic and road-based public transport. While the Essendon Junction Activity Centre provides an excellent range of transport options (trains, trams and buses), there is a clear lack of connections between bus, tram and train services. The absence of a dedicated modal interchange reduces the efficiency and usability of services. The removal of the level crossing is expected to significantly increase the desirability of the centre as a place to live, work and visit.

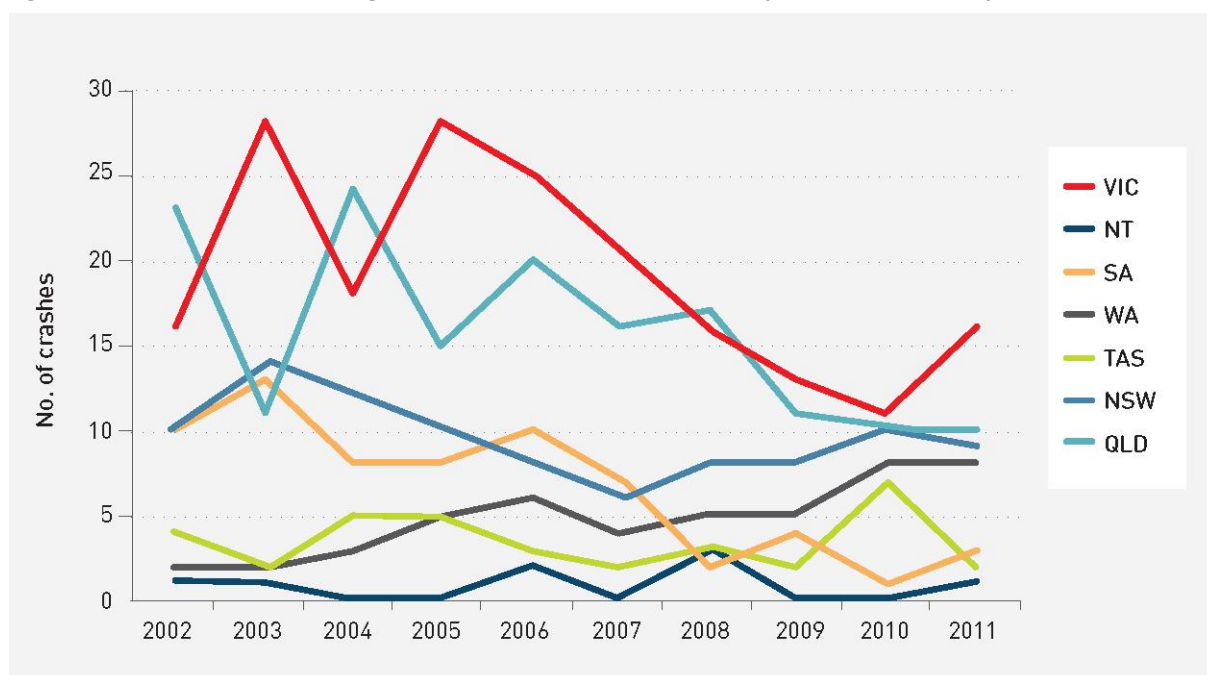
### 2.3.3 PROBLEM 3: Motor vehicle driver, cyclist and pedestrian frustration at level crossing delays invites risk-taking behaviour, causing serious incidents

#### *Risk-taking behaviour, causing serious incidents*

Of all types of road crashes, those between a motor vehicle and a train are amongst the most severe. Although relatively rare, these crashes attract community concern as the consequences have the potential to be catastrophic, often involving fatalities or serious injuries and can jeopardise the lives of a large number of people.

Collisions at level crossings in Victoria account for around one third of level crossing collisions between trains and road vehicles, and over half of all collisions between trains and pedestrians Australia-wide.

Figure 2-13: Number of level crossing crashes Australia wide, 2002 financial year to 2012 financial year



Source: Australian Transport Safety Bureau

Managing safety risks is a shared responsibility between the rail and road organisations that manage the networks, government agencies that oversee and regulate, and the people who use level crossings. Towards Zero<sup>19</sup> and Victoria's Road Safety Strategy are based on a Safe System approach to road safety that aims to minimise the risk of death or serious injury on the roads by taking into account the interaction between roads, vehicles, speeds and road users. The Safe System approach recognises that humans, as road users, are fallible and will make mistakes which result in crashes. Within the safe system model, if a mistake is made, the impact is reduced or negated by safer roads, vehicles, speeds and people. Road infrastructure plays a vital role in helping reduce crashes and minimising the severity of injuries if there is an accident at level crossings.

In the ten year period between 2005 and 2014, there have been 149 collisions between a train and road vehicle or pedestrian along a rail corridor across metropolitan Melbourne (this includes the 178 level crossings on the electrified network as well as all other level crossings across metropolitan Melbourne). Of these incidents, 38 resulted in fatalities and 22 resulted in serious injuries.<sup>20 21</sup>

<sup>19</sup> Towards Zero is a Government Initiative for a future free of deaths and serious injuries on our roads. Towards Zero group initiatives are coordinated through Victoria's Road Safety Strategy.

<sup>20</sup> Four fatalities occurred at level crossings that have since been removed and a number of fatalities occurred in between two level crossings and not at designated crossing points. Some of these incidents may be attributed to pedestrians crossing midblock to avoid delays at level crossings.

<sup>21</sup> Source: Transport Safety Victoria (TSV) data from 1 January 2005 to 18 May 2014 and National Road Safety Regulator (NRSR) data from 19 May 2014 to 31 December 2014.

Across the 50 level crossings that are part of the LXP, in the same period, there were over 60 collisions between a train and road vehicle or pedestrian, 20 of which resulted in fatalities.<sup>22</sup> As shown in Figure 2-14, risk taking behaviour is further evident with approximately 680 near-miss<sup>23</sup> incidents over the last decade, half of which involved pedestrians, reported at the 50 level crossings that are part of the LXP. Each of these near-misses had the potential to be a serious or fatal incident. Rail operators are required by law to report all near miss occurrences. However, anecdotal evidence suggests that near-misses at level crossings are far more frequent than reported given that a driver's interpretation of a near-miss can be subjective: for example, based on their perception of likelihood of impact, the level of emotional distress involved, speed of train travel and other factors.

Many level crossing users inadvertently engage in risky behaviour. Risk taking behaviour generally results from road users not detecting crossings or approaching trains, or ignoring or misjudging the risk that approaching trains pose. This could be as a result of limited crossing/train visibility, inattention, distraction, lack of knowledge regarding level crossings, and misjudgement of train speed or distance. A proportion of level crossing occurrences are due to deliberate violations of crossing rules.

Many unintentional errors can be partially explained by some road users finding it difficult to detect the signal from competing noise such as in-car distractions or other distractions or visually complex road traffic environments.

Extended boom gate closures cause some pedestrians and motorists to undertake risky crossings of the rail line while the boom gates are down or descending. Some drivers accelerate through the level crossing when the boom gates are about to close to avoid delay; some attempt to drive through crossing sites when boom gates are closed for unusually extended periods; or drivers can sometimes find themselves queuing across the rail line at sites where crossings are in very close proximity to intersections. This behaviour exposes drivers to an unpredictable environment, increasing the risk of injury or death.<sup>24</sup>

Of the 50 level crossings that are part of the LXP, Main Road, Centre Road, Bentleigh and Clayton Road show the highest number of pedestrian incidences with trains – all of which are due to higher pedestrian volumes in these major activity areas.

Grange Road, Heatherton Road and South Gippsland Highway crossings have the highest number of incidents involving vehicles, which is likely due to each site being in close proximity to nearby intersections. For example, the Grange Road and South Gippsland Highway crossings are in close proximity to major intersections with the Princess Highway and the Heatherton Road crossing is nearby to a roundabout.

In the 2010, 2012 and 2014 Royal Automobile Club of Victoria (RACV) Redspot Surveys, level crossings feature in the top 10 nominated congestion Redspots. In the 2014 survey, six of the top 10 sites were level crossing sites or roads in close proximity to a level crossing, highlighting ongoing community frustration with level crossings.

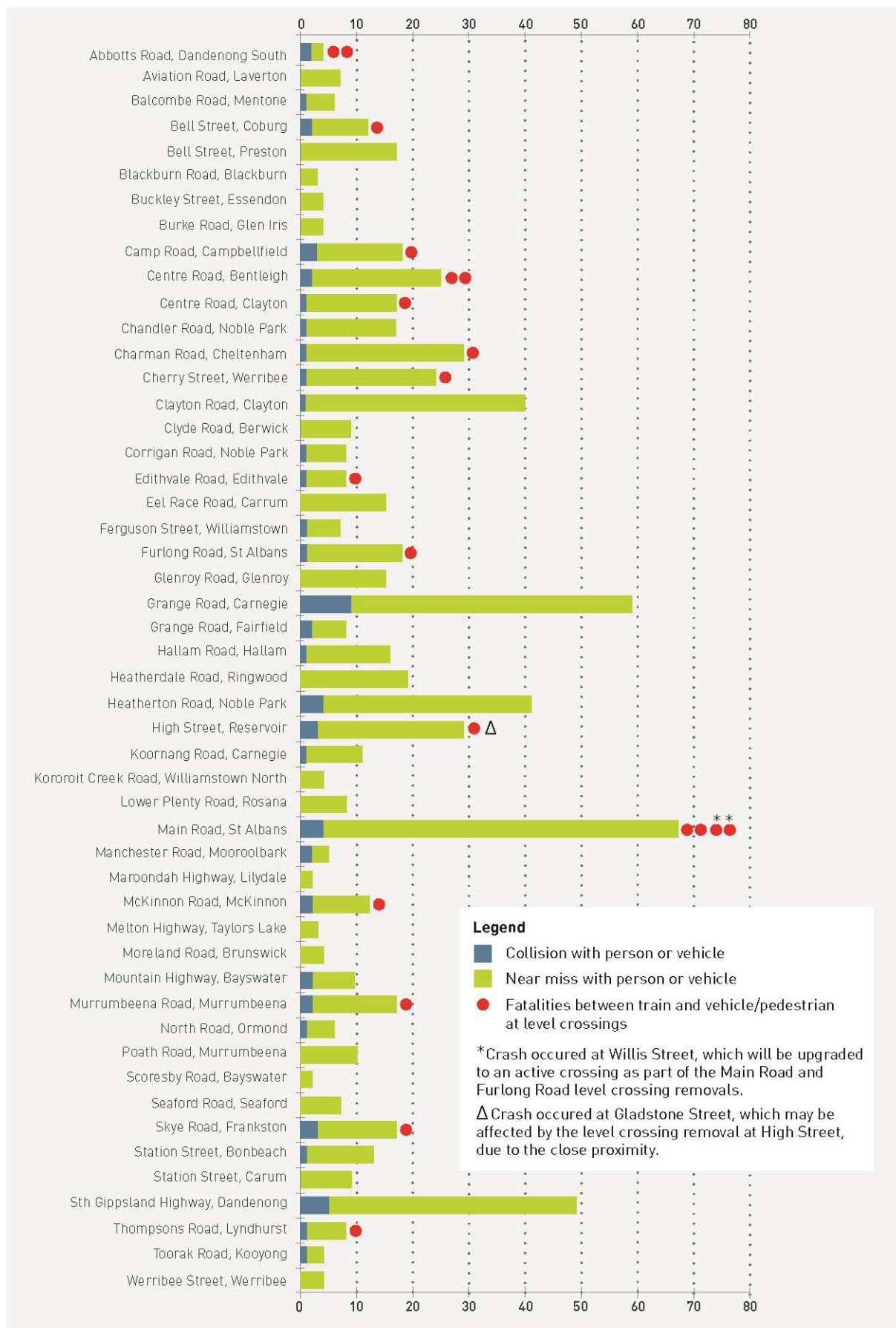
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<sup>22</sup> Detailed fatality information from Transport Safety Victoria, National Rail Safety Regulator and Road Crash Statistic Information, for the ten year period between 2005 and 2014 is provided in Appendix A.

<sup>23</sup> A near miss is any occurrence where the driver of a moving train takes emergency action, or would have if there was sufficient time, to avoid impact with a person, vehicle or other obstruction and no collision occurred. (Rail Safety Regulators Panel 2008a, p15)

<sup>24</sup> Source: Cooperative Research Centre for Rail Innovation Australia, An investigation of risk-takers at railway level crossings, 2012, Dr Amelia Searle, Prof Lee Di Milia and Prof Drew Dawson

Figure 2-14: Incidents involving trains with pedestrians or vehicles – last 10 years up to 31 December 2014



Source: Transport Safety Victoria, National Rail Safety Regulator



### **Risk of heavy vehicle crashes**

With the increasing number and size of heavy vehicles, the probability of a crash between a train and a heavy vehicle increases. Fatalities are not the only concern. Heavy vehicle crashes with trains can also impact on the safety of train passengers.

As well as causing loss of life and serious injury, the financial cost of these crashes can be substantial. There are medical and hospital expenses, the repair of tracks, trains, roads and vehicles, as well as the economic disruption to business and trade.

There are an increasing number of heavy vehicles in Australia. The Freight Movement Model indicates there are currently about 300,000 truck trips generated per day around Melbourne. By 2046, the number of trips undertaken by heavy road freight vehicles within Melbourne is forecast to more than double, to nearly 650,000 movements a day.<sup>26</sup>

Neither trains nor heavy vehicles travelling at high speed are able to swerve and stop in an emergency. Accordingly, increased activity on rail and road and consequentially at level crossings, can only lead to increased risk.<sup>27</sup>



*Collision at Springvale Road, Springvale level crossing*

***It is clear that level crossings are a major constraint to the viability of Melbourne's road and rail networks and to delivering the upgrades in rail capacity needed to support a growing city. Level crossings also present a safety risk, contribute to reduced local amenity and limit opportunities for urban renewal and residential and commercial development. These problems generate significant costs for individuals and businesses and erode Melbourne's liveability, accessibility and productivity.***

<sup>26</sup> *Victoria the Freight State*, August 2013

<sup>27</sup> *Inquiry into Improving Safety at Level Crossings – Report of the Road Safety Committee on the Inquiry into Improving Road Safety at Level Crossings*, Parliamentary Paper No. 170, 11 December 2008.

*Commercial-in-Confidence information has been redacted prior to publication*



## Chapter 3

### The imperative for change



### CHAPTER 3: THE IMPERATIVE FOR CHANGE - SUMMARY

The LXRP is being delivered within the context of a strongly growing Melbourne, where the population is increasing at an unprecedented rate and the demand for travel is expected to escalate over the coming decades.

Melbourne today is home to around 4.3 million people and is Australia's fastest growing city. The population is growing at an unprecedented rate and is forecast to reach 7.8 million people by 2051. This growth over the next 25 years will support an additional 1.7 million jobs.

As Melbourne grows, so does the demand for travel on the city's road and rail networks:

- Increasing demand on the road network is resulting in more cars on the road and more delays
- Increasing demand on the rail network is resulting in overcrowding and delays

A well-connected transport network is critical to Melbourne's liveability, but also to its economic activity, productivity and competitiveness. Without action being taken to remove level crossings, the network's connectivity and accessibility will be compromised and the problems identified in Chapter 2 will be exacerbated even further.

If we do not remove level crossings:

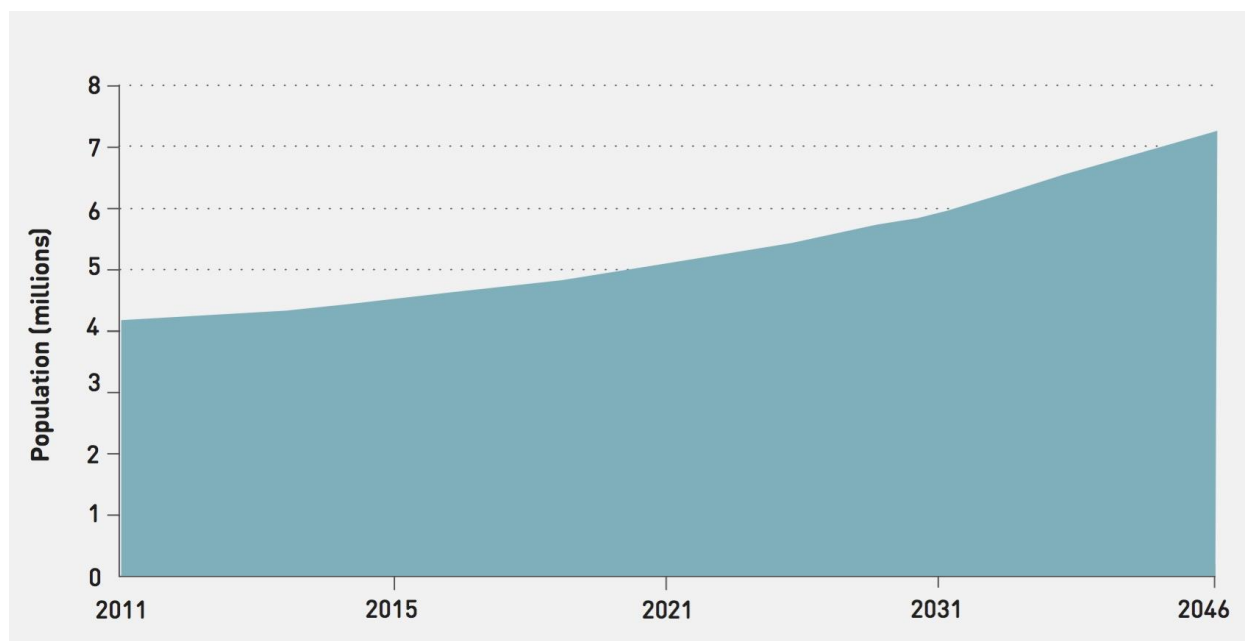
- journey times and the variability of journey times for private, business and freight vehicles across Melbourne's road network will increase
- vehicle operating costs will increase
- collision costs will increase
- public transport users will experience longer travel times on road-based public transport (buses and trams), overcrowded trains, reduced station amenity and delays to train services
- public transport becomes a less attractive travel option (especially for commuting), with flow-on impacts for the city's road network
- we will be unable to operate higher rail service frequencies in peak periods without extending boom gate closures even further and creating more delays for road users. This will impact on planned rail capacity upgrades, including the Cranbourne-Pakenham Line Upgrade (CPLU) and the Metro Tunnel
- community amenity and local accessibility will not improve
- the connectivity and accessibility of Melbourne's transport network will reduce, eroding the city's liveability
- opportunities for economic development, higher productivity and jobs growth will be limited

## 3 The imperative for change

### 3.1 Unprecedented population growth

Melbourne today is home to around 4.3 million people and is Australia's fastest growing city, having added over 600,000 residents in the past decade. This strong population growth is expected to continue, with Melbourne forecast to reach five million by 2020 and six million by 2031. By 2051, over 7.8 million people are expected to be living in Melbourne,<sup>28</sup> potentially making it Australia's largest city.

Figure 3-1: Projected population growth in Melbourne



Source: Victoria in Future 2014

Absorbing an additional two million people in less than 20 years is unprecedented in Melbourne's history and is already generating challenges, most notably from increased travel demand, such as movement of people and goods and reduced accessibility, and a growing divergence between infrastructure provision and the needs of high growth areas.

There are distinct patterns in the geographic distribution of Melbourne's population growth:

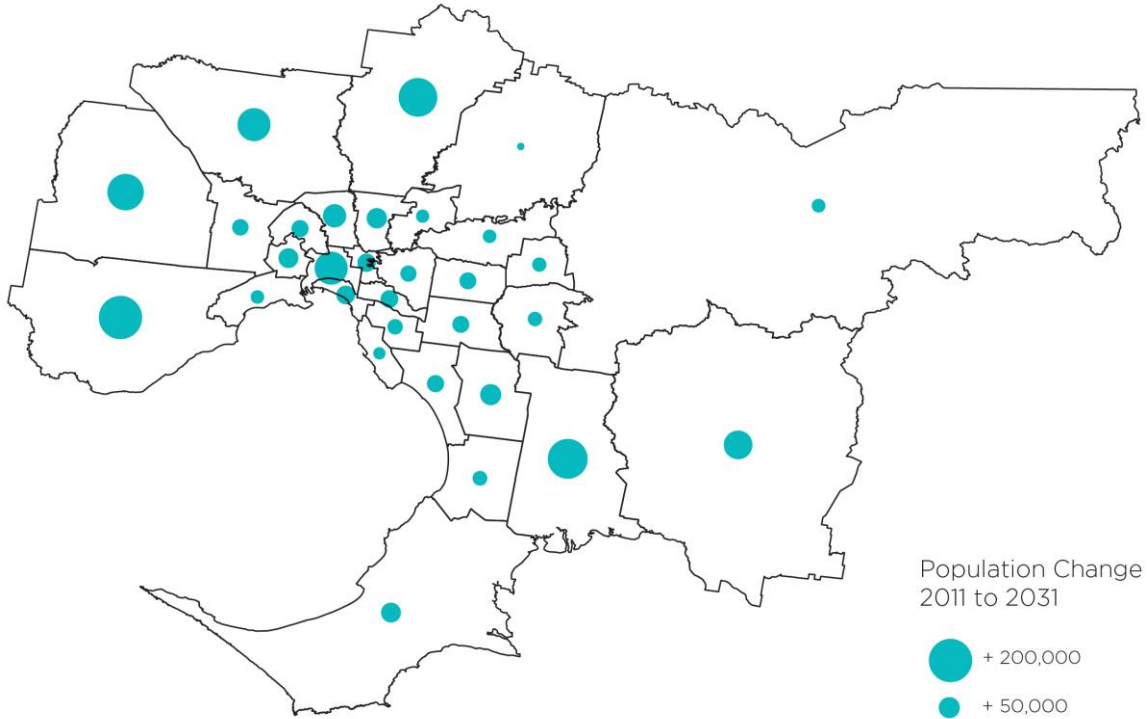
- Population growth has been strongest on the outskirts of the city, with the four municipalities with the largest growth since 2007 – Wyndham, Casey, Whittlesea and Melton and Hume – all located on the city's fringe.
- The population of the city centre is growing markedly, with the City of Melbourne experiencing average (compound) annual population growth of 4.3 per cent from 2007 to 2012.

These patterns are forecast to continue. The following figures show where Melbourne's population growth over the next 15 years is expected to be concentrated.

<sup>28</sup> Victoria In Future 2014

Figure 3-2 shows the total population growth (increase in number of people) by local government area (LGA). This map indicates that growth will be greatest in Melbourne's outer areas, particularly the west, north and south east.

Figure 3-2: Total population change by LGA, 2011 – 2031



Source: Victoria in Future 2014

## 3.2 An increasing demand for travel

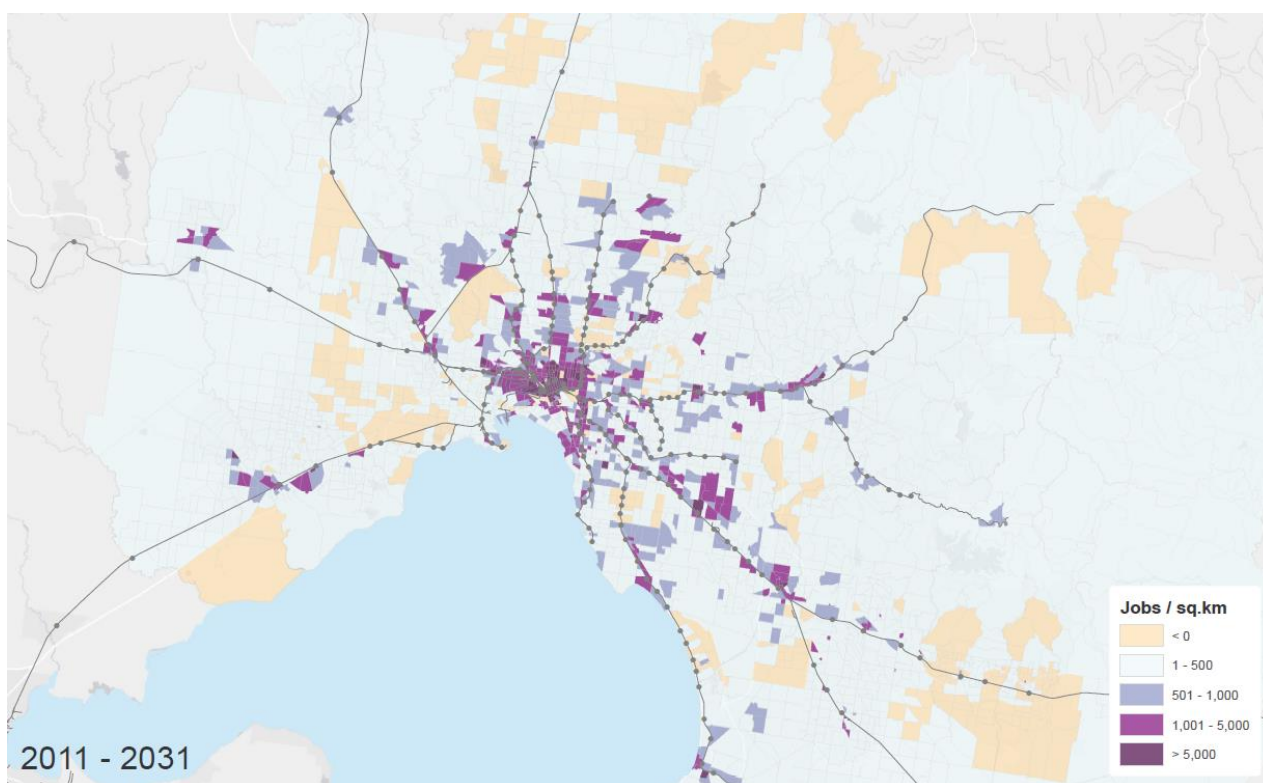
### 3.2.1 Overall travel demand

As Melbourne's population increases, so does the demand for travel. People make on average 3.5 trips per day to go to school, to go to work and to move around our city. With more people, are more trips. More people will need to get to and from work and education each day; more people will access services around the city; and more and more goods will be moving around the city and through the city's ports, airports and freight terminals.

Over the last decade, there has been a substantial increase in the demand for travel, which is expected to continue to increase in tandem with population growth. High growth in outer urban areas is also generating additional transport demand.

Melbourne's growth over the next few decades will add 1.7 million jobs in Melbourne by 2051<sup>29</sup> – and these jobs are expected to be created not only within existing employment centres, including the CBD and other employment clusters such as Parkville and Monash, but also in emerging employment clusters, such as La Trobe and Sunshine. The projected concentrations of employment are shown in the figure below.

Figure 3-3: Projected change in employment density from 2011 to 2031



Source: DEDJTR VITM inputs – forecast land use

<sup>29</sup> Plan Melbourne, pg 23

### Transport projections using the Victorian Integrated Transport Model

To help understand the problems associated with level crossings and the benefits achieved by removing them, LXRA undertook transport modelling using the State Government's strategic transport model, the Victorian Integrated Transport Model (VITM).

VITM forecasts the number of trips to be made based on the current and future land use (population, jobs, and educational enrolments). It determines the origins and destinations of motorised trips – or where people and goods are coming from and going to – and the mode of transport they are using – private vehicle, public transport, walking and cycling. Whilst VITM does not technically determine the origin and destination of walking and cycling trips, it does determine how many of these trips are generated per transport zone.

The model uses the official population forecasts from *Victoria in Future 2014* and forecast land use determined by the *Department of Economic Development, Jobs, Transport and Resources*.

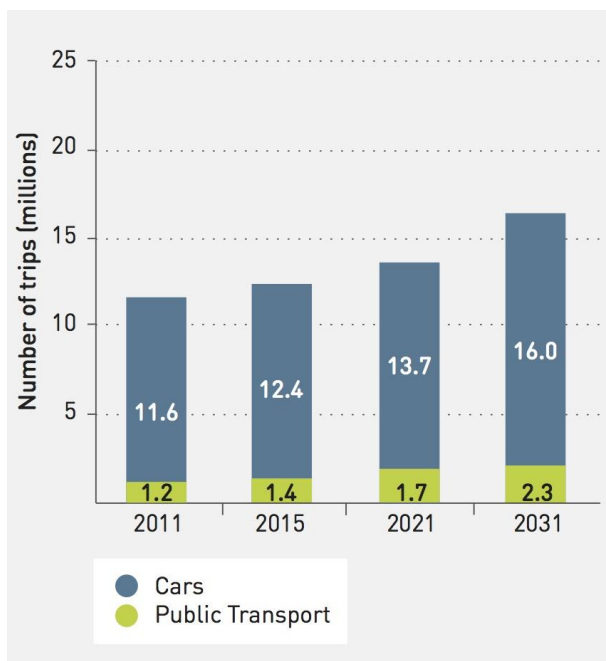
Transport modelling allows us to estimate what the future looks like under different investment scenarios – what happens if we do not remove level crossings? This is the base case. What happens if we *do* remove level crossings? This is the project case.

The complex nature of the Level Crossing Removal Project (LXRP) and its interdependencies with both Cranbourne Pakenham Line Upgrade (CPLU) and Metro Tunnel means that the level of road congestion around level crossings as a result of lengthy boom gate closures due to very high service frequencies on the Cranbourne-Pakenham Line, in particular, would be an unrealistic and unacceptable situation. A VITM modelling scenario, with level crossings remaining, without CPLU and Metro Tunnel, has been developed. All forecast future results presented in this chapter, assume that CPLU and Metro Tunnel do not go ahead without the LXRP. This means that the future with no level crossing removals does not have CLPU or Metro Tunnel in it either.

Other VITM runs representing different investment scenarios have been used to assess the benefits of the LXRP, as described in Section 8.3. Details of the modelling assumptions in each scenario are contained in Appendix D (redacted).

Note: level crossings cause adverse impacts to the transport network throughout the entire day. Results for the morning peak have been presented in this chapter given that a high proportion of people are on the move during this period.

Figure 3-4: Projected person trips, per day, on an average weekday



Source: VITM model projections of person trips under current and future transport network and public transport frequency, level crossing remaining, without CPLU and Metro Tunnel

Note: per person trips (cars) takes into account that cars can hold multiple people

The increasing demand for travel is already straining Melbourne's road and public transport networks and these pressures are set to intensify as the city continues to expand, leading to worsening problems and higher costs.

By 2031, person trips per day are projected to increase by over 40 per cent compared to the number of trips in 2011, with the proportion of trips made by public transport increasing from 9.4 per cent to 12.6 per cent.

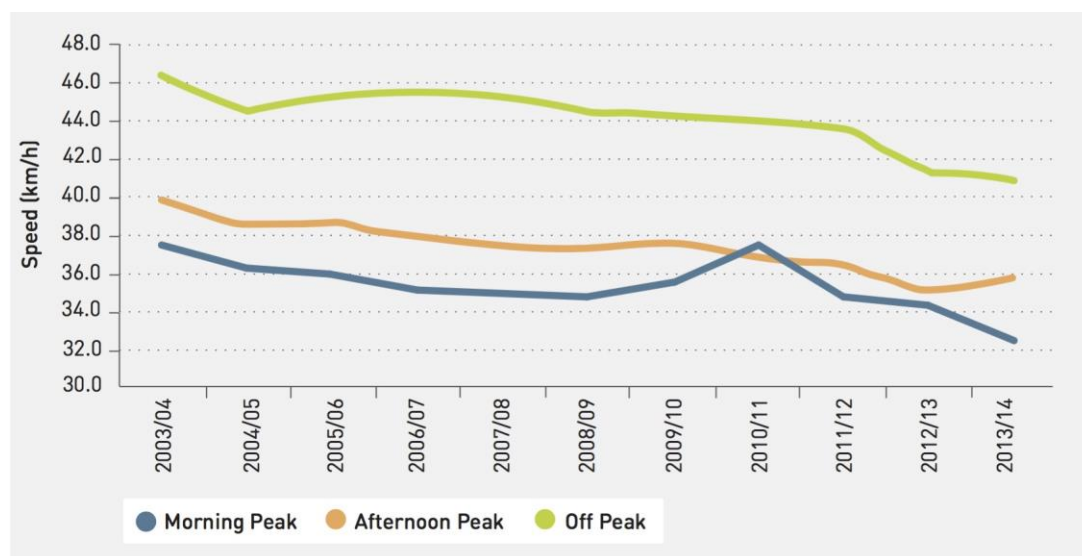
Figure 3-4 shows that even if public transport use doubles, most trips will still be made by private vehicles on the road network.

### 3.2.2 Road network: more demand, more vehicles, more buses

Over the last decade, there has been a major expansion in vehicle travel in Melbourne: a 17 per cent growth in vehicle kilometres travelled on the monitored road network.<sup>30</sup> While vehicle kilometres are growing, travel speeds are declining – this is often the case when roads fill up.

Figure 3-5 shows that the average travel speeds over the last decade have declined by 5 km/h (or 13 per cent) in the morning peak and by 4 km/h (10 per cent) in the evening peak. Off peak travel speeds, which are typically faster than in the peak hours, now come close to resembling the evening peak speeds of a decade ago.

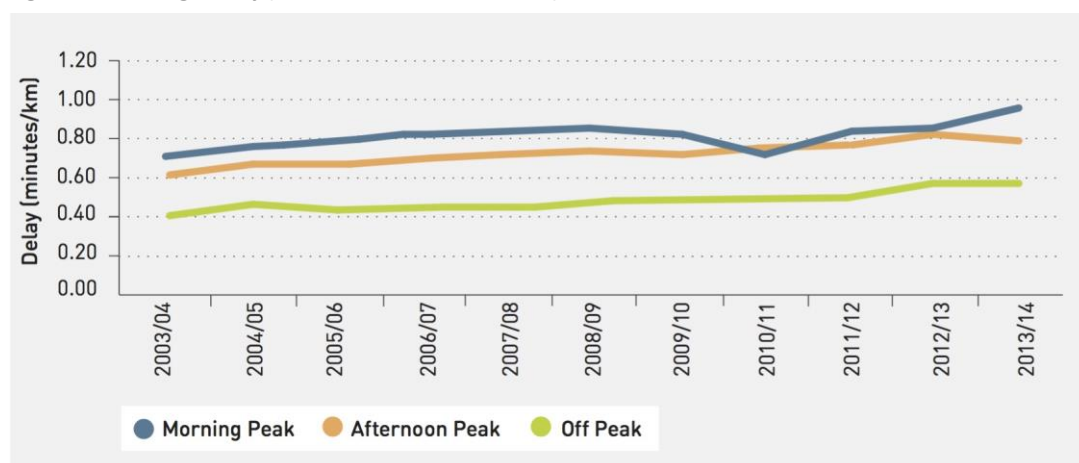
Figure 3-5: Average travel speed (on monitored road network)



Source: VicRoads Traffic Monitor 2013-14

When average travel speeds reduce, the travel times go up and people take longer to get where they are going than they should. Delay – excess travel time over the posted speed limit due to traffic, traffic signals and incidents – has grown steadily. For example, as shown in the figure below, morning peak delays have risen from 42 seconds per kilometre to almost one minute per kilometre, meaning a 20-kilometre trip now takes an average of five minutes longer than it did 10 years ago.

Figure 3-6: Average delay (on monitored road network)



Source: VicRoads Traffic Monitor 2013-14

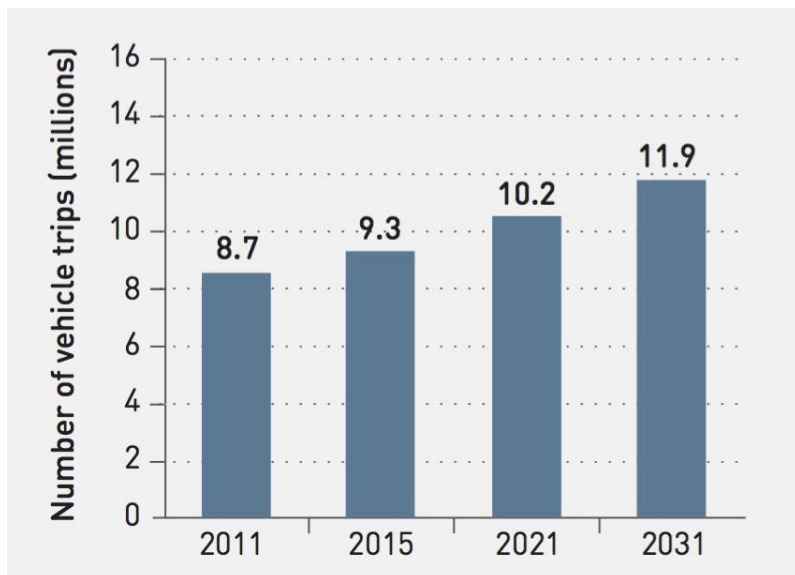
<sup>30</sup> The monitored road network includes all freeways and a sample of 22 per cent of arterial roads. Note that due to differences in the geographical coverage of the monitored road network and the road network represented in transport models, historical data and trends for the monitored network cannot be directly compared to forward-looking projections from transport models.

Assuming the program of 50 level crossing removals, CPLU and Metro Tunnel do not proceed, but other projects continue as planned, transport modelling undertaken for the LXRП estimates that road traffic will grow by a similar rate to that seen over the past decade: around 1.5 per cent per annum<sup>31</sup>.

Between 2011 and 2031, this amounts to a 37 per cent growth in both the number and total distance of vehicle trips.

Figure 3-7 shows the number of vehicle trips made on an average weekday in Melbourne increasing from 8.7 million in 2011 to 11.9 million in 2031.

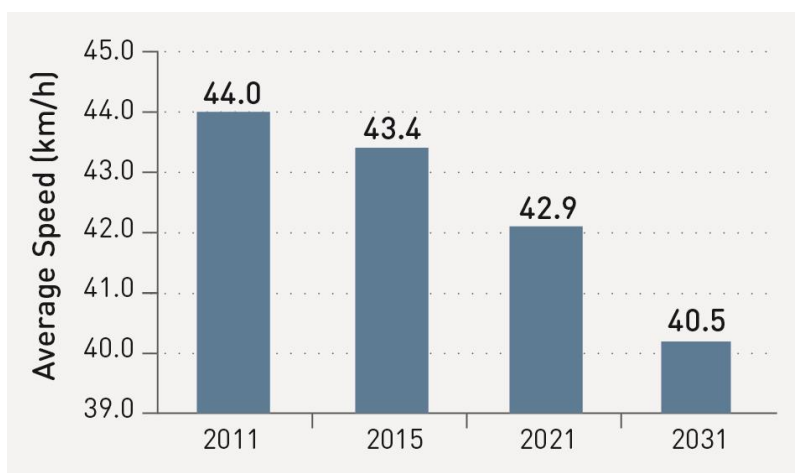
Figure 3-7: Projected road use, daily average weekday – number of vehicle trips



Source: VITM model projections of vehicle trips under current and future transport network and public transport frequency, level crossing remaining, without CPLU and Metro Tunnel

The number of Vehicle kilometres travelled is also expected to increase from 98.3 million in 2011 to 134.1 million in 2031.<sup>32</sup> In line with these trends, average travel speeds are expected to continue declining from 44 kilometres per hour in 2011 to 40.5 kilometres per hour in 2031, as shown in Figure 3-8.<sup>33</sup>

Figure 3-8: Projected average daily speeds on road network, average weekday



Source: VITM model projections of road network speeds under current and future transport network and public transport frequency, level crossing remaining, without CPLU and Metro Tunnel.

<sup>31</sup> VicRoads Traffic Monitor 2013

<sup>32</sup> VITM model projections of vehicle kilometres travelled under current and future transport network and public transport frequency, level crossing remaining, without CPLU and Metro Tunnel

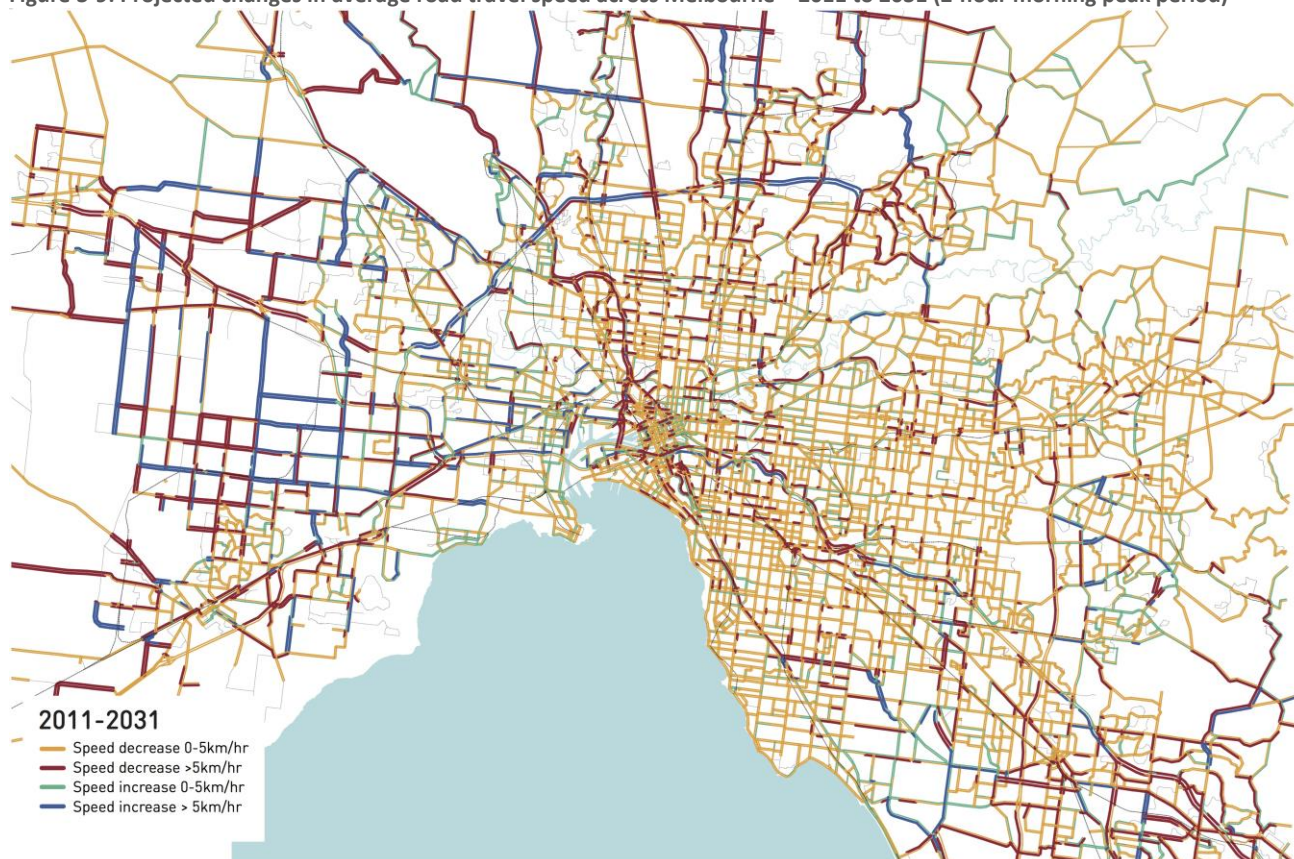
<sup>33</sup> Note the VITM average speed figures are not directly comparable to the historical data presented earlier for the VicRoads monitored road network. Figures 3–7 and 3-8 assume future planned transport projects and improvements are in place, that all LXRП level crossings remain and the CPLU and Metro Tunnel are not delivered.



Transport model projections also provide information on where the greatest increases in road traffic growth are expected to occur.

As road traffic grows, average travel speed is expected to deteriorate across significant portions of the road network. Figure 3-9 shows roads where speeds are expected to decrease by 0-5 kilometres per hour and in excess of 5 kilometres per hour (roads coloured in orange and red, respectively). The figure also shows roads where speeds are expected to increase by 0-5 kilometres per hour and in excess of 5 kilometres per hour (roads coloured in green and blue, respectively). The figure shows that people travelling in parts of the west are expected to have increasing travel speeds, which may be attributable to new developments and roads planned for the area.

Figure 3-9: Projected changes in average road travel speed across Melbourne – 2011 to 2031 (2-hour morning peak period)



Source: VITM model projections of average road network speed under current and future transport network and public transport frequency, level crossing remaining, without CPLU and Metro Tunnel

Road congestion is often expressed in terms of the ratio of traffic volumes to a measure of the theoretical maximum capacity of a road: the Volume/Capacity (V/C) ratio. As V/C ratios approach 1.0, roads become full and sensitive to change leading to excessive delays, queues and a decline in travel speeds. Many roads, particularly in the inner areas of Melbourne, are already approaching and exceeding this benchmark. V/C ratios are expected to worsen by 2031, particularly in the growth areas of the outer west, north and south-east. V/C maps for 2011 and 2031 are attached in Appendix A.

VITM transport model projections of future road network use show an increasing number of trips, vehicle kilometres travelled and vehicle hours travelled (for cars and trucks) with a steadily growing proportion of trips made by public transport. By 2031, an extra 3.2 million vehicle *trips* (cars and trucks) will be made daily on the road network, with an additional 1.1 million vehicle *hours* (cars and trucks) travelled (level crossing remaining, without CPLU and Metro Tunnel).

Areas in close proximity to rail corridors potentially face the worst impacts to traffic flow as rail services and boom gate closures increase in future. Transport model projections of future demand across significant rail corridors (or modelling screen lines) show a general increase in traffic volumes and decrease in travel speed over the corridors. The percentage of links, within these corridors, with V/C ratios approaching capacity<sup>34</sup> is increasing with some corridors seeing up to 40 per cent of all links approaching capacity in the peak periods by 2031. Road network use projections for key rail corridors are attached in Appendix A.

As road traffic volumes increase throughout Melbourne, the principal economic disbenefits of not removing level crossings are:

- Increased journey times and variability in journey times for private, business and freight vehicles across Melbourne’s road network;
- Increased vehicle operating costs;
- Public transport user disbenefits, such as impacts to travel times for road based public transport, overcrowded train services and reduced station amenity; and
- Accident costs.

**Table 3-1: Melbourne wide projections of future transport network use**

	Average weekday change from 2011 to 2031
Number of vehicle trips (cars and trucks)	3.2 million more vehicle trips per day
Proportion of public transport trips (%)	3.1 percent increase in public transport mode share per day
Vehicle Kilometres Travelled (VKT) – cars and trucks	35.9 million more vehicle kilometres travelled
Vehicle Hours Travelled (VHT) – cars and trucks	An extra 1.1 million hours travelled
Mean speed (Km/h) – cars and trucks	Mean travel speed reduced by 3.5 km/h
Network with V/C at or over 0.8 (%)	5.6 percent more of the road network approaching capacity

Source: VITM model projections under current and future transport network and public transport frequency, level crossings remaining, without CPLU and Metro Tunnel

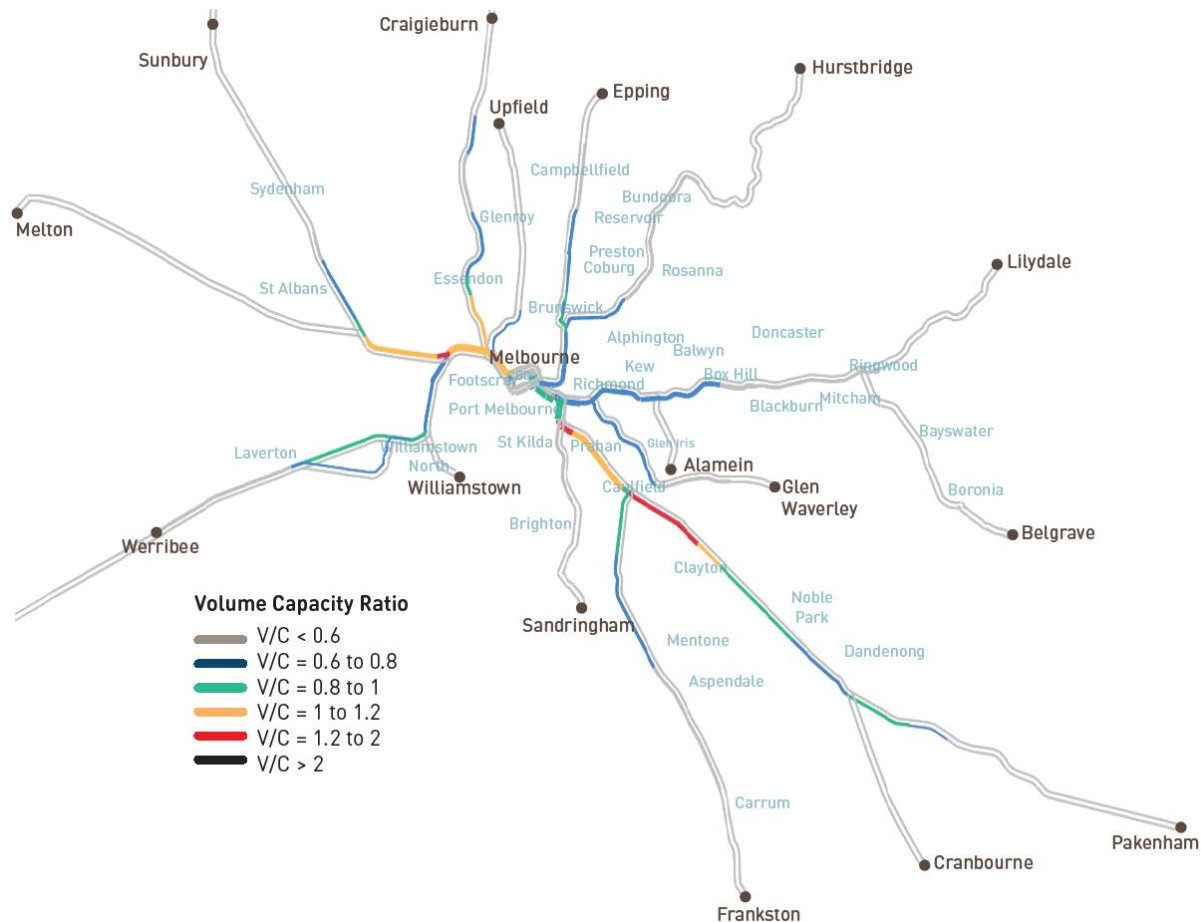
<sup>34</sup> V/C ratio is the ratio of traffic demand to road capacity and is used to measure the roadways performance. V/C ratio of 0.8-0.89 represents significant congestion on critical approaches, but roads are still functional.

### 3.2.3 Rail network: more passengers, more crowding, more delays

Population growth, road congestion, petrol price rises and greater environmental awareness have all contributed to more Melbournians using public transport. Trains are able to carry more than 1,000 passengers with the potential to carry 40,000 passengers per hour on a single line. Without rail to move high volumes of people, traffic on Melbourne’s roads would be unmanageable.

Patronage on Melbourne’s trains has grown by 70 per cent over the last decade with average weekday boarding on metropolitan trains forecast to double to 1.5 million by 2031<sup>35</sup>. As shown in orange and red in Figure 3-10, the rail network is already significantly constrained in places in 2011, particularly on the Dandenong and Northern groups.<sup>36</sup>

Figure 3-10: 2011 rail volume/capacity ratios – morning peak



Source: VITM model 2011 rail patronage. Capacity is based on rail vehicle load standard<sup>37</sup>

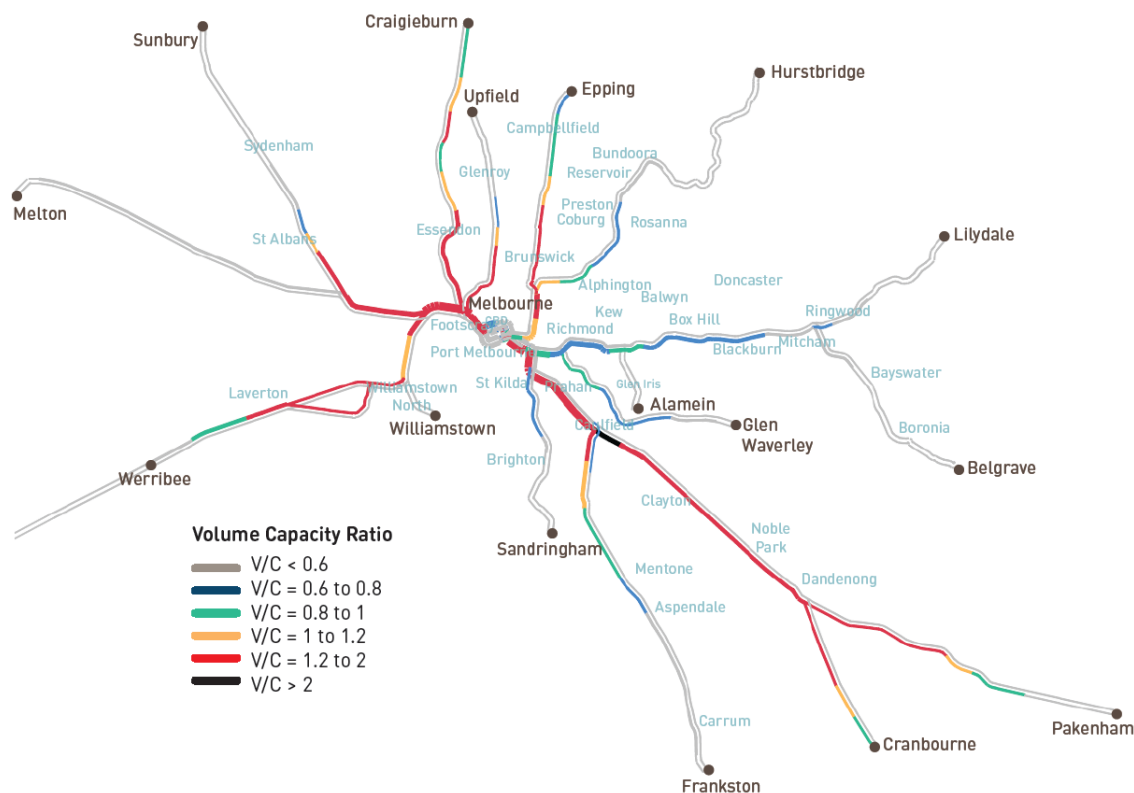
Figure 3-11 illustrates how severely constrained the majority of the metropolitan rail network is forecast to become if the number of rail services is not increased to cater for growing patronage demand. Almost every rail line would have sections that exceed capacity, shown in orange, red and black. Passengers at stations along these constrained sections will not be able to board trains.

<sup>35</sup> PTV patronage forecast

<sup>36</sup> Dandenong Group: Pakenham, Cranbourne and Dandenong Lines. Northern Group: Sunbury, Sydenham, Craigieburn and Upfield Lines.

<sup>37</sup> Vehicle load standard is defined in the rail franchise agreement between Public Transport Victoria and Metro Trains Melbourne, and represents the maximum number of passengers that should be planned to be loaded on a train.

Figure 3-11: 2011 rail frequency with future (2031) patronage demand, rail volume/capacity ratio – morning peak



Source: VITM model 2011 service levels with 2031 rail patronage. Capacity is based on rail vehicle load standard

**How would Melbourne’s road networks cope in 2031 with rail services constrained to 2011 service levels?**

In future the road network will be a lot busier if rail services are not improved and the capacity of the rail network is not increased.

Transport modelling shows that if public transport (rail services) is kept at current timetables (and capacity), and improvements are made to the road network, a significantly higher number of trips are forecast to be made on the road network rather than the public transport network. If rail services are not improved in future, an extra 146,000 trips are forecast to be made by car on the road network.

Table 3-2: Melbourne wide projections of future road network use, with rail services constrained

	Average weekday change
Number of car trips	Increase of 146,000 car trips each day
Vehicle Kilometres Travelled	Increase of 1,944,000 vehicle kilometres travelled each day
Vehicle Hours Travelled	Increase of 232,000 vehicles hours travelled each day
Mean speed	Decrease of the average travel speed by 1.3km/h

Source: VITM model projections with future travel demand, PT services constrained at 2011 levels, and with level crossings remaining

There has been unprecedented patronage growth on Melbourne’s metropolitan rail network over the past decade. Patronage has grown by 67 per cent from 2003-04 to 2012-13.

The unanticipated growth in patronage on the metropolitan railway in the years has a number of undesirable outcomes for the travelling public and the community generally, such as overcrowding and users having to travel at non-preferred off peak times and/or seek alternative modes of transport. These spill-over effects result in reduced productivity (in accessing employment and services) and increased transport congestion on other modes (particularly on roads) leading to an increase in travel and environmental costs.

Counts of patrons at the stations<sup>38</sup> immediately outside the CBD and patronage growth are used to determine when and where extra services may be needed to reduce crowding. A summary of these counts conducted by PTV in May and October of each year from 7am to 9am on weekdays is shown in Table 3-3.

Although overall annual train patronage growth appears to have flattened somewhat in the last few years, Table 3-3 shows that weekday *peak period* patronage has continued to increase.

**Table 3-3: Patronage counts at stations immediately outside the CBD, 2011 and 2014**

Group	Average daily count 2011 (actual)	Average daily count 2014 (actual)	Annual Average peak period growth rate (2011-2014)
Northern	39,985	44,249	3.4%
Clifton Hill	17,281	21,001	6.7%
Burnley	30,966	35,545	4.7%
Caulfield	38,150	41,438	2.8%
<b>Total Metro</b>	<b>126,382</b>	<b>142,233</b>	<b>3.6%</b>

Source: PTV Cordon Counts 2011 and 2014

Metropolitan Train Load Standard Surveys are conducted once a year in May to measure passenger loads against benchmark standards of capacity, which is 900 people on board. The rapid growth in patronage experienced over the last decade has resulted in capacity shortfalls and overcrowding, as evidenced by the number of services operating above the benchmark, i.e. with passenger loads that do not meet the PTV standard. The survey's findings help pinpoint which sections of Melbourne's rail line passenger loads are at their highest and at what times.

Table 3-4 shows the May 2015 survey for the morning peak period recorded a total of 47 services where passenger loads did not meet PTV standards; an increase on May 2014. The statistics also show that over a quarter of passengers travelling in the morning peak are on a crowded train.

In the 12 months to May 2015, three additional morning peak period services were introduced to the network. However, the percentage of passengers travelling on services exceeding the benchmark during the morning peak period continues to increase. Approximately a quarter of passengers travelling during the morning peak in 2015 are on an overcrowded train.

**Table 3-4: Morning Peak services benchmark levels (May 2009 to May 2015)**

	May 2009	May 2010	May 2011	May 2012	May 2013	May 2014	May 2015
Total number of morning peak services	210	211	232	237	246	248	251
Number of morning peak services above benchmark	54	64	42	45	31	41	47
% of morning peak services above benchmark	25.7	30.3	18.1	19.0	12.6	16.5	18.7
% of morning peak passengers on services above benchmark	35.8	41.4	25.7	26.1	17.8	22.1	26.1

Source: PTV Metropolitan Train Load Standard Survey

<sup>38</sup> The stations are North Melbourne, Richmond and Jolimont – these are known as “cordon” stations.

Average weekday boardings on metropolitan trains are forecast to more than double from 750,000 to 1.5 million by 2031. Across the network, the number of people travelling into the city in the morning peak is expected to grow by up to 65% by 2031 (from 2015). The rail lines serving Melbourne's growth corridors in the north, west and south-east will experience the highest levels of patronage growth.<sup>39</sup>

Overcrowding has a significant impact on train reliability and punctuality, particularly during peak times. As more passengers load onto train services, the dwell time at stations is extended which may impact on the punctuality of train services. This has a significant impact on the liveability of Melbourne.

Overcrowding and delays have a number of consequences for public transport users, including:

- Increased travel times – overcrowding on trains increases travel times as trains require longer periods at each station for passengers to board and alight. The cost to public transport users is foregone work and/or leisure time.
- Discomfort from overcrowding – the cost of crowding reflects the discomfort passengers feel from travelling in varying levels of crowded conditions. As the overcrowding becomes more severe, some people will not be able to board trains under normal operating conditions, resulting in some public transport users being diverted to road use. Commuters who experience crowded public transport journeys experience higher levels of commuting stress – associated with the increased invasion of personal space and uncomfortable and cramped conditions<sup>40</sup>

Metro Trains Melbourne's performance data shows that the Pakenham, Cranbourne and Frankston lines are the worst performing of all its services, with punctuality being 89 per cent, 90 per cent and 90 per cent, respectively, compared to 92.5 per cent across the whole network.<sup>41</sup>

## Rail network improvements

Public Transport Victoria has developed a plan based on rail capacity, to provide a 130 per cent increase in rail capacity within 20 years and move to a 'metro style' rail system.

PTV's 2012 *Network Development Plan – Metropolitan Rail* explains how Melbourne's rail network will evolve to meet the needs of train passengers in the short, medium and long term. Removing level crossings is a key component of PTV's plans to expand the capacity of the network to meet the travel needs of a growing population. The Plan includes aspirations to redesign train services to integrate seamlessly with trams and buses, and transform Melbourne's rail network into a metro-style system with increased service frequency. It should be noted that PTV's Network Development Plan is an aspirational plan for the increase of rail capacity based on PTV transport modelling. It is not Government Policy nor is it a committed program of service upgrades.

### Moving to a metro-style system

Metro-style rail systems feature:

- Frequent 'turn up and go' services
- Stand-alone, end-to-end lines where service disruptions on one line do not cascade across other lines, causing delays
- Separate train fleets, maintenance and stabling facilities for each line
- Modern signalling technology to maximise the number of trains that can operate on each line
- High capacity trains designed for quick boarding and alighting.

Level crossing removals support these features, allowing services to run more frequently and maintaining the reliability of services and timetables across the system.

The *Network Development Plan* envisages level crossing removals in locations where increasing train numbers are causing unacceptable traffic delays, beginning with the Caulfield-Dandenong corridor.

Other critical elements of PTV's metro-style system – stand-alone end-to-end lines, 'turn up and go' frequencies, and high-capacity trains and signalling – are being advanced through a major purchase of rolling stock under the Cranbourne-Pakenham Line Upgrade (CPLU) and through planning for the Metro Tunnel.

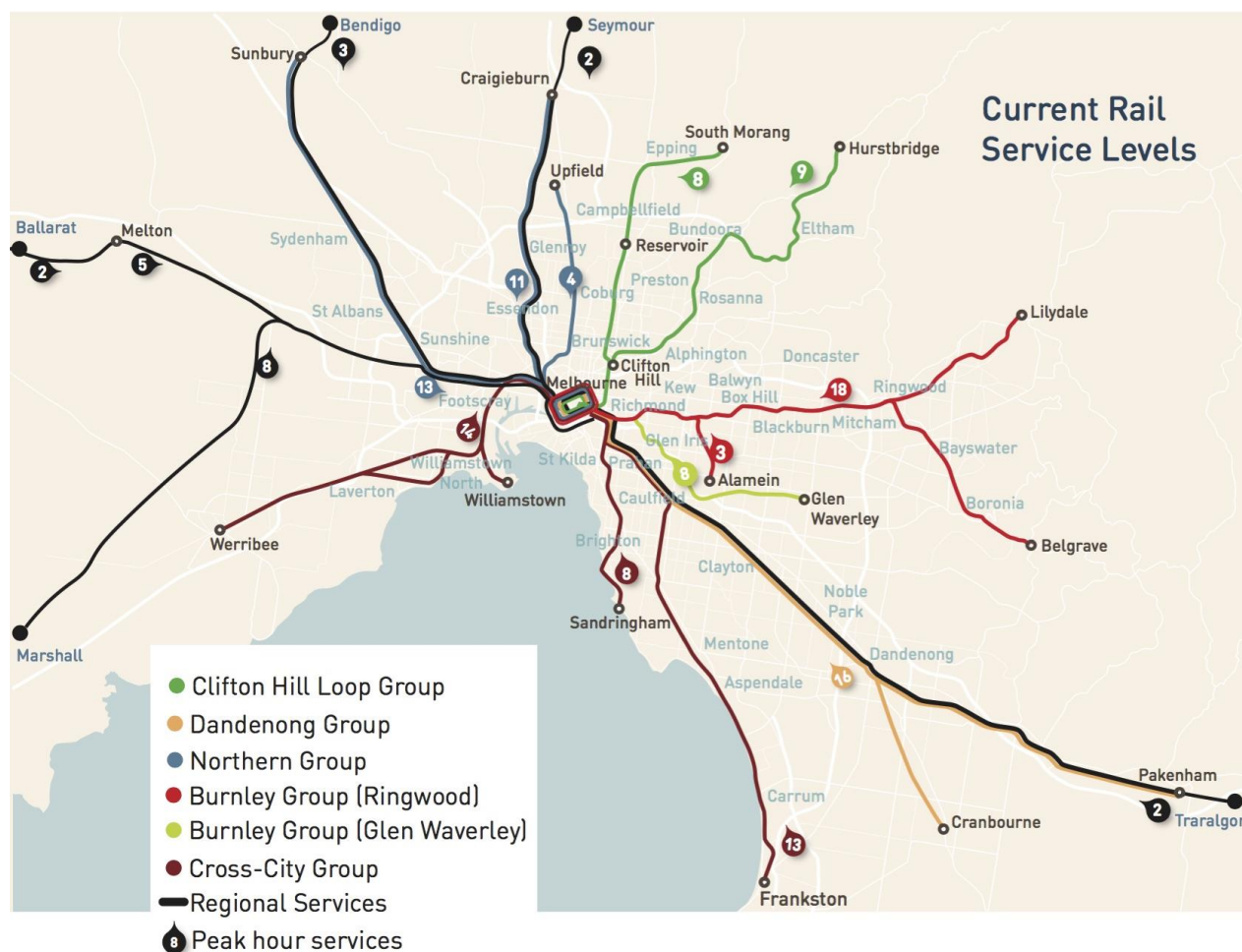
<sup>39</sup> PTV Metropolitan Patronage Demand Forecast Report (2015)

<sup>40</sup> Mairead Cantwell, Brian Caulfield, Margaret O'Mahony (Trinity College, Dublin, Ireland), "Examining the Factors that Impact Public Transport Commuting Satisfaction", *Journal of Public Transportation*, Vol. 12, No. 2, 2009

<sup>41</sup> 12-month average to March 2015 in PTV (2015), Track Record Monthly Reports. Measuring the proportion of trains that are at least five minutes late; Metro Trains must achieve punctuality of not less than 88 per cent.

PTV has identified that the strongest growth will take place on the Sunbury, Craigieburn, Upfield, Werribee and Cranbourne-Pakenham lines. Figure 3-12 and Figure 3-13 represent the current and future number of services according to the *Network Development Plan*.

Figure 3-12: Current number of services – one hour peak direction



Source: PTV Network Development Plan

PTV transport modelling suggests that in order to meet demand on the Cranbourne-Pakenham Line, the number of services during the one hour morning and evening peak periods would need to increase from currently 18 services to 24 services in future.<sup>42</sup> However, the potential for increasing the number of services on the corridor is constrained by the impact of boom gate closures on the road network.

PTV modelling also suggests that to meet future demand on the Craigieburn and Ringwood Lines, the number of services would need to increase from 11 and 18 to 18 and 21, respectively in the peak periods.

<sup>42</sup> PTV Network Development Plan – Stage 4. PTV Network Development Plan is an aspirational plan for the increase of rail capacity based on PTV transport modelling. It is not Government’s Policy or committed program of service upgrades.

Figure 3-13: Potential future number of services – one hour peak direction



Source: PTV Network Development Plan

As the demand for an increased number of rail services grows, the potential for providing new services is constrained by the presence of level crossings, as more rail services lead to more boom gate closures, which constrain the city's road network. For rail customers, the main impact of not removing level crossings is the inability of the rail network to provide the capacity required to keep pace with the demand for services, resulting in:

- Increased overcrowding on trains and at stations;
- More delays and variability in journey times; and
- Reduced attractiveness of public transport as a travel option (especially for commuting), with flow-on impacts for the road network.



### Dandenong Rail Corridor

The Caulfield-Dandenong Rail Corridor is under pressure during peak periods due to the recent growth in patronage. It will be unable to cope with future forecast patronage without adding extra services and increasing average boom gate closure durations – beyond what are already considered unacceptable. The Caulfield-Dandenong corridor now carries up to 80,000 metropolitan passengers each weekday, with 25,000 passengers travelling during the two-hour morning peak.<sup>43</sup>

The corridor has experienced strong growth over the last decade. Between 2004 and 2009, growth averaged 7.8 per<sup>44</sup> cent per annum at the city cordon. System shortfalls and overcrowding will worsen in future. The rapid growth in patronage experienced over the last decade has resulted in capacity shortfalls and overcrowding. More than a quarter of peak services are operating above the benchmark with over 35 percent or almost 9,000 peak period passengers travelling in overcrowded conditions.<sup>45</sup>

As highlighted in the CD9 Project Proposal, PTV forecasts that by 2019 around 26,000 peak period passengers on the Dandenong corridor would be travelling in overcrowded conditions if the existing timetable remains in place.<sup>46</sup> To meet demand, additional peak hour services will be needed.

Boom gate closure times have increased since 2011 due to the addition of extra services. Estimates indicate that by 2031, if future planned rail services occur, it would require boom gates to be effectively closed for over 90 per cent of the time during the morning peak period.<sup>47</sup> This would almost totally block the surrounding roads.

It is apparent that the number of rail services cannot be significantly increased until all level crossings between Caulfield and Dandenong are removed.

## 3.3 Maintaining Melbourne's liveability, connectivity and accessibility

A well-connected transport network is critical to Melbourne's liveability, but also to the city's economic activity, productivity and competitiveness. As Melbourne grows, maintaining the city's connectivity and accessibility are more important than ever, but it is also a much more challenging task than in the past.

The following sections describe the importance of connectivity and accessibility to Melbourne. The impacts of not removing level crossings (discussed in the preceding sections) – including less efficient road and rail networks – would reduce the connectivity and accessibility of the city's transport network, eroding Melbourne's highly valued liveability and limiting opportunities for economic development, higher productivity and jobs growth.

### 3.3.1 Connectivity is critical

Connectivity is primarily about convenience and cost. It is about people's ability to meet their daily needs by moving relatively easily around the city. It is about businesses being able to move goods efficiently and cost-effectively to customers and markets, and to have good access to a deep pool of workers. It also makes a place more attractive to visitors, who find it an easy and pleasant experience to see the city sights and travel to destinations around the city.

A well connected transport system offers greater accessibility to people. Greater accessibility is a catalyst for economic development and higher productivity. As accessibility is an important factor in people's decisions about where people work and base themselves and their businesses, an improvement in an area's accessibility will enhance its capacity to attract and retain businesses, jobs and households.

<sup>43</sup> Reported in Department of Transport (2012), Dandenong Rail Capacity Program: Grade Separations Submission to Infrastructure Australia

<sup>44</sup> CD9 Project Proposal, May 2015

<sup>45</sup> PTV Metropolitan Train Peak Passenger Loads

<sup>46</sup> 26,000 peak period loading is forecast for the two hour peak period. The typical load distribution is 60 per cent of demand in the one peak hour, with 40 per cent average in the shoulder or remaining hour.

<sup>47</sup> VITM model Input - percentage closures are calculated using closure frequency from PTV public transport service plans and closure times based on SCATS data and surveys completed by MTM

Poor connectivity is bad for people and can constrain access to major freight gateways and interstate and international markets, jeopardising some of Melbourne’s most important economic journeys and undermining the long-term competitiveness of local firms and industries. An increasingly congested and unreliable transport network also restricts opportunities for business expansion and diversification, as well as hampering commercial and residential development in growth areas and corridors.

For Melbourne to remain competitive and support jobs growth, it must continue to be a well-connected city where residents and businesses have access to a range of travel options and choices.

The figure below identifies some of the aspects of connectivity that are critical to local communities, Melbourne and Victoria.

Figure 3-14: Connectivity outcomes

For Communities	For Melbourne	For Victoria
<p><b>Supporting urban renewal and local jobs</b></p> <ul style="list-style-type: none"> <li>Improving access to jobs and services</li> <li>Reducing costs for local businesses</li> <li>Improving liveability and amenity</li> <li>Leveraging new economic opportunities and attracting investment</li> <li>Creating safer, more ‘walkable’ neighbourhoods</li> </ul>	<p><b>Boosting productivity and access to jobs</b></p> <ul style="list-style-type: none"> <li>Reducing the costs of doing business</li> <li>Increasing the supply of housing closer to jobs</li> <li>Shifting to higher value land uses Integrating markets and trade across the city</li> <li>Supporting an expanded central Melbourne</li> <li>Supporting the growth of knowledge-based industries</li> </ul>	<p><b>Building a connected state</b></p> <ul style="list-style-type: none"> <li>Strengthening links from regional Victoria to important economic nodes and gateways</li> <li>Reinforcing Victoria’s status as the ‘Freight State’</li> <li>Diversifying regional economies</li> </ul>

### 3.3.2 Productivity and access to jobs

Poor connectivity can cause an increase in the length of trips taken and more people to be travelling for longer. Poor connectivity harms productivity by making business-to-business access more difficult and increasing travel and transportation costs.

Key employment areas have been defined in *Plan Melbourne* as National Employment Clusters (NEC). These areas have concentrations of businesses and institutions that provide a diversity of employment opportunities, including knowledge jobs. Excluding the CBD, *Plan Melbourne* has identified six NECs with potential for high job numbers in suburban locations.

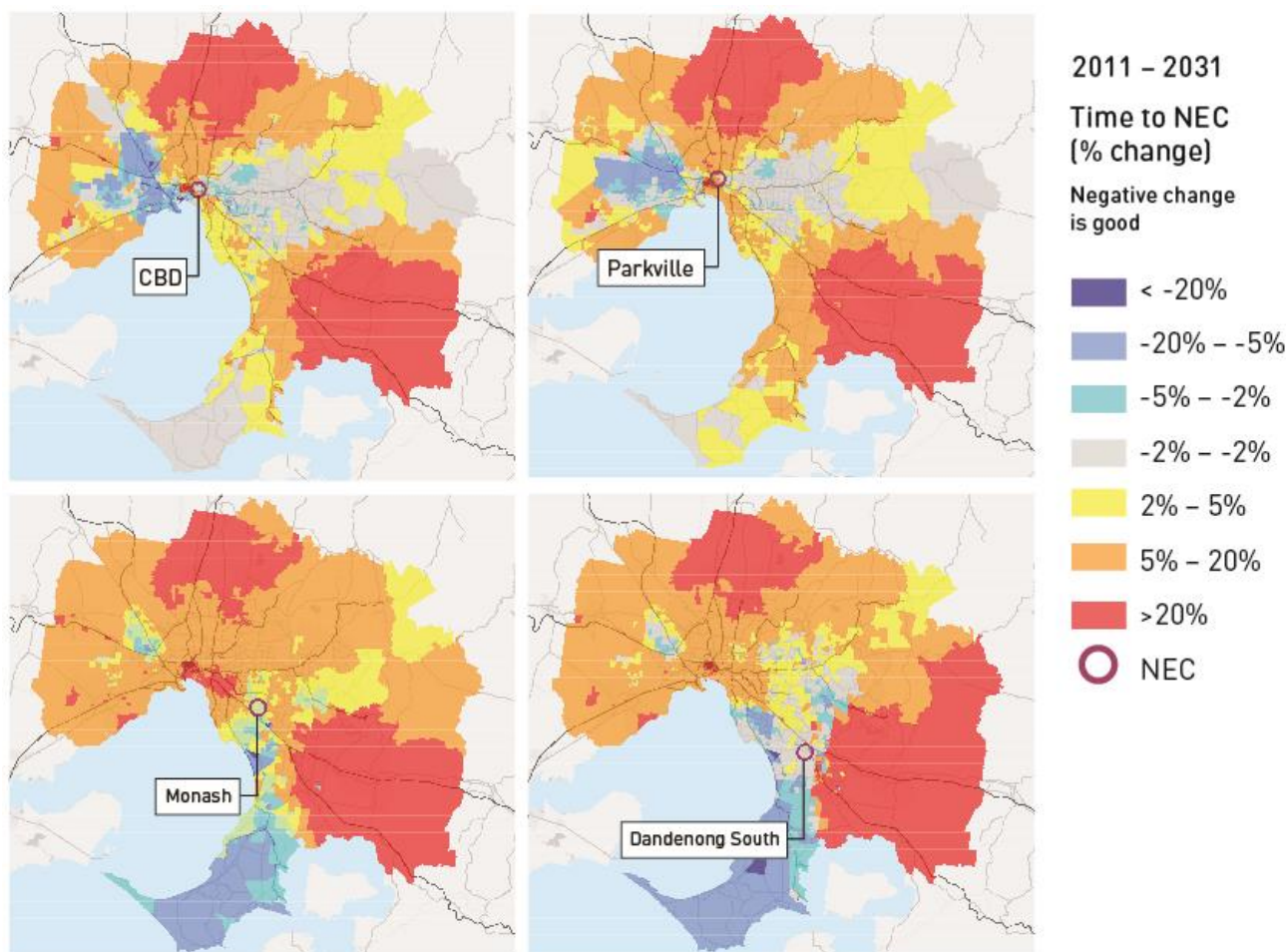
There are three existing NECs at Parkville, Monash and Dandenong South, as well as three emerging NECs at East Werribee, La Trobe and Sunshine.

Figure 3-15 illustrates forecast change in car travel time between 2011 and 2031, showing that without intervention, car trips to these key employment areas will become considerably longer across most of Melbourne. In 2031 it will take longer to access a NEC from most parts of Melbourne.

In 2031, it will take almost 1.6 million people at least five minutes longer to access the closest key employment area by car<sup>48</sup>. Some areas in the north and south-east, shown in red, will experience an increase in travel time of over 20 per cent, limiting access to a diversity of employment opportunities for many Melbournians.

<sup>48</sup> LXR P VITM model projections of travel time under current and future transport network and Public Transport frequency, level crossing remaining, without CPLU and Metro Tunnel

Figure 3-15: Projected change from 2011 to 2031 in car travel time (minutes) to each National Employment Cluster



Source: VITM model projections of travel time on the road network under current and future transport network and Public Transport frequency, level crossing remaining, without CPLU and Metro Tunnel

Reduced accessibility to jobs has particular impacts on areas at the urban fringe. Figure 3-16 shows, from the perspective of employees, the number of jobs accessible within a reasonable commute (45 minutes) by 2031.

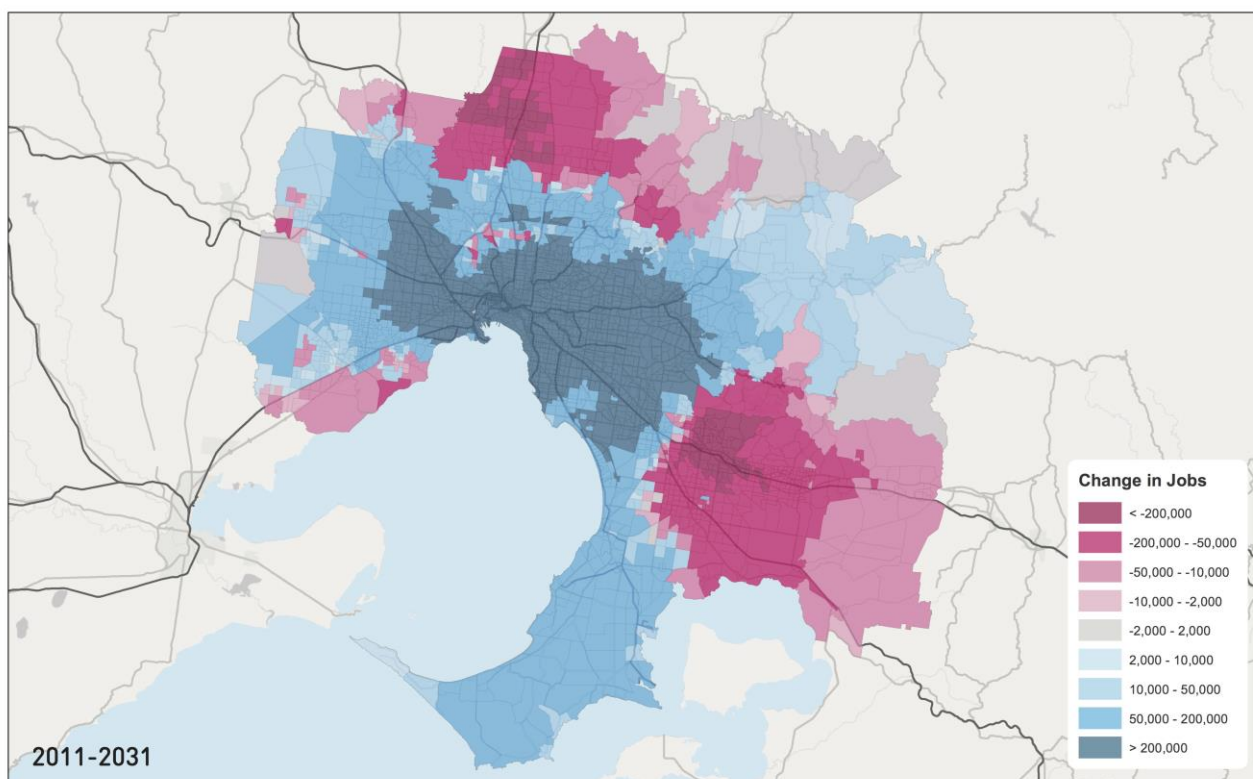
Although the overall number of jobs in Melbourne is increasing, in 2031 the population living in the north and south-east areas of Melbourne will have access to fewer jobs within 45 minutes by car than at present, as shown in magenta below.

Without intervention, there may be increased travel to job dense areas such as the inner city (shown in dark blue), exacerbating existing congestion problems that restrict access to jobs and services and reduce amenity.

#### Monash Employment Cluster

Monash Employment Cluster, which currently has the largest concentration of jobs outside the CBD (approximately 58,500), has a unique mix of education, research and industry participants. Almost 60% of Melbourne’s working age population lives within a 45-minute commute of the cluster. In 2031, this number will reduce significantly, with only 47 per cent of the working age population being able to get to Monash within 45 minutes.

Figure 3-16: The change in the number of jobs accessible within 45 minutes by car from 2011 to 2031. A positive change is good.



Source: VITM model projections of change in effective job density between current and future transport network and public transport frequency, level crossing remaining, without CPLU and Metro Tunnel

#### Access to jobs from Melbourne's growth areas

In the 2012 report *Growing Pains, Keeping pace with the transport needs of outer Melbourne and Geelong* the RACV found that "eight out of 10 people living in the outer areas use their cars as the main mode of transport and this translates to the highest levels of car usage across the state".

A heavy reliance on cars in the outer areas, (including Casey and Cardinia) contributes to road congestion. The RACV report acknowledges that level crossings are a significant barrier to the movement of people and discusses how slow delivery of infrastructure in the outer areas has also resulted in "longer travel distances needed to reach employment, education, health care and social services". As a result of congestion, people living in outer areas have access to fewer jobs within a 45 minute travelling distance.

Without a commensurate increase in jobs in the area, the expected strong population growth in the outer areas of Casey and Cardinia will result in many new residents in the area needing to travel to the inner city. This will exacerbate existing congestion problems.

### 3.3.3 Local accessibility

Social exclusion and unequal access to services is due to many factors (such as geography, income, disability and age), with transport playing a direct or indirect role. Transport related social exclusion is relatively high in outer urban areas where public transport services to access community services and employment are limited.

As described in Section 2.3.2, level crossings form a physical barrier that disconnects suburbs, activity centres and communities. This reduces accessibility to services, including access to health and education services and also reduces the time available for other recreational activities. Without intervention, this accessibility is likely to reduce further as Melbourne continues to grow.

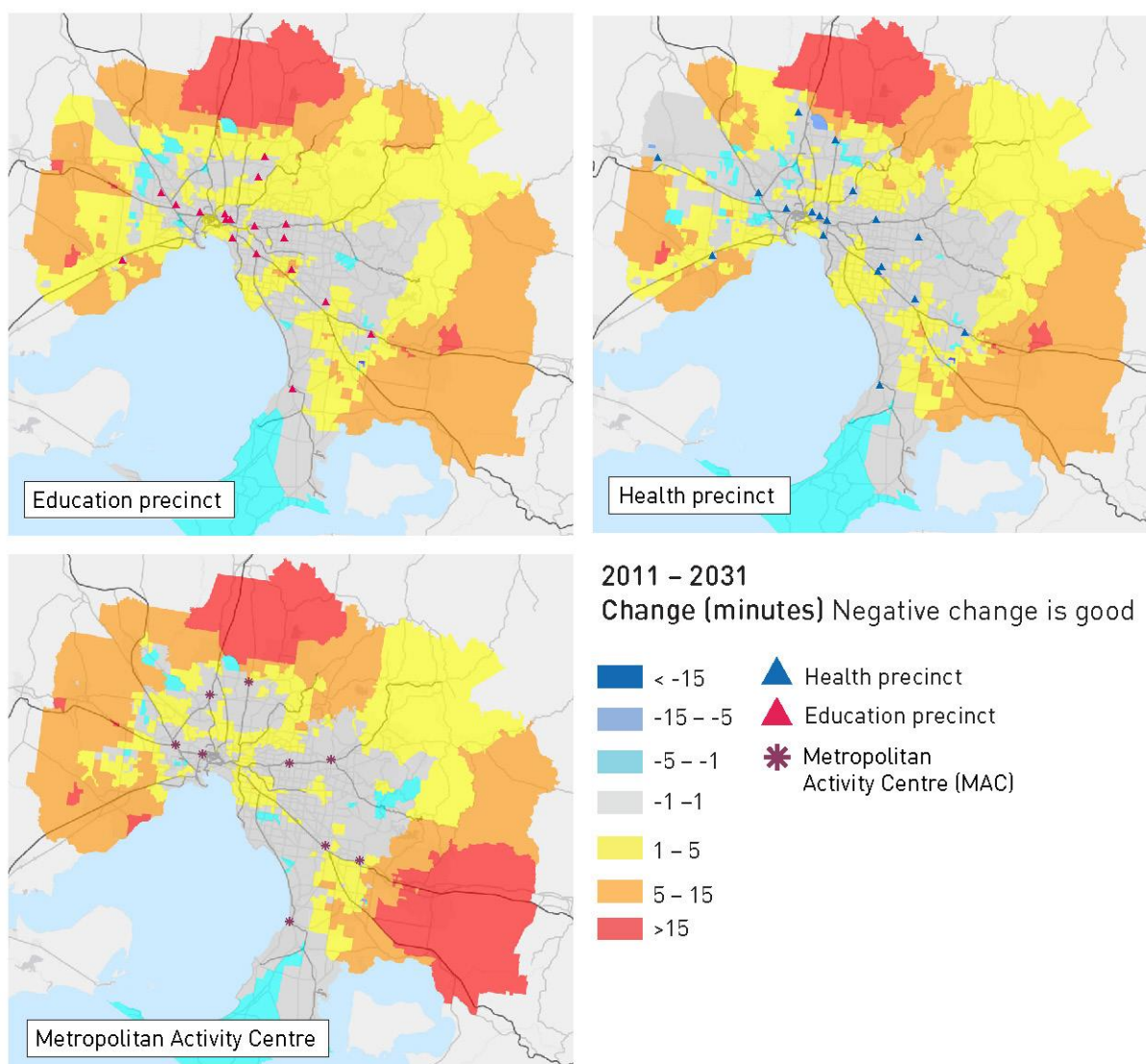
The accessibility maps presented in the following figures show that in the future it will take people (predominantly those living in the outer areas of Melbourne who have less access to public transport) longer to access Metropolitan Activity Centres, major health services and education precincts by car. Modelling indicates that in 2031, it will take

more than 650,000 people an extra five minutes to reach vital health services and over 910,000 people an extra five minutes to reach education precincts.<sup>49</sup> As access to these facilities is reduced, the opportunity to access a diverse range of jobs, activities and housing will also decline for many Melbournians.

Activity centres provide local communities with access to a wide range of goods and services and facilitate local economies. In 2031, almost 66 per cent of Melbourne’s population will have access by car to fewer activity centres within 20 minutes than they did in 2011, constraining opportunities to maximise economic growth in local areas.

Figure 3-17 illustrates the change in minutes, from 2011 to 2031, to the nearest major education precinct, health precinct and Metropolitan Activity Centre. Areas shown in yellow, orange and red (which correspond to growth areas of the outer north, south-east and west) will have the most significant deterioration in access.

Figure 3-17 : Car access (change in minutes from 2011 to 2031) to the nearest education precinct, major health precinct and Metropolitan Activity Centre

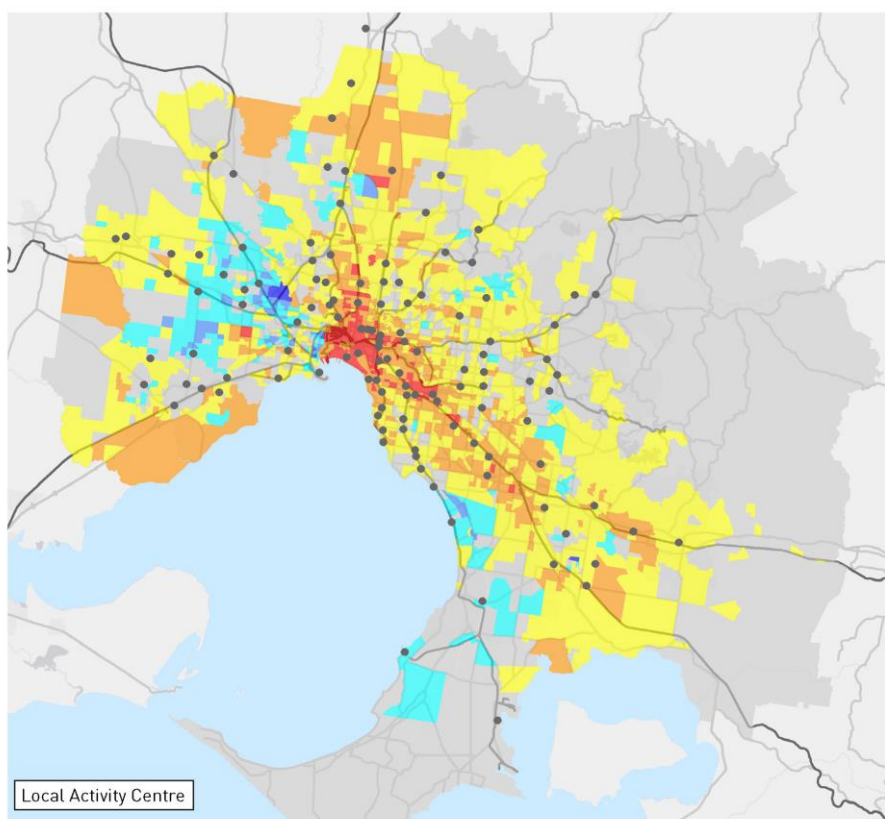


Source: VITM model projections of change in travel time between current and future transport network and public transport frequency, level crossing remaining, without CPLU and Metro Tunnel

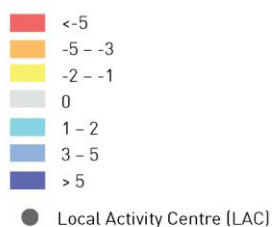
Figure 3-18 shows the change in the number of Local Activity Centres (LACs) accessible within 20 minutes by car from 2011 to 2031. Areas shown yellow, orange or red will be able to access less Local Activity Centres in future if level crossings are not removed.

Figure 3-18 : Change in the number of Local Activity Centres (LAC’s) accessible by car within 20 minutes, from 2011 to 2031

<sup>49</sup> VITM model projections under future transport network but with existing level crossings remaining



2011 – 2031  
Change in the number of LAC's accessible by car within 20 minutes.  
Positive change is good.



Source: VITM model projections of change in travel time between current and future transport network and public transport frequency, level crossing remaining, without CPLU and Metro Tunnel

**As Melbourne grows, the demand for travel increases, resulting in more cars on the roads, overcrowding on public transport (rail) and more delays.**

**By 2031, more people will be using the road and public transport networks. They will be travelling for longer and transport related social exclusion will worsen in outer urban areas where public transport services are limited.**

**A reduction in the overall connectivity and accessibility of Melbourne's transport network may erode the city's liveability and limit opportunities for economic development, urban renewal, higher productivity and jobs growth.**

# Chapter 4

## Benefits



#### **CHAPTER 4: BENEFITS - SUMMARY**

Removing level crossings will:

- Deliver significant safety improvements for drivers and pedestrians
- Improve travel around Melbourne – for train users, pedestrians, cyclists and drivers
- Make Melbourne’s roads more reliable, enabling people to better predict their travel times
- Stimulate economic growth by creating thousands of jobs during construction
- Improve access to Activity Centres and National Employment Clusters
- Revitalise local communities, with many areas benefiting from improved station precincts
- Enable more trains to run more often and on time

A Benefit Management Plan has been prepared that outlines the key performance indicators that will be used to measure and monitor achievement of the stated benefits.

The LXRP supports a number of key Victorian Government policies. It is a key enabler of major transport projects, such as the Metro Tunnel and the Cranbourne-Pakenham Line Upgrade.



## 4 Benefits

### 4.1 Project objectives

As identified in the Investment Logic Map in Chapter 2, the Level Crossing Removal Project has the following objectives. To provide:

- **Improved productivity from more reliable and efficient transport networks (45 per cent)**
- **Better connected, liveable and thriving communities (40 per cent)**
- **Safer communities (15 per cent).**

Associated objectives support or consider aspects such as the environment and sustainability, local development (including integrated development opportunities) and construction timing and costs.

Each objective is expected to deliver one or more measurable benefits, as defined in the Benefit Map (BM) provided in Figure 4-1 below and the Benefit Management Plan (BMP) provided in Appendix B. The BMP proposes a number of Key Performance Indicators (KPIs) to be used as measures for determining the successful delivery of these benefits as well as their existing performance (baseline), proposed performance targets and target timeframes, and the responsible person(s) for their reporting and achievement.

The Benefit Map includes:

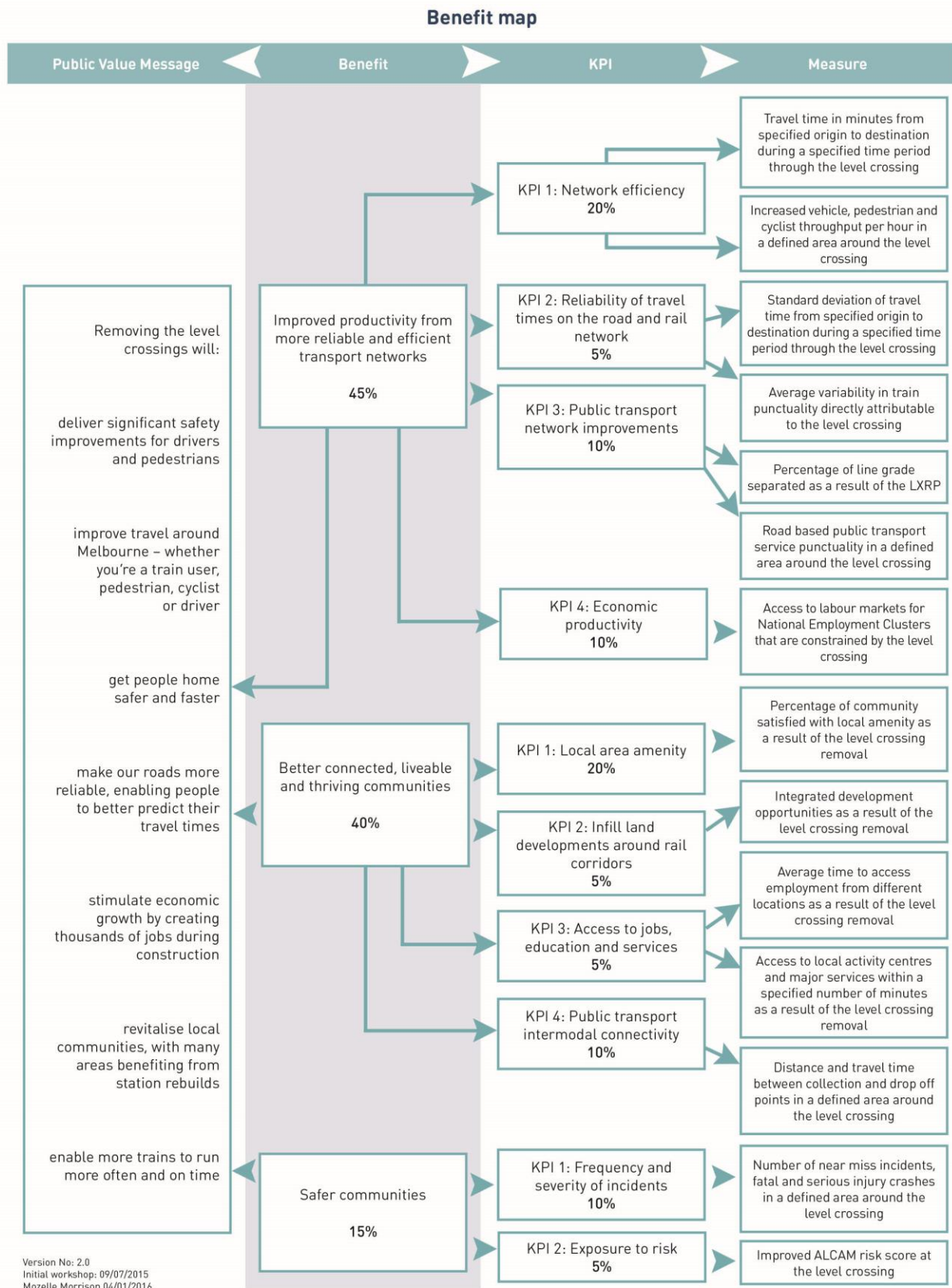
- **Public Value Messages** - these reflect long-term outcomes sought at the highest level or by the Victorian Government.
- **Benefits** – these reflect the contribution that the investment (the LXR) makes to broader government outcomes.
- **Key Performance Indicators** (KPIs or indicators) are the level of change that occurs as a result of an investment and reflect the contribution it makes to the benefits sought by organisation/s. (KPIs are supported by **measures** which are specific quantifiable units that can be used to assess and/or validate that an indicator has been met.)

These project objectives and associated objectives were used to inform the assessment criteria for the later project options analysis (see Chapter 6).

Development of the project objectives included consideration of:

- Transport system objectives and decision making principles listed in Part 2 of the *Transport Integration Act 2010*;
- DTF Business Case Guidelines, including consideration of the 'Investment Decision Checklist'; and
- Critical success factors from past level crossing removal projects.

Figure 4-1: LXR Benefit Map



RESPONSIBILITY FOR DELIVERING THE BENEFITS:		
Name: Kevin Devlin	Position: CEO Level Crossing Removal Authority	06/01/2016
Investor: Level Crossing Removal Authority	Facilitator: David Cochrane	Accredited Facilitator: Yes

## 4.2 Project benefits

The Program Benefit Map and Benefit Management Plan depict the logical connection of an investment's benefits to the KPIs, measures and targets. The BMP was developed using the benefits identified in the ILM in Chapter 2. The BMP identifies KPIs for each benefit that are meaningful and measurable. Each KPI will have indicative targets and dates for measurement. DTF templates and guidelines were used for the development of the Benefit Management Plan. The BMP will enable measurement of the LXR outcomes. The benefits will be measured and reported across the program, although some measures and KPIs will be collected for individual packages of works.

The ILM, Benefit Map and Benefit Management Plan were developed following a series of workshops, which included consideration of the problem and benefits statements from previous ILM's and BMP's for level crossing removal projects and other programs; these were reviewed in detail to accommodate the program level issues and were used to determine the contribution (in percentage) that each benefit will provide. The ILM, Benefit Map and Benefit Management Plan were also circulated to stakeholders from various Government departments for comment.

### 4.2.1 Improved productivity from more reliable and efficient transport networks

Addressing the congestion and delays caused by level crossings will improve the efficiency of Melbourne's transport networks by reducing travel times and queues and, in particular, by improving the variability of travel times. Improving the variability of travel time has productivity benefits, as motorists and commuters do not need to allow for extra travel time when planning trips in the area and businesses can plan deliveries and other journeys with greater certainty.

Reliable travel times are related to improved safety, efficiencies for freight transport, and improved quality of life for road users who experience less delay, frustration and uncertainty in planning their journeys and route choices. Unreliable travel times are caused by recurring congestion (bottlenecks) and nonrecurring congestion (traffic incidents, signal faults, weather, work zones, and special events).

As described in Chapter 2, the variability in travel time as a result of boom gate closures is a significant problem for road users. As traffic demand and rail frequency increases, travel time and variability of travel time at level crossings also increases. Transport modelling demonstrates that the removal of level crossings can have a noticeable improvement in the variability of travel times. For example, at Bell Street, Preston, the increase in traffic demand in 2031 has severe implications for the network if the level crossing is still in place. With the level crossing in place, travel times almost double in both peaks network-wide and the travel time variability increases by the same amount. Removing the level crossing in 2031 has a positive impact on the travel times, with a reduction of around 8 per cent in both peaks while the travel time variability reduces by 11-13 per cent in both peaks.

Currently, train movements are given absolute priority at all level crossings resulting in efficiency losses for all other road users. The removal of level crossings will provide an opportunity to facilitate good pedestrian and cycling access into and within activity centres, prioritise trams and buses on key public transport routes that link activity centres, give a better level of certainty to travel times for cars and improve travel time for trucks on important routes that link freight hubs.

#### ***Benefits to freight movements***

The benefits will foster improved business-to-business interactions and freight movements. For example, the removal of level crossings enables increased rail capacity under the Cranbourne-Pakenham Line Upgrade and Metro Tunnel projects. This in turn will attract more people to use the public transport system, freeing up road network capacity for freight operators. This is particularly important for the south-east corridor, where growth in nationally significant employment clusters including Monash and Dandenong South will rely on efficient access for high value freight movements.

Furthermore, the combination of increased rail capacity and the level crossing removals will provide additional network efficiencies in key locations such as the National Employment Clusters of Monash, Dandenong and Parkville. The efficiency of freight movements will increase. As a critical input to the production and sale of physical goods, lower freight costs will feed through into wholesale and retail prices, delivering savings to businesses and households right across Victoria that can be used to grow consumption and investment.

### ***The ability to run more trains***

The number of rail services that can run along some rail corridors, such as the Cranbourne-Pakenham rail line, is limited by the amount of time that the boom gates can be lowered before there is a significant impact on the capacity and throughput of the road network. The removal of level crossings will allow an increase in the number of rail services and more flexible train timetabling options to become available under the Cranbourne-Pakenham Rail Upgrade and Metro Tunnel projects. This will support the implementation of PTV's Network Development Plan to increase the number of rail services, which will improve service delivery, address overcrowding on trains and improve connectivity across Melbourne. In turn, these improvements will help to drive higher levels of productivity and support greater access to jobs.

The deployment of new trains on the Cranbourne-Pakenham line will enable the existing fleet on this line to be deployed to other rail lines to provide additional services to meet current and future demand. The introduction of these new trains will enable up to 22 additional services to run in each two-hour peak across other lines. These additional trains can be deployed to lines such as Werribee, Craigieburn, South Morang, Hurstbridge, Ringwood, Frankston, Sandringham and Pakenham, enabling additional services to be accommodated on these lines.

Over the longer term, the greater efficiencies fostered by the LXR throughout Melbourne will be likely to increase business profitability and draw new business investment, particularly around activity centres and National Employment Clusters.

An increase in the number of rail services will deliver social benefits not captured by standard economic measures, including more personal time (as a result of reduced or more reliable travel times) and reduced discomfort for rail passengers from overcrowding on trains.

The LXR will assist in delivering the Government's commitment to deliver the Metro Tunnel as a means of unlocking the centre of the train system, enabling major improvements in capacity, reliability and frequency of services across some of the city's busiest train lines..

### ***Improved bus-train interchanges***

The removal of level crossings will result in improved co-ordination of bus, tram and rail services. For example, opportunities to connect bus routes will be created – including at Main Road, St Albans and Blackburn Road, Blackburn – further improving service delivery, enhancing transport integration and increasing public transport mode share.

### ***Better walking and cycling***

Strategic Cycling Corridors are being developed to improve cycling to and around activity centres in metropolitan Melbourne. These will typically be selected on the basis of providing links to a National Employment Cluster or a Metropolitan Activity Centre and are routes that cater for the highest, or potentially highest, cycling volumes. A number of level crossings being removed as part of the LXR are on Strategic Cycling Corridors. These projects will provide bicycle links into and around station precincts, improving the connectivity of high priority bicycle networks.

The removal of congestion points across the road network improves traffic flows, which reduces emissions and pollutants from car-based travel, benefitting Melbournians who regularly walk or cycle. In addition, provision has been made for improvements to, and expansion of, public transport, cycling and walking infrastructure, which will assist in encouraging a transport mode shift in local areas, enabling greater environmental benefits to be delivered.

## 4.2.2 Better connected, liveable and thriving communities:

Removal of level crossings will reduce delays and increase the attractiveness of living and investing in areas surrounding the crossings. Comfortable and safe public transport, pedestrian and cycling areas and connected precincts encourage businesses to set up high value enterprises, resulting in a concentration of activities that improve the amenity of local areas and further heighten interest in development in the area.

### Enable an investment pipeline of transit-oriented development and urban-renewal (Direction 1.6 of *Plan Melbourne*)

*Plan Melbourne* identifies precincts to accommodate future growth, including activity centres and urban renewal precincts and sites. A key element of *Plan Melbourne* is an expanded central city and a series of new urban renewal precincts that will have the capacity to accommodate a large proportion of Melbourne's future housing needs close to transport and services. Urban renewal precincts and sites, particularly around stations will be a major source of housing to meet Melbourne's growth needs.

*Plan Melbourne* identifies a pipeline of urban renewal precincts and sites around the existing and planned rail and wider transport network, to unlock investment opportunities for the private sector and maximise the state's return on infrastructure investment. The transport projects will create opportunities for urban renewal and employment precinct development near new stations.

Places of state strategic significance include National Employment Centres, Metropolitan Activity Centres, transport gateways, state-significant industrial precincts and health/education precincts. Places of local significance include local activity centres, neighbourhood centres, other industrial land and other urban renewal sites. Land around railway stations and train corridors can provide valuable development opportunities, due to the access to public transport.

### **Better railway stations**

Improvements to station precincts as part of the level crossing removal projects will satisfy transport integration requirements and stakeholder, community and transport users' expectations. These improvements will deliver better public realm, amenity and public transport outcomes that will facilitate urban renewal opportunities. A number of new train stations will also be built to replace existing stations, which is expected to deliver a significant amenity benefit for all passengers and in particular, interchange passengers at some of these stations, depending on the nature of their interchange improvements.

New station and interchange options delivered through the LXP will aim to provide:

- Access that complies with the Commonwealth *Disability Discrimination Act 1993* (the DDA)
- Connectivity between modes within the station precinct
- Connectivity across the surrounding area through the station precinct
- Integration of the station precinct with the surrounding land uses
- A high level of personal safety for all staff and the general public
- Security of public and private infrastructure and assets
- Amenity improvements in the station precinct and surrounding area.

New stations will encourage transport oriented development and the related passive safety benefits, for example from the adoption of Crime Prevention through Environmental Design (CPTED) principles (such as land use mix and activity generators, building design, lighting, equitable access to all areas and wayfinding). Subiaco station, described below, is a good example of where upgrading a railway station can stimulate transit oriented development in an area.

### Case study – Subiaco Station, Perth, Western Australia

Subiaco is an inner-suburban centre located approximately three kilometres west of the Perth CBD. The focal point of the Subiaco central urban renewal area is the redeveloped railway station precinct.

The Subiaco Redevelopment Authority rebuilt the Subiaco Railway Station and lowered the Fremantle–Perth Railway Line into a cutting and tunnel for an 800-metre section near the station. This created space for a pedestrian precinct adjoining the station and enabled connections to be built between the existing town centre and for the residential and redevelopment areas on the northern side of the line.

The visually striking roof structure around the railway station platforms provides shelter for passengers and is a powerful landmark in the heart of Subiaco.

The below-ground but open-air station has a strongly pedestrian-focused core area, designed to create a sense of enclosure, comfort and intimacy. At surface level, the space around the railway station is designed to welcome pedestrians and cyclists.



Source: Transit Oriented Development Guide, Growth Management Queensland, Queensland Government

Access to public transport is essential to ensure that all Victorians can contribute to the community and have access to the services they need to reach their potential. New stations will include DDA-compliant facilities, making public transport more accessible to people with disabilities and fostering greater social inclusion.

High quality urban design of station areas and surrounding access points creates safer, more attractive places that encourage local residents and visitors to use these areas more frequently and across a greater span of hours. Reducing community severance and dislocation will create more ‘walkable’ local neighbourhoods, delivering health, social and environmental benefits.

A study by the McCaughey VicHealth Wellbeing Unit at the University of Melbourne reports that “access to a multi-modal transport system is a critical social determinant of health, facilitating access to employment, education, food, health and social services, and family and friends”. A growing body of evidence “links transport-related physical activity (i.e. walking and cycling as modes of active transport), public transport use and driving with specific built environment attributes”. Built form attributes include “the presence of transport-related infrastructure (e.g. footpaths, controlled crossings, proximal public transport stops, car parking availability), as well as street connectivity, land use mix, residential and employment densities, and access to local shops and services”.<sup>50</sup>

<sup>50</sup> Badland, H, Robert, R, Butterworth, I, Giles-Corti, B. (2015), *How Liveable is Melbourne?* McCaughey VicHealth Wellbeing Unit, The University of Melbourne

Figure 4-2: Springvale level crossing removal project: before and after



### ***Better connected and thriving communities***

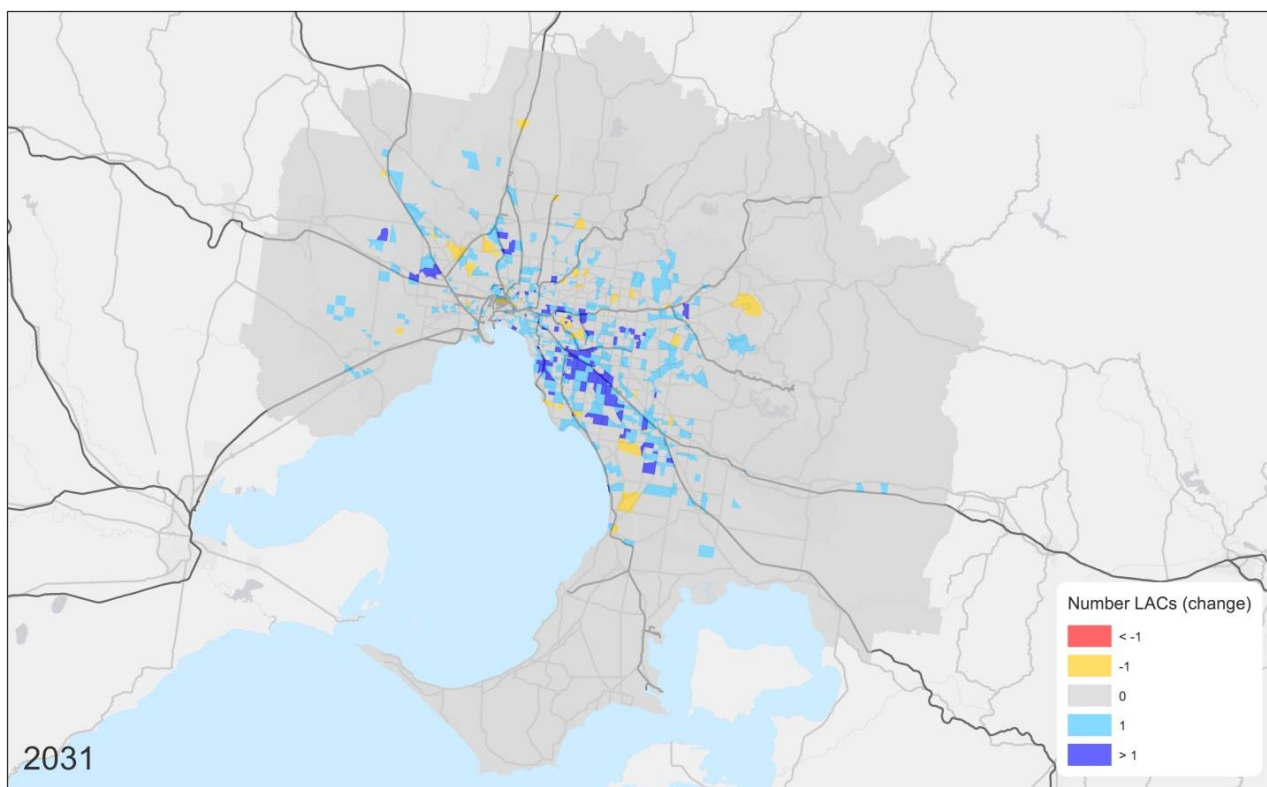
Removal of the level crossings and associated redevelopment of the station precincts will support future population growth and some of the city's fastest growing areas. Economic prosperity will be enhanced through better access to jobs and improved freight efficiency. The program will support social and economic inclusion, enabling more people to more easily use the rail and road networks to access jobs and services.

A key part of the Plan Melbourne vision is the creation of a city of "20 minute neighbourhoods" – the planning and development of areas at the local level so that people can access a range of local services and facilities, ideally within 20 minutes of home.

Evidence of the severance caused by level crossings and their impact on local communities is detailed in Chapter 2. Figure 3-17 in Chapter 3 illustrates the impact that the future public transport network (required to respond to Melbourne's current and future growth) would have on severance of the local activity centre *without* 50 level crossings being removed.

Figure 4-3 shows these same Local Activity Centres (LAC's) in a future 2031 scenario whereby additional services along the Cranbourne Pakenham line and along the Belgrave Lilydale lines occur *with* 50 level crossings removed. Although the 2031 scenario includes a population increase of 1.8 million people and an increase in trips of approximately 2.5 million, there is an evident increase in local accessibility, indicating that local communities will reap the benefits of improved accessibility around their activity centres as a result of the level crossing removals.

Figure 4-3: Change in number of Local Activity Centres (LAC's) within 20 minutes by car as a result of 50 level crossing removals – positive change is good.



There are 32 level crossing removals at, or in close proximity (within one kilometre) to, a Metropolitan Activity Centre or a Local Activity Centre. Eleven level crossing removals are located within or close to existing or emerging National Employment Clusters.

Of the 50 level crossings removals, many will include new stations and improved transport interchange facilities. The removal of the level crossings and metropolitan network modernisation program (such as new stations and improvements in public transport access) will help to unlock urban renewal opportunities in these areas.



### Supporting employment clusters

#### **St Albans Activity Centre**

Ginifer Station and Furlong Road are identified within *Plan Melbourne* as part of the emerging Sunshine National Employment Cluster, which has the potential to build a critical mass of tertiary education, health-related training, healthcare, retail and professional services, provide employment opportunities and increasingly become a major destination for people travelling throughout the regional catchment. Integrated public transport services will be vital to the success of the Sunshine cluster, ensuring that workers can commute easily to the cluster as well as moving locally within the cluster itself.

#### **Werribee**

The East Werribee National Employment Cluster is the largest undeveloped piece of land owned by the Victorian Government in the Melbourne metropolitan area. The precinct is currently home to a number of research and development organisations, including CSIRO Food and Nutritional Sciences, Melbourne University and Victoria University, and several medical facilities including Werribee Mercy Hospital. The cluster will ultimately provide well over 50,000 jobs across a wide range of industries and sectors to support Melbourne's growing western suburbs.

Werribee City Centre has at its core the municipality of Wyndham's primary train station and bus interchange. Werribee Station is located between two level crossings being removed as part of the LXR. A major road network and off-street pedestrian and cycle paths radiate around the Werribee City Centre, providing strong links to surrounding areas.

The City of Wyndham's Structure Plan recognises that land around the station and train corridor can provide valuable development opportunities due to public transport accessibility and is encouraging higher density development and mixed retail, employment and residential uses in this area. The LXR will unlock opportunities to use this land to realise the full potential of the area.

### 4.2.3 Safer communities

Removing rail and road intersections will eliminate the conflict points between trains and road users and trains and pedestrians, reducing the number of crashes in areas surrounding level crossings caused either directly through dangerous behaviour near the level crossing or as a result of excessive congestion and unpredictable traffic movements. Improvements to pedestrian and cycling links delivered as part of these projects will also enhance safety at level crossings and intersection sites.

The LXR will simplify these complex urban environments, removing 50 level crossings that recorded over 60 collisions between a train and a road vehicle or pedestrian in the ten-year period between 2005 and 2014, 20 of which resulted in fatalities.

Improvements to the station precincts as part of the level crossing removal projects will also improve safety in these areas for commuters, shoppers, pedestrians and others moving through or around the stations. Where new stations are provided, this includes works to ensure stations comply with requirements for DDA, lighting and security, station car parks and interchange facilities.

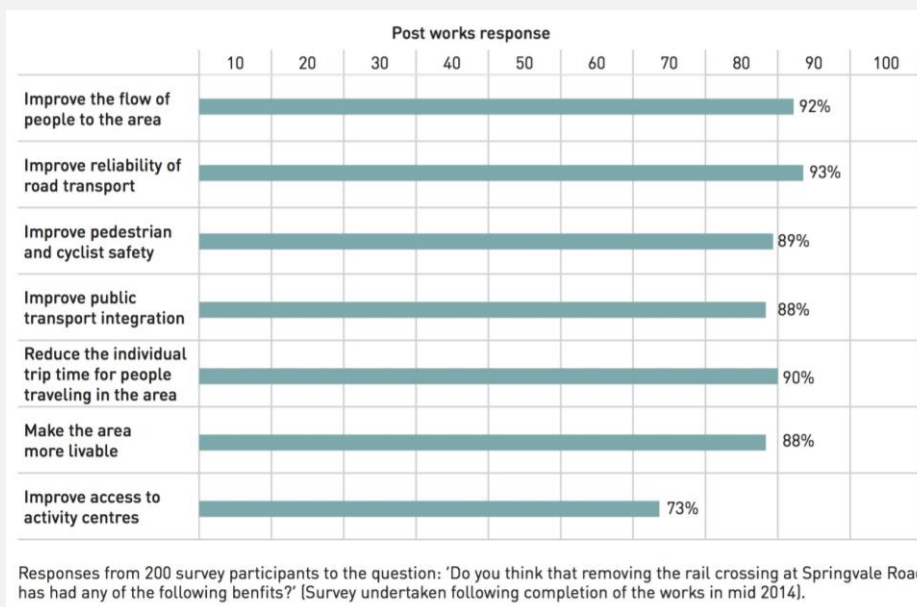
### Springvale Level Crossing Removal – community perceptions of benefits

Following completion of the level crossing removal at Springvale in 2014, VicRoads undertook research to gauge public and stakeholder satisfaction with the project. The results overwhelmingly indicate that the level crossing removal has had a significant positive impact on the level of satisfaction of Springvale residents.

Key findings include:

- Perceptions of feeling safe as a pedestrian in the vicinity of level crossing were rated an average of *8.1 out of 10* (compared with a rating of 6.3 out of 10 prior to the works being undertaken).
- Feeling safe as a passenger or motorist close to the level crossing was rated an average *8.3 out of 10* (compared with a rating of 5.7 out of 10 prior to the works being undertaken).
- Feeling safe as a train user close to the crossing was rated an average of *8.2 out of 10* (compared to a rating of 6.7 out of 10 prior to the works being undertaken).
- Feeling safe at the car park: 81% said they felt more safe.
- Satisfaction with parking was rated an average of *7.5 out of 10* (compared to a rating of 4.9 out of 10. prior to the works being undertaken).

Figure 4-4: Perceived benefits of the removal of the level crossing at Springvale Road, Springvale



## 4.3 Evidence of benefit delivery

The following Key Performance Indicators (KPIs) will be used to demonstrate benefits of level crossing removal projects:

- Network efficiency
- Reliability of travel times on the road and rail network
- Public transport network improvements
- Economic productivity
- Local area amenity
- Infill land developments around rail corridors
- Access to jobs, education and services
- Public transport intermodal connectivity
- Frequency and severity of incidents
- Exposure to risk

LXRA will oversee the implementation of the investment, including the delivery of the expected benefits. LXRA will be responsible for monitoring the achievement of performance targets and for advising on actions to be taken to improve any area where the performance target is not achieved.

Using baseline information along with historical and projected data, LXRA has developed benchmark target KPIs as part of this business case. The specific reporting information for each KPI is detailed in the Benefit Management Plan, provided in Appendix B.

***As road traffic volumes increase throughout Melbourne, the principal economic benefits of removing level crossings are:***

- ***Improved journey times and reduced variability in journey times for private, business and freight vehicles across Melbourne's road network;***
- ***Reduced vehicle operating costs;***
- ***Public transport user benefits, such as reduced travel times for road based public transport, less crowded train services and improved station amenity; and***
- ***Reduced accident costs.***

***There are also a range of benefits, which are not necessarily quantifiable, such as travel time savings for pedestrians and cyclists at level crossings, the value of amenity improvements for properties near level crossings, and the benefits of better connecting communities on a local scale wherever rail corridors and level crossings currently form a barrier that impedes local connectivity. That these are not readily quantifiable does not imply they are insignificant in scale (particularly the local amenity impacts).***

***The economic benefits of the LXRP are described in detail in Chapter 8.***

*Commercial-in-Confidence information has been redacted prior to publication*

## Chapter 5

### Level Crossing Removal Program



## CHAPTER 5: LEVEL CROSSING REMOVAL PROGRAM - SUMMARY

Level crossings in Melbourne have been removed one by one in recent times. This incremental approach to removing all level crossings will go some way towards addressing the identified problems, but the scale of the problem is so big that it calls for a change in the scale of investment and in the design of the overall strategic response.

Bundling level crossing removals as a coordinated program has advantages over a site-by-site approach during both planning and delivery, including:

- Delivers better value for money
- Provides the ability to have a well-developed assessment framework that encourages optimising project outcomes and avoids the risks of ad-hoc implementation
- Offers greater flexibility to sequence level crossing removals to match with rail capacity investments, road projects or other works, leveraging benefits from coordinated infrastructure delivery
- Provides a better understanding of the information gaps that will de-risk procurement
- Enables costs savings from packaging or bundling sites and from providing a predictable pipeline of work for industry
- Realises benefits that are not possible when removals occur site-by-site – such as greater travel time and other savings generated from augmenting the metropolitan rail network; wider economic benefits from increasing effective density through improved accessibility and increases in a corridor's attractiveness for urban renewal

The removal of 50 level crossings is the core element in this strategic response. Each of the level crossings nominated in the LXP contribute to addressing the problems identified in Chapter 2 to varying degrees. However, achieving the full range of benefits identified in Chapter 4 will require a number of associated activities that go beyond providing the basic infrastructure required for grade separation. The LXP supports four broad strategic interventions:

- Separating road and rail networks at critical junctions
- Implementing the Metropolitan Network Modernisation Program
- Improving the urban amenity and physical integration of activity precincts and communities along rail corridors
- Identifying and facilitating development opportunities along rail corridors.

A number of strategies, policies and programs support the LXP in targeting and facilitating the removal of level crossings in Melbourne.

## 5 Level Crossing Removal Program

### 5.1 A strategic response

Over time, governments have undertaken level crossing removals across Melbourne, including the three most dangerous crossings identified in a 2007 risk assessment: Springvale Road (Nunawading), Springvale Road (Springvale) and Mitcham Road (Mitcham).<sup>51</sup> Planning for several other high priority sites was underway before the 2014 Victorian election and an annual VicTrack level crossing upgrade program continues to deliver smaller-scale safety treatments (such as upgrades to flashing lights and boom gates or installation of pedestrian gates).

Continuing with this incremental approach will go some way towards addressing the problems caused by level crossings. But the scale of the problem, and the realisation that level crossing delays are no longer a localised issue but one affecting the city-wide transport network, calls for a change in the scale of investment and the design of the overall strategic response.

There are good reasons for intervening via a programmatic, network-wide model, as outlined in the box below.

#### The benefits of a coordinated program of level crossing removals

Bundling level crossing removals as a coordinated program realises advantages over a site-by-site approach during both planning and delivery. Advantages include:

**Project optimisation.** Progressing project options selection and design under a well-developed assessment framework for optimising project outcomes (benefits, cost, risk, community acceptance and integrated development opportunities) ensures that project delivery will consistently support program objectives and value for money considerations.

**A more coherent value proposition to present to stakeholders.** Moving ahead with multiple stand-alone level crossing removals would be a less co-ordinated and efficient approach during the planning stages and could lead to incoherent implementation of strategies for optimising delivery and funding opportunities, including possible Commonwealth funding. Upfront determination of program-wide costs and benefits also presents a clearer picture of the aggregate funding task and the overall rationale for level crossing removal investments to the Government and public alike.

**A better process for learning and improvement.** A co-ordinated and sequenced program of commercial procurement justifies a greater upfront investment in identifying and addressing program-wide information gaps, and allows for lessons from each tender process to have both greater currency and to be more readily applied to subsequent tenders in order to deliver improvements in commercial value and risk allocation.

**Cost savings.** There may be cost savings from exploiting economies of scale, from packaging or bundling sites and from providing a predictable pipeline of work for industry. Disruptions to the road and rail network due to construction can also be better managed and minimised when delivering a program of works.

**A greater understanding of interactions.** Adopting a coordinated approach enables a comprehensive understanding of interactions (such as enabling elements and interdependencies) both within the level crossing removals program, and as the program relates to other aspects of Melbourne's transport and land use system and investment pipeline. Informed by this understanding, a programmatic model provides greater flexibility to sequence level crossing removals to match with rail capacity investments, road projects or other works, leveraging benefits from coordinated infrastructure delivery.

**Longer term benefits.** A coordinated program that aligns with strategically important transit corridors can realise other benefits not possible when removals are planned site-by-site. Complementary investments made possible by 'clearing' rail corridors of crossings could deliver significant economic benefits (e.g. through travel time and cost savings from upgrading the metropolitan rail network) as well as wider economic benefits from increasing the effective density of the city through accessibility improvements. Removing level crossings along a corridor may also increase a corridor's attractiveness for urban renewal, and generate economic benefits from greater densification. On certain corridors multiple removals under the LGRP bring sections of the line closer to the complete separation proposed by PTVs network development plan.

<sup>51</sup> Springvale Rd in Nunawading, Springvale Rd in Springvale, and Mitcham Rd in Mitcham. The 2007 ALCAM assessment is referred to at <http://ptv.vic.gov.au/projects/railway-crossings/railway-crossing-safety-initiatives-and-upgrades>

The removal of 50 level crossings is the core element in this strategic response. Each of the level crossings nominated in the LXRPP contribute to addressing the problems identified in Chapter 2 to varying degrees.

However, achieving the full range of benefits identified in Chapter 4 will require a number of complementary activities that go beyond providing the basic infrastructure required for a level crossing removal.

Therefore the LXRPP supports four broad strategic interventions:

- 1. Separating road and rail networks at critical junctions**
- 2. Implementing the Metropolitan Network Modernisation Program**
- 3. Improving the urban amenity and physical integration of activity precincts and communities along rail corridors**
- 4. Identifying and facilitating integrated land use along rail corridors.**

The first of these interventions comprises the primary infrastructure delivery task for the program. The others will be addressed via the process of planning, designing, procuring and delivering this infrastructure. In some cases, this means supporting or enabling actions by other entities. The range of activities and asset investments proposed to be delivered by the LXRA is shown in the Investment Logic Map developed for the program.

Central to the importance of the urban amenity and development opportunity strategic interventions is the recognition that the proposed infrastructure works – many of which sit at the heart of local communities and will shape their immediate environments and character for decades to come – present both opportunity and risk. The opportunity is for ‘place-making’, better transport and land use integration, improving the urban aesthetic and creating liveable and thriving communities. The risk is that the additional expenditure does not produce the desired outcome.

## 5.2 Separating road and rail networks

Level crossings can be removed by closing the road, by separating the levels of the road or rail or by a combination of providing an alternative crossing of the rail corridor and closing the existing road.

Separating the level of the road or rail is known as ‘grade separation’. There are four typical grade separation options. There are also ‘hybrid’ options where local conditions make the four typical grade separation options unsuitable and a mix of lowering/raising both the road and the rail is the optimal solution. These are described below. While all of the options ‘remove’ the level crossing, they each have varying benefits, impacts and costs.

Each option has advantages and disadvantages when considered from the various perspectives that might be used to judge them, such as road operating efficiency, rail operating efficiency, local amenity, connectivity, efficiency in land-use and adaptability to future needs.

The overall outcome and how it is perceived over time depends on *how* the infrastructure is designed and delivered, not just *what* option is chosen.

Options are also not ‘off the shelf’ solutions and nor do they come ticketed with a standard price. The practical feasibility and cost of each solution varies across sites, due to differences in rail network operations, topography, geology, the local environment, local road layouts, proximity to other major infrastructure and adjacent land use.

Accordingly, the suitable solution for each site will depend on a number of factors, including the particular site conditions and the local context. There is no clear-cut hierarchy of options in terms of cost, function or amenity.

This means that determining the right solution for a site is not ultimately a technical question, but one involving a multi-criteria analysis that considers the program objectives, benefits and outcomes across a range of areas including environment, community urban design and costs. This is described in Chapter 6.

### ***All solutions can be designed well***

Mitigation measures can be employed to eliminate or minimise adverse impacts and complementary elements can be included in the design to enhance the benefits.

Integrated development opportunities are possible with all level crossing removal options: the extent to which development can occur depends on several factors such as availability of land and existing surrounding land uses.

Each option is described in more detail below. These descriptions are general and do not take account of local constraints and issues. Each of these options needs to be considered in light of the local context for each site.



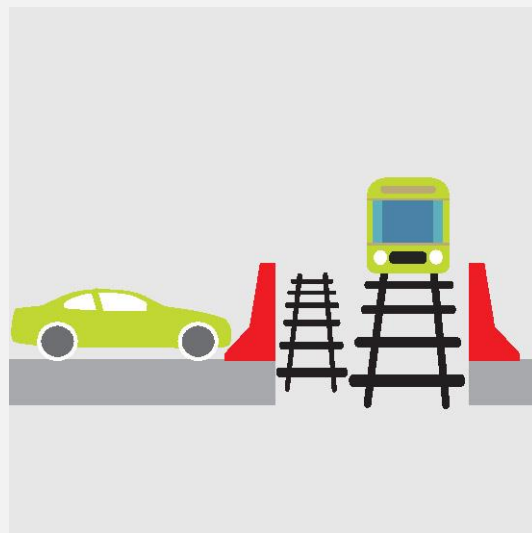
## ROAD CLOSURE

This option involves closing the road at the level crossing. No new alternative crossing of the rail corridor is provided. This is effectively similar to the boom gates being permanently down. Road traffic needs to find an alternative route.

This option addresses the core safety problem and may work well in locations where there is a low volume of road traffic and there are alternative crossings of the rail corridor nearby.

However, closing roads is rarely an appropriate option and does little to address the urban amenity and road congestion issues identified in the ILM.

While closing roads may be the cheapest form of *removing* a level crossing, it may be met with some resistance and will almost always have a negative impact on community severance.



## ROAD OVER RAIL

The rail line remains at its existing level and a new road bridge is constructed over the rail line. Local road and pedestrian accessibility is maintained by providing alternative access or with local service roads.

This option:

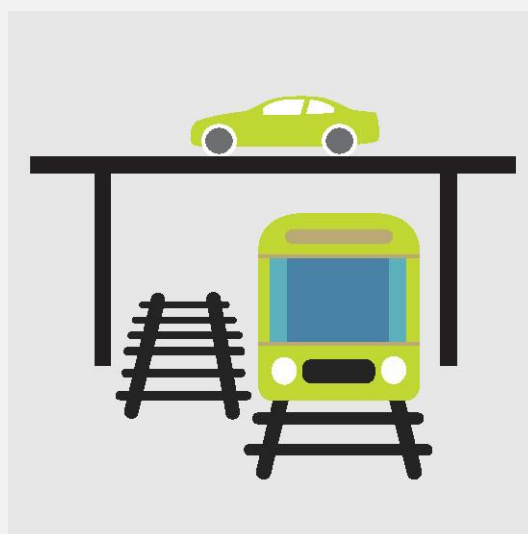
- Addresses the core transport problem
- Addresses the core safety problem
- Addresses community severance by making access across the rail corridor easier at the site where the level crossing used to be
- Does not address local amenity problems in built up areas.

Road over rail grade separations work well in areas where there is less dense land use and outside of activity centres where there tends to be less property access points off the road

Road over rail also works well in locations with wide road reserves – meaning that any service roads required to maintain localised access can be provided without land acquisition.

Road over Rail solutions often do not require any modifications to rail platforms because the level of the rail does not change.

Where there are nearby train stations, access to them needs to be maintained for all modes.



## ROAD UNDER RAIL

The rail line remains at its existing level and the road is lowered to pass underneath the rail. A new bridge is constructed to allow the rail to remain at its existing level. Local road and pedestrian accessibility is maintained by providing alternative access or with local service roads

This option:

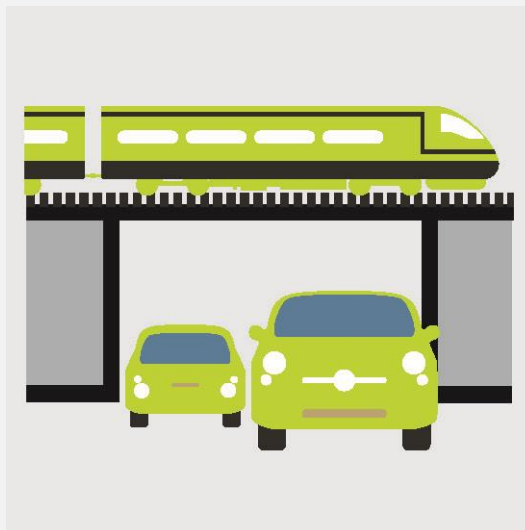
- Addresses the core transport problem
- Addresses the core safety problem
- Addresses community severance by making access across the rail corridor easier at the site where the level crossing used to be
- Improves urban amenity, particularly in built up areas.

Road under rail works well in areas where there is less dense land use, outside of activity centres where there tends to be less property access points off the road.

Where there are nearby train stations, access to them needs to be maintained for all modes.

Road under rail solutions often do not require any modifications to rail platforms because the level of the rail does not change.

Additional pedestrian bridges may be used to maintain or improve access across the lowered road to maintain access.



## RAIL UNDER ROAD

This option involves lowering the rail line beneath the existing road. A new bridge is built to maintain the road at its existing level.

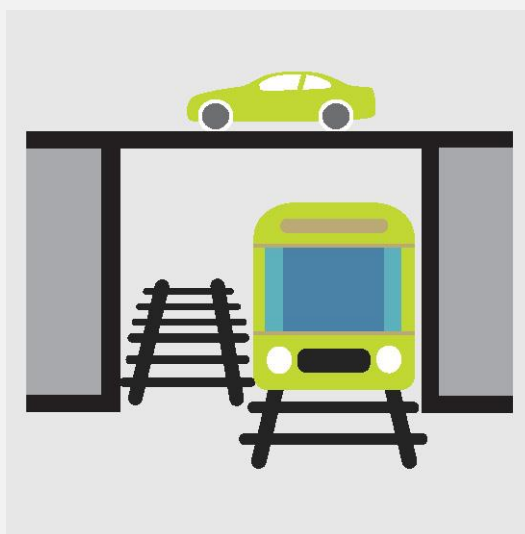
This option:

- Addresses the core transport problem
- Addresses the core safety problem
- Addresses community severance / local amenity problems by making access across the rail corridor easier at the site where the level crossing used to be and maintaining the connectivity of the local network.

A rail under road solution works well when road over and under solutions would significantly impact local accessibility and connectivity.

Where there are nearby train stations, these need to be modified or rebuilt to suit the new rail level.

Additional pedestrian / cycling bridges may be used to improve access across the lowered railway.



## RAIL OVER ROAD

The road is maintained at its existing level and a new rail bridge is built over the road. Modifications to train stations are required, at least to the platform levels, to suit the new rail level.

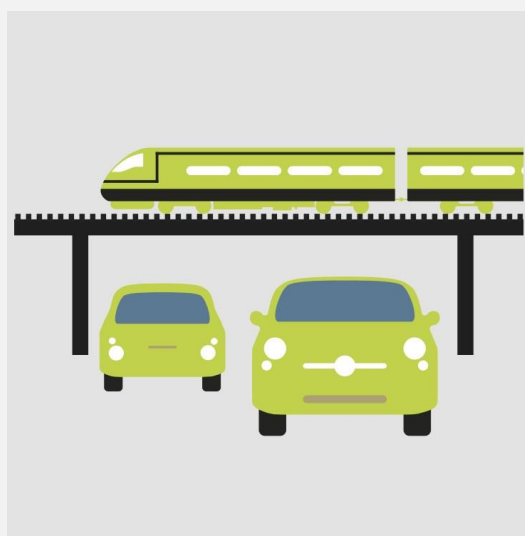
This option:

- Addresses the core transport problem
- Addresses the core safety problem
- Addresses community severance / local amenity problems by making access across the rail corridor easier at the site where the level crossing used to be and at other locations

Rail over road works well when road over and under solutions would significantly impact local accessibility and connectivity.

Where there are nearby train stations, these need to be modified or rebuilt to suit the new rail level.

Elevating the rail line provides opportunities for increased connectivity across the rail corridor.



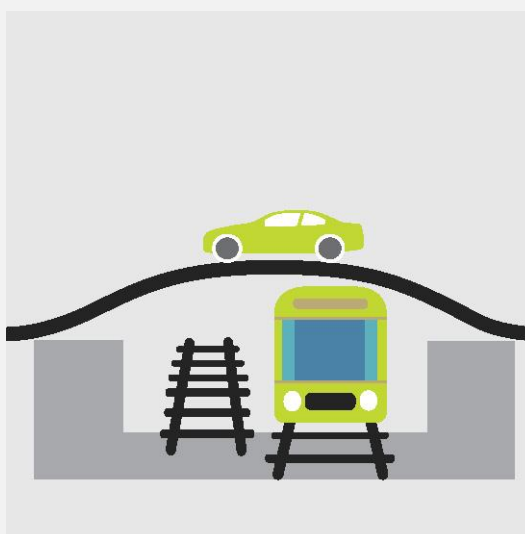
## HYBRID OPTIONS

Hybrid options are variants of road over/under rail and rail over/under road options. Instead of raising or lowering only the road or rail to achieve the required vertical clearance for vehicles, both the road and rail are raised/lowered.

Hybrid options work well when there are technical constraints that make straight road over/under rail and rail over/under road options not feasible, or more expensive.

This may be due to overhead utilities, geotechnical issues or geometric road/rail design constraints.

Hybrid options provide similar benefits as their typical road/rail over/under counterparts.



### CLOSE ROAD AND PROVIDE FULL GRADE SEPARATED CROSSING OF THE RAIL LINE NEARBY

This option involves closing the level crossing (effectively closing the road to traffic) and providing a new grade separated rail crossing at an alternative nearby location.

This option:

- Addresses the core transport problem
- Addresses the core safety problem
- Addresses community severance / local amenity problems and can provide a strategic road network benefit.

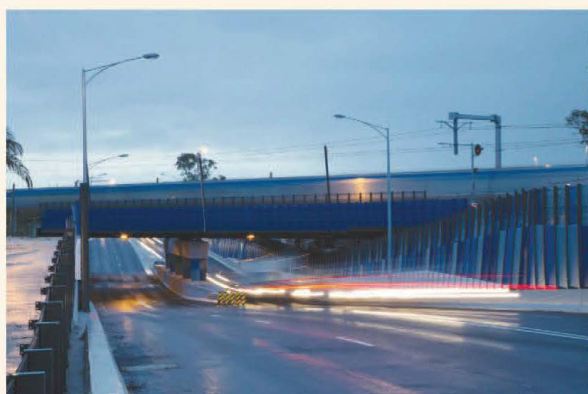
This option works well when there are technical challenges with separating the road and rail at the nominated level crossing location and a nearby alternative is available.

This option also works well when there is an overall strategic road network benefit by connecting the road network across the rail corridor at the alternative location.

These options may include other works to ensure that the new alignment does not create other issues at the alternative location. For example, a newly created intersection may result in increased traffic volumes and congestion.

Pedestrian access across the railway would either be provided at the alternative crossing location or by a pedestrian overpass or underpass.





Anderson Road, Sunshine (Road-under-rail)



Balaclava Station (Rail-over-road)



Collins Street (Road-over-rail)



Mitcham Station (Rail-under-road)

## Melbourne's existing 'grade separated' road/rail crossing

Each form of grade separation can be seen on Melbourne's rail network already. For example:

- Rail-under-road solutions can be seen in the recent grade separations at Springvale, Nunawading and Mitcham stations, as well as on older parts of the network such as between South Yarra and Caulfield.
- Road-over-rail bridges can be seen on Collins Street, near Southern Cross Station and near Burnley station.
- Rail-over-road bridges feature in many inner urban locations such as Balaclava, Glenferrie and the stations between Jolimont and Clifton Hill.
- Road-under-rail solutions can be seen in the recent grade separations of Anderson Road, Sunshine, as part of the Regional Rail Link project, and Taylors Road in St Albans near Keilor Plains station.

## 5.3 Metropolitan Network Modernisation Program

At many of the 50 level crossings, the LXP will deliver road improvements, railway station improvements, improvements to public transport access and improved pedestrian and bicycle facilities. These improvements are complementary to the core transport project of removing the level crossing, however they are important elements of the program to ensure that the benefits are achieved.

The LXP interacts with many elements of the transport network. This project has a clear relationship with road networks, including those with priority for car, bus, tram, freight traffic as well as impacts to emergency services.

Many level crossings have significance for bus networks and interchanges, and walking and cycling networks. This is particularly the case for crossings in the vicinity of train stations, many of which are in activity centres. Train stations play a critical role in connecting passengers with nearby community facilities and employment destinations.

A range of transport network improvements, from major rail and road projects, through to small-scale improvements, all of which support pedestrian movements and cycling, are made possible or made better by level crossing removals. Because of the significance of these major projects for Melbourne's overall transport plans, and because the opportunity to realise localised but valuable transport improvements is substantial in aggregate across the 50 locations, the facilitation of these metropolitan network modernisation program improvements has been identified as an important aspect of the overall strategic response to the problems identified in Chapter 2.

While implementation of rail, road and bus network improvements are responsibilities of other agencies, identification of these opportunities, joint planning where appropriate and ensuring delivery is co-ordinated with level crossing removals are important actions falling under the remit of the LXP and the development of Works Package/Project Proposals.

Bus network routing and timetabling changes to capitalise on reliability improvements in the vicinity of level crossings may be possible in certain locations where, at present, the design and operation of some bus routes are constrained by rail corridors and congested level crossings. This includes some cases where bus routes are designed to avoid having to cross the rail corridor and routes where punctuality and patronage are negatively impacted by the rail corridor or by local road and station precinct layouts that do not support efficient modal interchange. Identifying these opportunities and working with PTV to ensure they are capitalised upon in road and station redesign will be an important element in the development of Works Package/Project Proposals and the delivery of each level crossing removal.

Similarly, level crossing removals may open opportunities for more efficient road network design and operations, including potential for revisions to the road use hierarchy developed by VicRoads. For example, the removal of level crossings may alter traffic patterns such that certain roads can become preferred traffic routes, with the function of other roads altered in order to better support local traffic. There may also be opportunities to deliver new road links in conjunction with level crossing removals as part of the longer term development strategy. Working with VicRoads during Works Package/Project Proposal development will identify these opportunities. This may result in changes to the scope of level crossing removal project design (such as incorporating active or passive provision for additional lanes in future) to better support future road network plans.

Re-design of stations and access points to better support pedestrian movements, activate station precincts and better integrate stations with surrounding activity centres is another important consideration in scoping level crossing removals. Identification of these opportunities will occur during Works Package/Project Proposal development and will be guided by both stakeholder views and the LXRA Urban Design Framework, described in Section 9.9.1.

## 5.4 Urban Amenity and physical integration of activity precincts and communities

Removing a level crossing is more than an engineering project. Many crossings are adjacent to train stations that often sit at the heart of local communities, while non-station sites can also have sensitive land uses nearby. The infrastructure that replaces a crossing will often have a major impact on the form and amenity – the ‘look and feel’ – of the local area, and designing grade separations to maintain or enhance the attraction of these areas is a critical challenge. The risks are significant – the infrastructure will remain for generations – but so are the opportunities.

Level crossings are often identified as an eyesore and as degrading nearby land, therefore constraining the ability to ‘join up’ activity centres severed by rail lines. Regardless of the infrastructure option chosen, removing the crossing will remove some of these unattractive elements.

Each solution also carries risks of poor amenity outcomes if not designed carefully. While some impacts are inherent to the infrastructure option, many amenity risks can be mitigated by good design, for example, by incorporating additional elements into the project to avoid noise issues or visually unattractive structures.

Level crossing removals also offer a broader ‘place-making’ opportunity – the opportunity to aid local walkability, improve station access and activate station precincts. Good urban design can also ensure that opportunities are realised to make the structures not only more attractive, but also more functional for users and the community.

To guide the scoping of projects under the LXRP, and ensure high-quality design to mitigate these risks and take advantage of the opportunities, an Urban Design Framework (UDF) has been developed by the Level Crossing Removal Authority. The framework outlines how good design can help avoid adverse impacts and enhance the urban realm. The UDF is further described in Section 9.9.1.

## 5.5 Integrated land use along rail corridors

### 5.5.1 Integrated planning and value capture

Transport and land-use decisions are inextricably linked: the connectivity to markets and services that transport infrastructure provides influences the type and intensity of development in that area (sometimes negatively, for land in close proximity to busy roads or railways).

As recognition of this point has grown, policy approaches have emphasised closer integration between transport and land-use planning. Victoria has led the way in this regard, with the *Transport Integration Act 2010* specifying integration of transport and land use as an objective to be supported by transport decisions. This objective is reinforced in the *Plan Melbourne* metropolitan planning strategy, which recognises integrated land use and transport planning as a key concept in planning for Melbourne’s future and includes a direction to “define a new city structure to deliver an integrated land use and transport strategy for Melbourne’s changing economy”.<sup>52</sup>

Integrated planning can occur at all levels, from the city- or network-wide to the local<sup>53</sup> At the city scale, land releases coordinated with major transport extensions can ensure residential development is channelled towards areas with good access to jobs and services. On a local scale, encouraging more intensive development in the immediate vicinity of transport nodes (such as rail stations) can make the most of existing transport infrastructure. This type of action at the micro-level can support macro-level objectives of a denser, more connected and more productive distribution of residents and businesses.

In parallel with this evolution in thinking about integrated planning has come an increasing recognition that transport projects (or planning changes) which stimulate more intensive land uses ultimately deliver much of their benefits to landowners, not transport users, as the rents and values of land with improved connectivity rise. This has motivated moves by government to ‘value capture’ – adopting a beneficiary-pays funding approach that sees the uplift generated by better transport (or relaxed land use restrictions) monetised and used to fund the upfront investment, thereby reducing reliance on traditional tax bases.

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<sup>52</sup> Direction 1.1, *Plan Melbourne*

<sup>53</sup> See National Guidelines for Transportation System Management for discussion (NGTSM), Vol. A, p12

Value capture can involve a variety of instruments, from new taxes or charges on beneficiaries to the sale of development rights on state-owned land that has been enhanced by transport improvements. The former are best suited to where transport improvements generate substantial gains to a well-defined set of beneficiaries, which is not typically the case for level crossing removals. In pursuing value capture through the LXR, the Government has adopted a position that integrated development opportunities should be fully explored as part of the design of solutions. It is not proposed that LXR's approach to realising value capture opportunities will take into consideration any new taxes or charges.

## 5.5.2 Opportunity and approach

Level crossing removals and new stations provide an opportunity to undertake integrated development around stations, both to activate station precincts and improve local amenity (as discussed above), as well as to make better use of currently under-used land, encourage development around public transport networks and contribute to more efficient patterns of development across the wider city.

Development on surplus state-owned land adjacent to railway tracks or on sites created by the infrastructure works (such as sites over or under rail tracks or roads) can be used to improve the character of station precincts and potentially encourage complementary actions by developers, Councils or other parties.

Integrated development by the state in concert with level crossing removals could deliver a double dividend: as well as promoting better land use and local amenity, it could also generate additional revenue or offset project costs, thereby reducing the overall cost of the program to taxpayers (a 'value capture' approach).

Across the program as a whole there is potential for a moderate, but not insignificant, percentage of the overall program cost to be recouped as development revenue.

*The Government's Project 10,000* election platform laid out a substantial role for property development on and around rail infrastructure to help fund level crossing removals and improvements to station facilities. As part of an overall strategic response designed to deliver connected, productive and thriving communities, the LXR will take this role forward by actively exploring opportunities for integrated property development as described in the sections below. A broadly consistent approach will be used across projects, albeit with the approach to later projects drawing on lessons learned from earlier projects.



## Approach to integrated property development



Mockingbird station, Dallas, Texas, USA



Chatswood station, Sydney, Australia



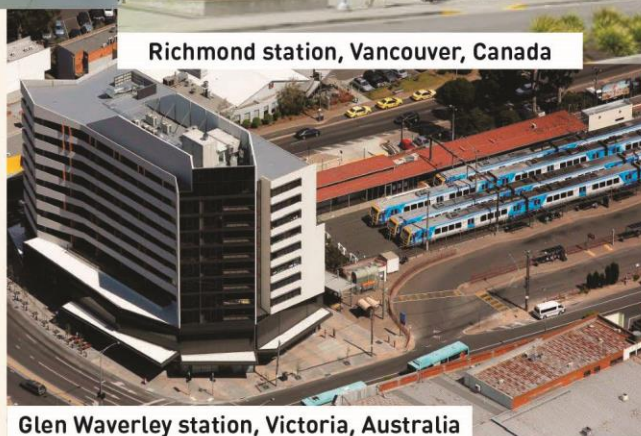
Stratford station, London, UK



Richmond station, Vancouver, Canada

### Integrated property development delivers positive outcomes

The integration of land use and transport can have substantial community benefits. These benefits include greater choice of housing close to jobs and everyday conveniences, as well as the option of reduced car use (which can save the householder money).



Glen Waverley station, Victoria, Australia

Planning and design for this integration must take an approach appropriate for each particular location. Examples of places that have been successfully renewed in this way include Chatswood station in Sydney and Subiaco station in Perth. Other examples include Stratford station in London, Richmond in Vancouver, Canada and Mockingbird station in Dallas, Texas, USA. These approaches have improved access to jobs, created more housing choices and stimulated redevelopment of former industrial zones or rail land. Creating value from underutilised rail land will improve access to the station, safety and amenity. In Victoria, VicTrack's IKON Glen Waverley development has transformed the station precinct with retail, commercial and residential facilities – the project delivered a 10-storey mixed use apartment and retail development that includes ground-floor retail, an office level, and 116 one-and-two-bedroom apartments over eight levels, and two levels of basement parking. Part of the proceeds from the development funded station forecourt upgrades.

Source: Plan Melbourne

A key change in the approach towards integrated property development across the LXP, in comparison to previous level crossing removal projects, is the focus on:

- Identifying potential commercial opportunities integrated with the infrastructure works at an earlier stage in project planning;
- Including provision for these opportunities in project scope/design, while allowing scope for bidders to innovate in their approaches to realising the opportunities; and
- Providing greater certainty to bidders about the planning envelope and possibilities for the site, while also providing a process for community consultation to influence these possibilities.

Each level crossing site and infrastructure solution will present different opportunities for complementary property development and at some sites no practical opportunities will be present. Development potential at each location will depend on a range of factors, availability of suitable land and the nature of existing land uses around the site. Whether this potential can be realised will also reflect market appetite for the sites and the commercial risks involved, as well as additional costs of any works required to enable development to proceed (such as constructing a pad over sunken rail lines).

Recognising the unique circumstances of each site, identification of development opportunities will be done via Works Package/Project Proposals and the procurement process, not through program-level planning. An initial scan of opportunities across the program has been conducted to estimate the quantum of revenue achievable and to inform the design of value capture activities at project level, but thorough scoping of opportunities will occur at project level.

Works Package/Project Proposals will assess site-specific integrated property development opportunities, which may include a combination of retail, commercial or residential development on:

- Project land which is surplus to project requirements;
- Air space over the transport infrastructure;
- Land adjacent to the project land, which is either already owned by the state or acquired by the state as part of the project; and
- Other commercial opportunities such as signage, advertising rights and agreements relating to telecommunications and other infrastructure services.

Works Package/Project Proposals will also outline potential opportunities for the state to acquire land adjacent to the project land and either on-sell that land to private sector developers or, alternatively, consolidate the adjoining land with property within the project area to maximise the potential development rights.

In some cases, identifying these opportunities may lead to additional elements or packages being added to the original project concept. For example, these might include improvements to local amenity, enhanced access for residents in the area around the new asset or additional engineering works to permit construction over rail lines. While this may lead to a project with a higher upfront capital cost, the investment will result in an overall higher net return from property development revenues. This is an important consideration in determining project scope and will inform Works Package/Project Proposal recommendations on whether the prospective benefits are commensurate with any additional cost.

In some cases, the state will facilitate development opportunities that are ready to go to market immediately. However, not every value capture opportunity will be immediately realisable; for example, the cost of enabling works (such as capping sunken track) at some locations will exceed the expected value of the sites created. In these situations, the state's actions will be designed to preserve the option to conduct later development if market conditions are supportive, by either investing in enabling works that prepare the site for development or by defining the scope of works so as not to preclude the possibility of enabling works and development to be undertaken in future.

Through the procurement process for each package of works, the project scope will also be carefully defined to elicit innovation by the market, leaving sufficient latitude for bidders to bring forward innovative ideas about how best to achieve revenue and urban renewal objectives at each site.

This process at project level has already begun. As noted above, discussions around enhancing the first package of level crossing removals with property development are underway and the market engagement process for the Caulfield-Dandenong sites has encouraged bidders to team up with development partners to submit options for development opportunities in addition to the core infrastructure works.

## Planning approvals

Where previous grade separation projects have permitted value capture ideas to be put forward by proponents, there has not always been clarity about the feasible types of development or the state's role in facilitating these. This has made it difficult to compare alternative bids that have used different assumptions about planning approvals.

In relation to the LXP, there are a range of facilitating actions the state can take that will provide certainty around timeframes and planning restrictions to bidders in order to maximise the uptake of property development opportunities.

The planning approvals pathway builds on the approach used to facilitate level crossing removals to date, which uses ministerial powers under the *Planning and Environment Act 1987*. A two-stage process will be adopted for each site where value capture opportunities are identified. In instances where no value capture opportunities are identified, only the first stage will be required.

**Stage 1** provides certainty for the core project deliverable, being the level crossing removal. This stage involves the Minister for Planning preparing a planning scheme amendment to facilitate the level crossing removal works, as well as any works required to enable development opportunities within the area.

**Stage 2** involves appointment by the Minister of an Advisory Committee to consider and advise on development opportunities available and the appropriate planning controls to enable these. Each committee will consult with relevant stakeholders and affected persons and provide them with an opportunity to make a submission, before finalising recommendations to the Minister about the appropriate planning controls for the site. The Minister will then decide on the proposed planning scheme amendments to facilitate the development and assign a Responsible Authority to oversee the project.

## 5.6 The LXP in the broader context

A number of strategies, policies and programs support the LXP in targeting and facilitating the removal of level crossings in Melbourne.

### 5.6.1 Victorian context

Successfully delivering the benefits identified above will align with key policies and legislation guiding the provision of integrated and improved transport services in Victoria. The relationship between the benefits sought by the LXP and key Victorian Government policies is outlined in Table 5-1.

#### The Transport Integration Act 2010

The *Transport Integration Act 2010* (the TIA) came into effect on 1 July 2010 and is Victoria's principal transport statute. The Act aims to ensure that transport and land use agencies work together to develop an integrated and sustainable transport system, and sets out six transport system objectives and seven decision-making principles to guide agencies:

The TIA's six transport system objectives cover:

1. Social and economic inclusion
2. Economic prosperity
3. Environmental sustainability
4. Integration of transport and land use
5. Efficiency, coordination and reliability
6. Safety and health and wellbeing

By addressing the Problems identified in Chapter 2, a range of benefits will be delivered:

- Support social and economic inclusion as people can more easily use the transport network to access jobs and services.
- Enhance economic prosperity through accessibility to jobs and improved freight efficiency.
- Promote environmental sustainability by empowering public transport use and alleviating congestion
- Integrate transport and land use along rail corridors
- Improve efficiency and reliability of the road network and enable increased capacity on the rail network
- Increase safety by removing the hazards associated with level crossings and enhance wellbeing by encouraging active transport (walking and cycling)

Table 5-1: Alignment with Victorian Government policy, guidelines and plans

Benefit	Policies, Guidelines and Plans
Improved productivity from more reliable and efficient transport networks	Network Development Plan – PTV Dec 2012 – Chapters 3, 4, 5 and 6 Victorian Government Planning Framework – Chapters 2, 3 and 4 Public Transport Guidelines for Land Use Development 2008 (DoT) – Chapter 5 Project 10,000 State Planning Policy Framework – Sections 13, 14, 16, 17 and 18 Draft Planning Policy Framework VicRoads Network Operating Plans (SmartRoads) Our Cities Our Future - National Urban Policy
Better connected, liveable and thriving communities	Victorian Government Planning Framework – Chapters 4 and 5 Public Transport Guidelines for Land Use and Development 2008 (DoT) – Chapter 2 State Planning Policy Framework – Sections 13, 14, 16, 17 and 18 Draft Planning Policy Framework Our Cities Our Future - National Urban Policy
Safer communities	Project 10,000 Our Cities Our Future - National Urban Policy

These plans, guidelines and policies are described in detail in below.

### **Project 10,000**

Removal of the level crossings is consistent with the Victorian Government’s *Project 10,000* commitment to:

- Remove 50 dangerous and congested level crossings on the metropolitan rail network, to increase train capacity and reduce congestion on the roads;
- Unlock land at, or close to, train stations;
- Actively pursue appropriate development opportunities that arise from level crossing removals, and reinvest the proceeds back into the public transport system; and
- Investigate cycling links alongside train corridors.

Undertaking multiple level crossing removals at the same time will provide opportunities for efficiencies in the delivery of these projects.

### **Network Development Plan – Metropolitan Rail**

Public Transport Victoria’s 2012 Network Development Plan – Metropolitan Rail is a suburb-by-suburb, line-by-line, demand-led strategy for planning Melbourne’s rail system over the next two to three decades. The Plan is designed to:

- Expand the capacity of the existing rail network to meet the growing needs of the city
- Re-design train services to maximise opportunities for seamless coordination with buses and trams
- Extend the rail network to areas currently not served by metropolitan rail.

The Plan sets out a staged approach to strengthening and securing Melbourne’s rail network, with the delivery of projects dependent on Commonwealth and State Government funding.

The delivery of the plan will provide a 50 per cent increase in peak hour capacity within 10 years and more than 100 per cent increase within 20 years. The rail network’s track-side signal system will be gradually replaced with new high capacity signalling to allow more trains to run on the network and Melbourne will shift to new, high capacity trains that can carry up to 1100 passengers.

The Plan is built around a fundamental shift in timetabling and train operations as Melbourne moves to a modern metro-style network common in major cities around the world – essentially a ‘turn up and go’ service across the network every day of the week.

Without investments such as the LXR, as the number of train services increases, level crossing closures will eventually become so frequent that many critical roads will cease to be effective traffic routes.

It should be noted that PTV's Network Development Plan is an aspirational plan for the increase of rail capacity based on PTV transport modelling. It is not Government policy or a committed program of service upgrades.

### ***Plan Melbourne Refresh***

*Plan Melbourne* is currently undergoing a review, led by the Department of Environment Land Water and Planning (DELWP) in consultation with the Metropolitan Planning Authority, DEDJTR, PTV and VicRoads. A discussion paper was released in October 2015. It is anticipated that a refreshed *Plan Melbourne* be released following community and stakeholder consultation.

*Plan Melbourne* sets out the State Government's vision for Melbourne and is designed to guide the planning and development of Melbourne through to 2050, with a strong focus on integrating land use, infrastructure and transport planning to meet the city's future population, housing and employment need.

### ***State Planning Policy Framework***

One of the objectives of the State Planning Policy Framework (SPPF) is to manage the road system to achieve integration, choice and balance by developing an efficient and safe network and making the most of existing infrastructure. The planning framework (section 18) requires the provision of grade separation at railway crossings. Under the SPPF, any new rail-road intersections created by new road or rail projects must be grade separated.

### ***Local Council Structure Plans***

Council Structure Plans provide a long-term framework for communities catering for between 10,000 to 30,000 people. Council structure planning is fundamental to making Victoria's growth areas attractive, accessible and well-connected places. Structure Plans lay out roads, shopping centres, schools, parks, housing, employment and connections to transport and also address complex issues such as biodiversity, cultural heritage, infrastructure provision and council charges.

Many established areas in Melbourne have the capacity to substantially increase their populations and attract new businesses and jobs, but access to and from these areas is limited by the current constraints of the transport system. The LXR will enable more efficient use of underutilised land near rail corridors and allow an increase in rail services to improve links to job rich areas and local amenities, which in turn will support the liveability and amenity of growing areas.

### ***Public Transport Precinct Policy***

The Public Transport Precinct Policy is part of the PTV Network Technical Policy suite of asset and process policies. The Policy outlines high level principles to ensure precincts are designed to create high quality transport outcomes for the State as required by the *Transport Integration Act* and to better meet the needs of customers and key stakeholders. The Policy's principles focus on:

- People: facilitating customers' public transport journeys, offering a reliable, safe, predictable and comfortable experience
- Connections: clear and efficient connections between public transport services, walking and cycling and other private modes
- Environment: well designed and highly considered urban design, architecture and landscape.

The LXR will be aligned with the Policy principles, providing opportunities for urban renewal close to rail and further development along the rail corridors. These will be supported by increased rail services. Removing level crossings will remove bottlenecks and barriers created by boom gates and enable more reliable intermodal interchange points, which will encourage active transport, improve public transport connections and support suburban employment growth.

## ***Public Transport Guidelines for Land Use and Development***

The Public Transport Guidelines for Land Use and Development assist with decision making on statutory and strategic planning proposals for land use developments that affect public transport planning and delivery. The Guidelines are used by Public Transport Victoria to assess planning permit applications in its role as a Referral Authority. The guidelines state that the design of transport routes at new developments must provide for grade separation at railway crossings.

## ***Metro Trains Melbourne's (MTM's) "Melbourne Metro Strategic Operational Plan, 2015"***

The three main strategic objectives of the Plan are to:

- Improve the customer experience, including adding additional infrastructure capacity to enable additional services and improvements to intermodal connectivity through improvements to stations;
- Enable patronage growth through High Capacity Signalling and High Capacity Metro Trains, such as on the Dandenong Corridor; and
- Deliver five fully segregated railway groups and a simplified network, resulting in a network that supports more frequent and reliable services.

The level crossing removal projects as part of the LXR, including new stations and improvements to bus interchanges, are featured in the Plan and are required to achieve its strategic objectives.

## ***SmartRoads***

SmartRoads is an integrated strategy that aims to better manage the use of roads, consistent with land use, and to encourage more efficient and sustainable transport modes. SmartRoads recognises the increasing importance of public transport, walking and cycling as transport modes.

SmartRoads promotes the best use of the arterial road network by using a set of guiding principles to establish priority use of roads for different modes of transport at particular times of the day. This facilitates better community outcomes by providing 'best fit' services to road users, thereby enhancing urban amenity. The approach ensures that decisions about the operation of the road network support integrated land use and transport planning.

### ***Road Use Hierarchy***

The Road Use Hierarchy allocates priority road use by transport mode, place and time of day. This hierarchy is considered an essential part of a planned approach to managing congestion and improving overall road safety outcomes. A road use hierarchy recognises the role of mixed-use urban places and the growing diversity and demand on transport.

### ***Network Operating Plans***

The Network Operating Plans developed under SmartRoads underpin future on-road transport strategies and respond to land use changes and community aspirations in a growing, changing city. The plans are reviewed whenever significant changes to the transport system occur or when network performance at particular locations becomes problematic.

The LXR supports the road use hierarchy priorities by delivering transport infrastructure that responds to gaps identified in network performance through network fit assessments.

## ***Active Transport Victoria***

A key election commitment of the Government is the \$100 million safer active transport infrastructure fund, and the establishment of a new authority, called Active Transport Victoria, to promote cycling and walking. The fund will go towards dedicated paths, routes to railway stations and into the CBD from middle and inner suburbs, and new routes in regional areas.

The LXR will complement the work being planned by Active Transport Victoria by improving pedestrian and cyclist access into station precincts and activity centres.

## **Victoria's Road Safety Strategy 2013-2022**

Victoria's Road Safety Strategy, in line with the National Road Safety Strategy, is based on a Safe System approach to road safety that aims to minimise the risk of death or serious injury on the roads by taking into account the interaction between roads, vehicles, speeds and road users. The Safe System approach recognises that humans, as road users, are fallible and will make mistakes which result in crashes. Within the safe system model, if a mistake is made, the impact is reduced or negated by safer roads, vehicles, speeds and people.

Level crossings are locations of potentially catastrophic (multiple fatality) accidents. The LXR P aligns with the strategy principles by removing the potential conflict between trains and all road users.

### 5.6.2 National context

#### **Infrastructure Australia's Infrastructure Audit, Infrastructure Plan, and Priority List**

Infrastructure Australia's most recent national audit (April 2015) recognises a number of ongoing challenges around:

- The demand for urban transport;
- The significance of Melbourne's key employment precincts and growth areas in a national context;
- The need for a focus on productivity benefits of infrastructure investment; and
- The sustainability of current funding models for land transport.

The audit encapsulates a number of transport policy and planning reform issues of particular interest to Victoria, some of which complement the objectives of the level crossing removal program.

- *Transport demand*  
Demand for urban transport is expected to increase significantly and exceed capacity on some corridors, with associated costs of congestion.  
The freight task is expected to increase significantly and will require wider use of higher productivity vehicles and a growing role for rail. This will impact on existing level crossings.
- *Planning*  
There is a need for a strong and consistent pipeline of future infrastructure projects.  
Urban transport decisions need to complement land use decisions.  
The need for more engagement and transparency with the community throughout the infrastructure planning and decision making process.

In February 2016 Infrastructure Australia released its first Infrastructure Plan, developed following consultation on the audit. The plan sets out the infrastructure challenges and opportunities Australia faces over the next 15 years, and the solutions required. Amongst other recommendations for reform is a recommendation that governments upgrade legacy capital city passenger transport infrastructure to deliver higher capacity, high-frequency services across all modes.

In the Infrastructure Priority List released concurrently, Infrastructure Australia identified the Cranbourne-Pakenham level crossing removals as a "high priority" initiative, along with the Cranbourne-Pakenham Line Upgrade and Metro Tunnel – both of which deliver higher capacity high-frequency services, and are projects for which the LXR P is a key enabler. Melbourne level crossing removals more generally were identified as a "priority initiative".

*Commercial-in-Confidence information has been redacted prior to publication*



# Chapter 6

## Project options



## CHAPTER 6: PROJECT OPTIONS - SUMMARY

A wide range of potential options are available to the LXR. These have been reviewed, assessed and refined to establish a budget envelope for delivering a credible range of options at each level crossing removal site.

An Options Assessment Framework has been developed to assess and shortlist a range of options at each site in a consistent manner that meets both the Project Objectives and timelines. This approach will ensure that the assessment of options is cost-effective, defensible, comprehensive, transparent and consistent across all sites.

The assessment framework was applied to all level crossing removal sites, except the first 20 sites, for which recommended solutions were already developed. The application of the framework resulted in the identification of a Reference Option for each site.

The Reference Option represents a feasible solution for removal of the level crossing (such as Rail under Road or Road over Rail) , plus the Metropolitan Network Modernisation Program improvements ( including new train stations, improved public transport access, and new pedestrian and cycling links) and amenity improvements such as landscaping and streetscape improvements.

The Reference Options represent a point-in-time view developed in February 2016 of how the LXR could be delivered. There may be other feasible options for removing level crossings at some sites. Further detailed investigation and public consultation will be undertaken and will inform the recommended solution(s). Individual Project Proposals or Works Package Proposals, outlining the recommended solution(s), will be prepared for each level crossing removal site (or package).

The Reference Options selected for the 50 sites comprise the following:

[Redacted content]

As part of these Reference Options, the following Metropolitan Network Modernisation Program improvements for the 50 sites will be provided:

[Redacted content]

Opportunities to provide integrated development of state-owned land within and nearby existing rail and road corridors as part of the LXR have also been considered [Redacted content]

Further detailed investigation and consultation with community and government stakeholders will be undertaken as the project progresses via Project/ Works Package Proposals and the procurement process, to properly understand and evaluate the site-specific conditions that influence the integrated development opportunities available.

## 6 Project options

### 6.1 Assessment of project options

To identify the most appropriate project option for each site, an options assessment process must be undertaken. As LXRA was established after options assessments were completed for a number of sites, the assessments undertaken differ in approach and in the level of detail undertaken. However, while the approaches have been different, each site has undergone a stringent assessment using variations of multi-criteria analysis, and testing with the market through competitive bid processes to compare shortlisted options. This has determined the approach that will deliver the greatest overall net benefit for each site and package of level crossing removals.

#### 6.1.1 Previous approaches to selecting options

##### ***Projects under construction***

The establishment of the LXRP places a stronger priority on the need for a broader project and a more rigorous timeline to ensure the program's delivery.

Projects already underway were incorporated into the LXRP. They comprise:

- Four sites at Blackburn Road, Main Road, Burke Road and North Road for which full business cases had already been completed by VicRoads and approved – these business cases included a detailed analysis of each site (using a multi-criteria analysis) and comprehensive discussions with stakeholders and the community to determine the recommended options for each site.
- Six other sites at McKinnon Road, Centre Road (Bentleigh), Furlong Road, Heatherdale Road, Mountain Highway and Scoresby Road underwent a more streamlined options assessment process to identify the recommended solutions.

##### ***Thompsons Road***

Given the scope and timing of the project, and the Government's commitment to deliver 20 level crossing removals by 2018, VicRoads has included the removal of the level crossing within the broader Thompsons Road Duplication Project business case. The business case includes an options assessment for the level crossing removal to determine the recommended solution.

##### ***Caulfield-Dandenong Level Crossing Removals and Rail Upgrade Project (CD9 Project)***

The CD9 Project includes the following 9 level crossing sites:

- Grange Road, Carnegie
- Koornang Road, Carnegie
- Murrumbeena Road, Murrumbeena
- Poath Road, Murrumbeena
- Clayton Road, Clayton
- Centre Road, Clayton
- Corrigan Road, Noble Park
- Heatherton Road, Noble Park
- Chandler Road, Noble Park

The Project Proposal for the CD9 Project was developed prior to the development of the LXRA Options Assessment Framework described in Section 6.1.2. The Project Proposal assessment process outlined an initial analysis of the options to provide certainty regarding engineering feasibility, benefits derived, and potential impacts of each option. This assessment process produced a shortlisting of project options. A more detailed assessment was undertaken of the shortlisted options, based on appraisals by technical specialists who rated each option in terms of its economic, social and environmental impacts according to qualitative criteria assessment ratings.

The option for each site on the CD9 was finalised through the procurement process via a competitive alliance. Under this procurement process, tenders were evaluated against a framework that includes price and non-price attributes. There were incentives for tenderers to innovate during the design process to develop a solution that demonstrates value-for-money to the Government.

## 6.1.2 LXRA Options Assessment Framework

The LXRA Options Assessment Framework has been created to support the selection of Reference Options, and Final Assessment of Project Options for the remaining 30 sites.

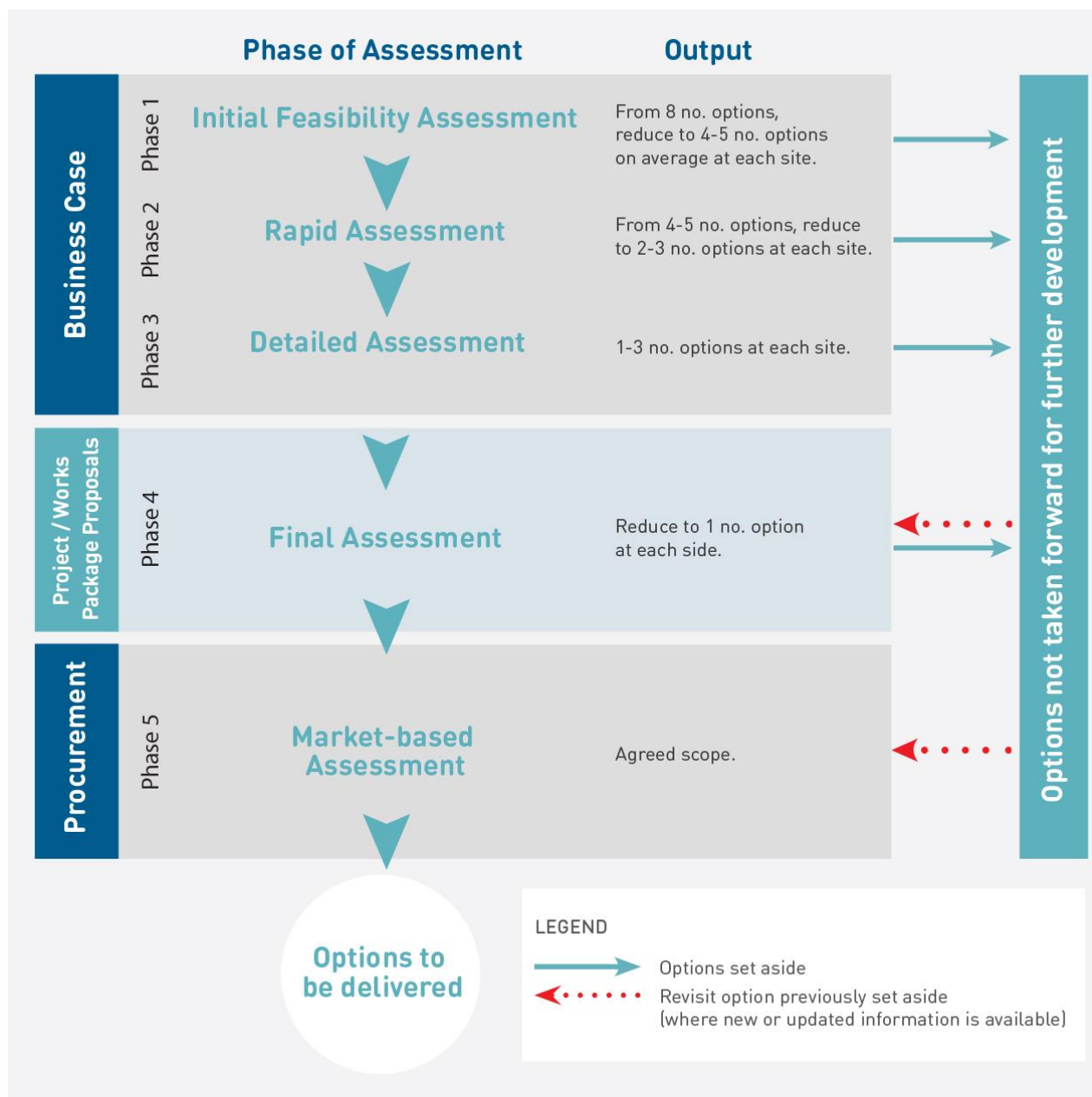
This framework aims to create a consistent approach to assess and shortlist a range of options at each site that meets the LXRP objectives and timelines. This approach will ensure that the assessment of options is cost-effective, defensible, comprehensive, transparent and consistent across all remaining sites.

The framework requires options assessment to be carried out in five phases.

1. Initial Feasibility Assessment
2. Rapid Assessment
3. Detailed Assessment
4. Final Assessment
5. Market-based Assessment.

The phased approach and the time at which each phase occurs in the project cycle are shown in Figure 6-1. At each stage options may be set aside and not taken forward to the next stage of assessment.

Figure 6-1: Options Assessment Framework



The **Initial Feasibility Assessment** identifies options that are considered technically not feasible to implement. These options are set aside, thereby providing a shorter list of options at each site to take forward for further development and assessment. The assessment is based on an evaluation of the viability of the option taking into consideration local features and factors, and its alignment with the Government’s policy to remove 50 Level Crossings by 2022.

From the short list of feasible options, the **Rapid Assessment** identifies the options to be further developed and taken forward to the detailed assessment phase. The option identification is based on a qualitative assessment of the performance of the option against Project objectives and Project outcomes.

During the **Detailed Assessment** a detailed evaluation of the performance and impacts of the remaining options identifies options to be taken forward to the Final Assessment Phase.

The **Final Assessment** involves a further detailed assessment of the performance and impacts of the remaining options, using more detailed site information, the LXP Urban Design Framework (refer Section 9.9.1) and further developed design documentation. This assessment will inform the scope of the Recommended solution.

The **Market-based Assessment** is an assessment of proposals put forward by bidders during the procurement stage to ensure that the proposed solution still meets the project objectives and will deliver the expected benefits.

Under this framework, the first three phases of assessment have been completed for the remaining 30 level crossing sites. The Final Assessment will be undertaken as part of the development of Works Package/Project Proposals and the Market Based Assessment will be undertaken during the procurement stage for each delivery package.

#### Assumptions and limitations of options development and assessment

The Options Assessment Framework undertaken for the sites includes the following key assumptions and limitations:

- The assessments undertaken to date are desktop reviews, based on preliminary and publically available information.
- Utility infrastructure was identified from Dial Before You Dig service and VicTrack asset data.
- Preliminary construction assessments were undertaken
- Options development is based on a like-for-like replacement of existing infrastructure
- Topographical information is preliminary
- Further consideration of the LXP Urban Design Framework and environmental impacts will be undertaken as part of the Works Package/Project Proposals.

At the end of each assessment phase a review of options set aside in previous assessment phases may occur. Options may be brought back into consideration as additional information from detailed site investigations, design development (including urban design) and constructability assessment become available, and further consultation with stakeholders is undertaken. For example, detailed geotechnical investigations may identify shallow ground water levels which may be contaminated. This could make a rail under road solution difficult and more expensive to construct and therefore a rail over road option may be a more feasible solution. Similarly, during the Market-based assessment phase, tenderers may identify innovative design and/or construction methodologies which may warrant previously set aside options to be brought back into consideration. Decisions for bringing options back into consideration will be clearly documented within the assessment of the current phase.

### 6.1.3 The multi-criteria analysis

The outcome of first three phases of the options assessment framework is a qualitative assessment for each option against set criteria to ensure a consistent approach across all sites. The multi-criteria analysis (MCA) describes the performance of options against measurable criteria to which specific weightings are assigned. The MCA for the LXP divides the analysis between three broad primary criteria, each of which has a specific set of secondary criteria to assess. The measured outcomes fall within three levels of performance, which have been developed to align with the benefits of the LXP and having regard to the *Transport Integration Act 2010*, as described in Section 5.6.1.

The table below summarises the MCA criteria and ratings. The full Options Assessment Framework and MCA is provided in Appendix E.

The criteria (primary and secondary) and the consideration and measures for each criterion have been developed to reflect the Program Benefits and KPIs.

Table 6-1: Summary of multi-criteria analysis

Primary Criteria	Secondary Criteria	Rating
Alignment with Project Benefits	Improved productivity through more reliable and efficient transport networks Better connected, liveable and thriving communities Safer communities	<i>Clear Improvement</i> <i>Marginal Improvement</i> <i>No Improvement</i>
Project Outcomes	Capital cost Whole of life cost Integrated development opportunities Timeframe Delivery risks Compliance with design standards and best practice Protection of future assets	<i>Strong Performance</i> <i>Average Performance</i> <i>Poor Performance</i>
Project Impacts	Land acquisition Impacts Land use impacts Environmental impacts Temporary impacts	

The multi-criteria analysis is further described in Appendix E

## 6.2 Recommended Options for 20 level crossing sites

The first 20 level crossing removal sites have been through robust options selection processes and the recommended options have been confirmed. While the processes vary, they are similar in nature to the Options Assessment Framework described in section 6.1 above.

The table below summarises the current recommended solutions for the 20 level crossings.

Table 6-2 – Recommended solutions for 20 level crossing sites

Site	Recommended Solution
Blackburn Road, Blackburn	Rail under Road
Burke Road, Glen Iris	Rail under Road
Centre Road, Bentleigh	Rail under Road
Centre Road, Clayton	Rail over Road
Chandler Road, Noble Park	Rail over Road
Clayton Road, Clayton	Rail over Road
Corrigan Road, Noble Park	Rail over Road
Furlong Road, St Albans	Rail under Road
Grange Road, Carnegie	Rail over Road
Heatherdale Road, Mitcham	Rail under Road
Heatherton Road, Noble Park	Rail over Road
Koornang Road, Carnegie	Rail over Road
Main Road, St Albans	Rail under Road
McKinnon Road, McKinnon	Rail under Road
Mountain Highway, Bayswater	Rail under Road
Murrumbeena Road, Murrumbeena	Rail over Road
North Road, Ormond	Rail under Road
Poath Road, Hughesdale	Rail over Road
Scoresby Road, Bayswater	Rail under Road
Thompsons Road, Lyndhurst	Road over Rail

## 6.3 Reference Options for 30 level crossing sites

For the remaining 30 level crossing sites, the first three phases of assessment have been completed under the Options Assessment Framework, and options were identified to be taken forward to the Final Assessment stage.

One of these options for each site is presented in depth in this Business Case. This is known as the **Reference Option**, and has been selected for the purposes of informing the funding envelope to deliver the LXR and conducting the program appraisal as of **February 2016**.

Based on the information available, the Reference Option is a feasible option to remove the level crossing, but not the only option. There may be other still feasible options for removing level crossings at some sites.

During the development of Works Package/Project Proposals, a **Recommended Solution** for each site will be selected based on the outcomes of the Final Assessment,

The Reference Options represent a point-in-time view as of February 2016, of how the program might be delivered. The Reference Options do not necessarily reflect the Final Assessment and Recommended Solution contained in Works Package/Project Proposals.

The tables below list the options examined in the Detailed Assessment, and those to be taken forward to the Final Assessment. The Reference Options are presented by railway line. The context for each of the railway lines is described in terms of key activity centres, employment clusters and precincts, and current land uses. Detailed site characteristics are provided for each site, followed by an outline of the key scope items of the Reference Option and the rationale for its selection.

Impacts of the Reference Option, any associated future proofing works, and integrated development opportunities are also described. These descriptions are based on preliminary investigations as of February 2016, and are not exhaustive. They are therefore subject to change as options are developed further in consultation with the community. Further investigation of these impacts, future proofing options, interfaces and opportunities for synergies with other projects, for example Metro Tunnel, will be detailed in the Works Package/Project Proposal stage.

An initial assessment of the potential integrated development opportunities associated with the Reference Option at each of the remaining 30 level crossing sites has been completed by property development advisors. The result of this initial assessment serves as a guide for LXRA to further analyse the opportunities and to open dialogue with its stakeholders which may inform and influence the selection of the recommended solution(s). Using the MCA, three broad considerations were developed for the analysis of integrated development opportunities:

- **Development potential in the area.** This involved a high level review of development activity in the area, broader location context e.g. proximity to CBD and land uses surrounding the VicTrack land;
- **VicTrack site analysis.** This reviewed the scale, location, shape etc. of VicTrack land; and
- **Local government readiness/supportive planning context.** This involved a high level review of local planning context.

This analysis was undertaken as a desktop review. The analysis was undertaken assuming that the sites are vacant and available for development with no encumbrances, environmental, cultural heritage and/or ecological issues that could impact on use and development.

Analysis of the above considerations determined the extent of development opportunities associated with the Reference Option at each of the remaining 30 sites. The outcome of this analysis was given a category; low, medium or high, and this category is noted in each site summary. The definition of these categories is outlined in Table 6-3.



Table 6-3 – Categorisation of the viability of development opportunities

Consideration	Definition		
	Low	Medium	High
Development Potential in the Area	<ul style="list-style-type: none"> <li>▪ Little to no evidence of development activity in the area, both private and public</li> <li>▪ Small amounts of land under development</li> <li>▪ Underlying land values do not support development</li> <li>▪ Lack of amenity to support new development, for example the site is located away from infrastructure to enable development, i.e. utilities, transport, shopping, education, etc.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Examples of development in the area</li> <li>▪ Some sites under development</li> <li>▪ Underlying land values may support new development of scale</li> <li>▪ Some amenity in the area to support new development, for example the site is located near some existing infrastructure to enable development, i.e. utilities, transport, shopping, education, etc.</li> </ul>	<ul style="list-style-type: none"> <li>▪ High amount of development activity in the area</li> <li>▪ Easily identifiable land under development</li> <li>▪ Underlying land values support higher and better use to current built form</li> <li>▪ Established amenity in the area to support new development, for example the site is located within an area that has established infrastructure to enable development, i.e. utilities, transport, shopping, education, etc.</li> </ul>
VicTrack Site Analysis	<ul style="list-style-type: none"> <li>▪ VicTrack land does not provide scale to support redevelopment within VicTrack site boundaries</li> <li>▪ Site not strategically located with respect to surrounding development and future redevelopment opportunities</li> </ul>	<ul style="list-style-type: none"> <li>▪ VicTrack land provides some scale which may support redevelopment within VicTrack site boundaries</li> <li>▪ Location of VicTrack land provides some strategic advantage, for example at the periphery of an activity centre.</li> </ul>	<ul style="list-style-type: none"> <li>▪ VicTrack land provides significant scale with respect to the local area and will support redevelopment within VicTrack site boundaries</li> <li>▪ VicTrack land strategically located with respect to surrounding land uses; for example, in the middle of an activity centre</li> </ul>
Local Government readiness/ planning context to support	<ul style="list-style-type: none"> <li>▪ Current planning controls discourage redevelopment of VicTrack sites and/or surrounding land</li> <li>▪ No strategic documents demonstrating development potential for the area</li> </ul>	<ul style="list-style-type: none"> <li>▪ Current planning controls allow some redevelopment from current built form, may provide enough scale to justify redevelopment</li> <li>▪ Strategic document drafted demonstrating Council's strategic planning direction for the area</li> </ul>	<ul style="list-style-type: none"> <li>▪ Current planning controls support development of VicTrack land and/or surrounding land</li> <li>▪ Strategic document in place clearly demonstrating Council's planning policy and desired built form outcomes for the area</li> </ul>

Integrated development opportunities at a broader program level are discussed in Section 5.5.

Real Options (refer Section 7.4) were considered alongside the development of the core project options for the 30 sites and will be considered further during the development of the Works Package / Project Proposals.

### 6.3.1 Altona Loop Line

The Altona Loop Line is part of the Werribee Rail Line, which connects to Melbourne’s western suburbs and the emerging East Werribee employment cluster. The Altona Activity Centre is along the Altona Loop Line.

There are six level crossings on the Altona Loop Line. The level crossing at Kororoit Creek Road, Williamstown North will be removed under the Project.



**Kororoit Creek Road** in Williamstown North is an arterial road providing a key east-west connection between Williamstown, Princes Freeway (west) and the western suburbs. Under the SmartRoads Road User Hierarchy, the road is classified as an Other Traffic Route and Bicycle Priority Route at the level crossing. The land use surrounding the crossing is predominantly industrial, with the majority of uses and large sites related to oil refining and associated industries.

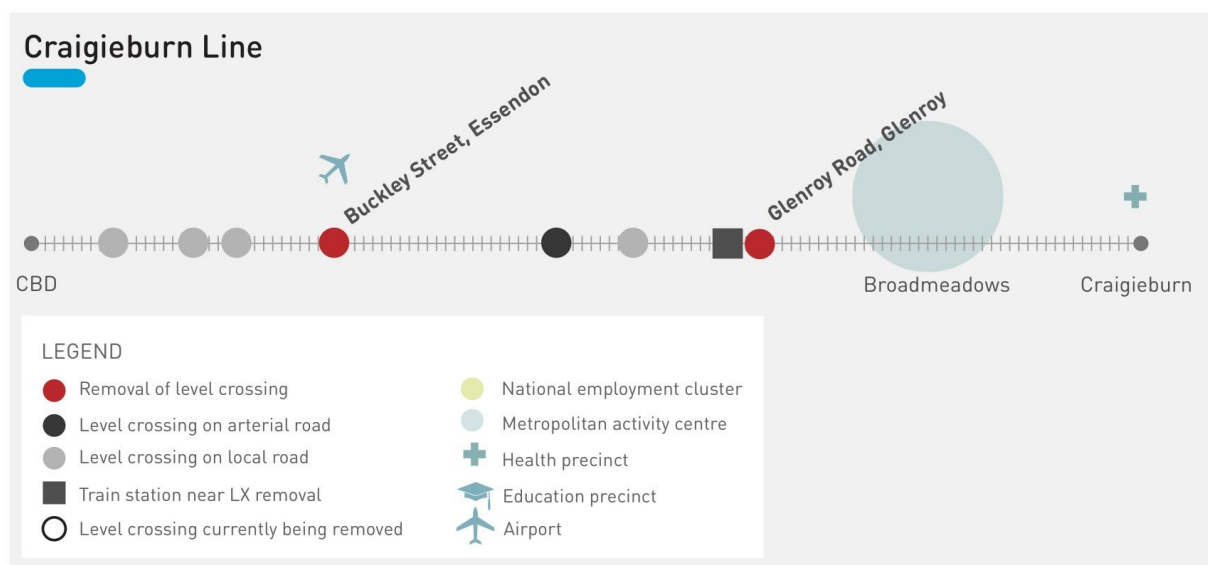
Kororoit Creek Road, Williamstown North	

<sup>54</sup> Online construction methodology assumes majority of works will be constructed on the existing rail alignment, requiring rail occupations to undertake the works. Offline construction methodology assumes majority of works can be constructed adjacent to the existing rail alignment, minimising rail occupations and disruption to the train line. Therefore trains can be run while construction works are occurring. Offline construction depends on the availability of land adjacent to the rail corridor.

## 6.3.2 Craigieburn Line

The Craigieburn Line serves the northern suburbs of Melbourne. There are a number of activity centres along the line, including Glenroy, Roxburgh Park and Craigieburn. There is also a Metropolitan Activity Centre at Broadmeadows.

There are seven level crossings on the Craigieburn Line. Two level crossings will be removed under the Project: Buckley Street, Essendon and Glenroy Road, Glenroy.



**Buckley Street** in Essendon is a declared arterial road and is considered to be a traffic, bus and bicycle priority route under the Smart Roads Road Use Hierarchy. The level crossing is located in the heart of the Essendon Activity Centre immediately south of Essendon Station. The area around Essendon train station consists of a mix of land uses including retail, cafes, restaurants and offices as well as sport, education and leisure facilities. The centre also acts as a modal interchange providing important connections between train, bus and tram services.

Essendon is located approximately 8 kilometres north west of the Melbourne CBD and is generally characterised by large-scale single residential dwellings and more recent medium to high density development around activity centres and public transport.

**Glenroy Road** in Glenroy is an east-west arterial road that connects Hadfield and Glenroy to Pascoe Vale Road. It is classified as a traffic, pedestrian and cycle priority route. The level crossing is located within the Glenroy Activity Centre, which is a focus for business, shopping and community services. The activity centre includes the Pascoe Vale Road and Wheatsheaf Road shopping centres, the industrial area to the east of the rail line and land abutting these areas.

Glenroy is located approximately 14 kilometres north west of the Melbourne CBD and is historically a mid-level, affordable northern residential suburb with some industrial use properties. Glenroy is currently undergoing significant development, whereby older housing stock is being developed to provide predominantly townhouse and unit development.

**Buckley Street, Essendon**

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Details of Reference Option

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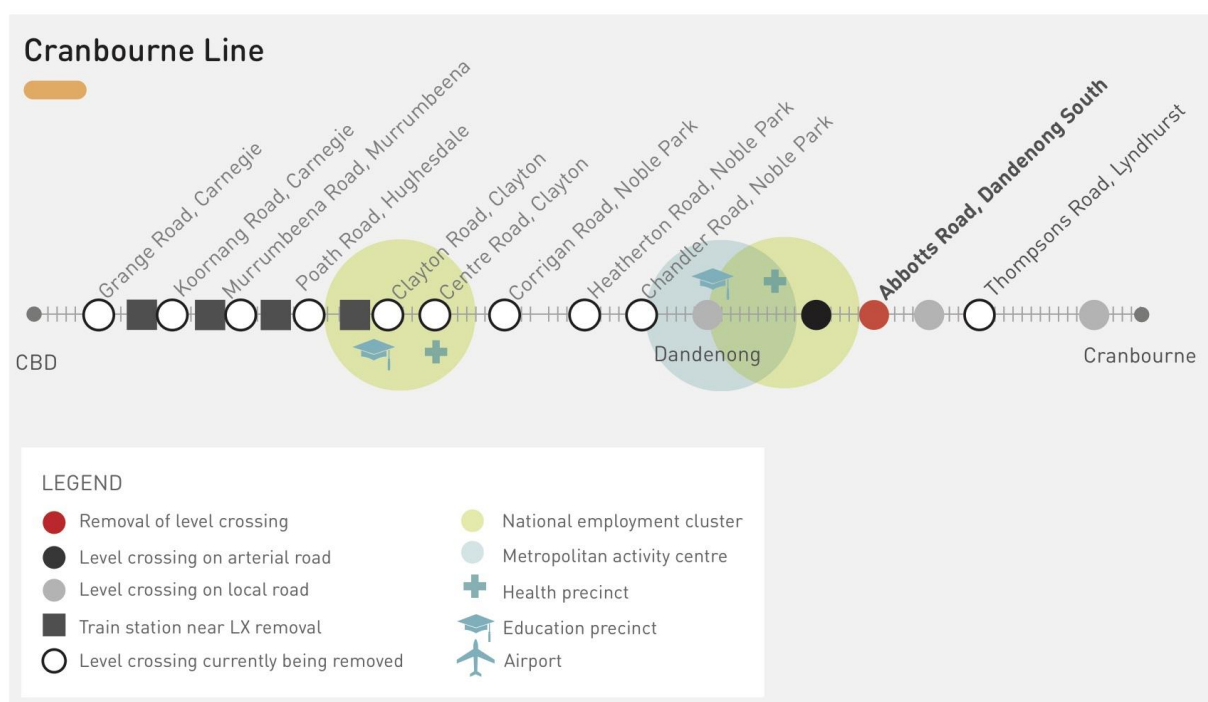
Glenroy Road, Glenroy	
Details of Reference Option	

### 6.3.3 Cranbourne Line

The Cranbourne Line runs south-east from the Melbourne CBD and splits at Dandenong Station into the Cranbourne Line alongside the South Gippsland Highway leading into the Southern Industrial Precinct.

There are a number of activity centres running along the line including Oakleigh, Clayton, Caulfield, Carnegie, Springvale, Noble Park and Cranbourne. There are two National Employment Clusters (Monash and Dandenong South) and one Metropolitan Activity Centre at Dandenong.

There are 15 level crossings along the Cranbourne Line with nine level crossings being removed under the Caulfield Dandenong 9 (CD9) project, Thompsons Road in Lyndhurst being removed as part of the VicRoads Thompsons Road duplication project, and one level crossing, Abbots Road, Dandenong South will be removed under the Project.



**Abbots Road** in Dandenong South is a local collector road, approximately 2.7 kilometres north of Lynbrook Station and 800 metres west of the South Gippsland Highway, with land use predominantly comprising industrial developments. It is not classified under the VicRoads SmartRoads Road Use Hierarchy.

Abbotts Road, Dandenong South	
Details of Reference Option	

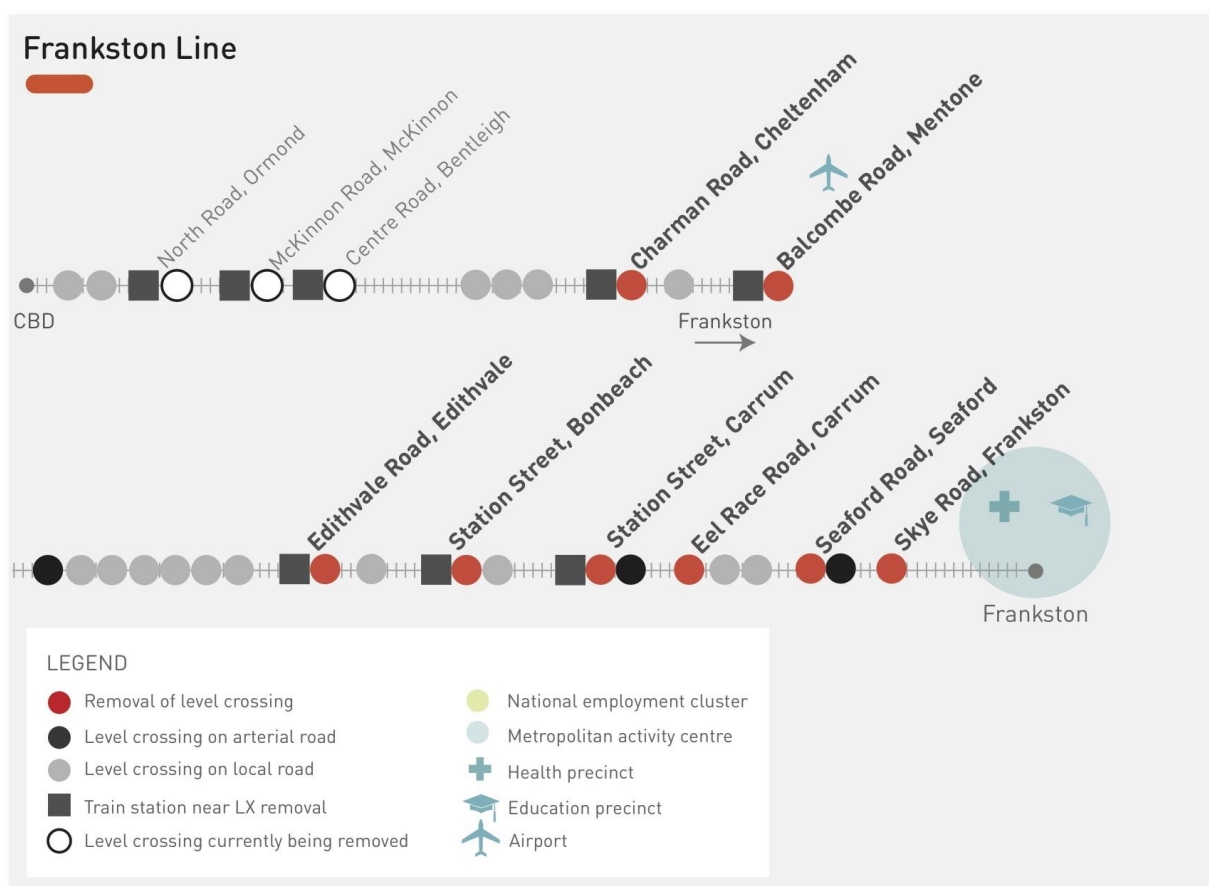


### 6.3.4 Frankston Line

The Frankston Line connects to the southern bayside suburbs of Melbourne, running alongside the Nepean Highway into the Frankston Metropolitan Activity Centre where Frankston Hospital and Monash University (Frankston Campus) are located. Other activity centres along the line include Chelsea, Mordialloc, Mentone, Cheltenham (Southland), Moorabbin, Bentleigh and Glenhuntly.

There are 30 level crossings along the line, with three level crossings currently under construction (North Road, McKinnon Road and Centre Road). A further eight level crossings will be removed under the Project:

Balcombe Road, Mentone	Seaford Road, Frankston
Charman Road, Cheltenham	Skye Road, Frankston
Edithvale Road, Edithvale	Station Street, Bonbeach
Eel Race Road, Carrum	Station Street, Carrum



**Balcombe Road** in Mentone is a declared arterial road that runs east-west between the Nepean Highway and Port Phillip Bay at Black Rock. It is designated as an Other Traffic, Bus Priority and Pedestrian Priority, and Bicycle Priority Route at the level crossing. The level crossing site is located approximately 21 kilometres south of the Melbourne CBD within the suburb of Mentone, a bayside suburb. The area comprises low, medium and some high density residential property with some older industrial and local commercial use properties.

The surrounding land uses around Balcombe Road generally comprise of one and two level local retail and commercial properties to the west, low medium and high density residential to the east, low density residential to the north and commercial and educational use properties to the south. Mentone is increasing in value due to its accessibility via road and rail, proximity to the CBD and Port Phillip Bay and other positive amenity such as major and local retail

centres. Development activity in the Mentone is apparent, evidenced by recently completed townhouse and apartment developments, and other development currently under construction.

**Charman Road** in Cheltenham is a local road that is considered a key north-south road for the bayside suburbs of Cheltenham, Beaumaris and Mentone. Under SmartRoads it is classified as a Bicycle, Pedestrian and Bus Priority Route at the level crossing. The level crossing is located approximately 20 kilometres south east of the Melbourne CBD within the suburb of Cheltenham. The area comprises residential, industrial and commercial uses and includes Southland shopping centre. Surrounding the level crossing, property types comprise a mix of recreational (golf courses, cemetery), industrial, commercial /retail and residential use properties.

Cheltenham is increasing in value due to accessibility via road and rail, proximity to the Melbourne CBD and Port Phillip Bay, and other positive amenity such as major and local retail centres. Like Mentone, development activity in the area is apparent as evidenced by recently completed townhouse and apartment developments and other developments currently under construction.

**Edithvale Road** in Edithvale is an arterial road that connects the beachside suburbs between Mordialloc and Patterson River to the Mornington Peninsula Freeway and suburbs to the east. It is classified as an Other Traffic Route at the level crossing under SmartRoads. The surrounding land use is residential but largely commercial to the west of Nepean Highway.

**Eel Race Road** in Carrum is a local road with no priority routes. Land use in the area is predominantly one and two-storey residential buildings. There is an Early Learning Centre immediately opposite the level crossing.

**Seaford Road** in Frankston is a declared arterial road that provides east-west connectivity within the south-eastern suburbs of Melbourne. It is classified as an Other Traffic and Bicycle Priority route under SmartRoads. The surrounding land use is predominantly residential with the R.F Miles Reserve occupying the north-west quadrant of the level crossing.

**Skye Road**, also in Frankston, is a local east-west road. Nearby Overton Road provides a key east-west connection between the Nepean Highway and the Frankston Freeway. The level crossing at the intersection of Overton Road, Skye Road, Wells Road and Dandenong Road East is a critical barrier to this east-west connection. SmartRoads designates Skye Road as an Other Traffic, Bus and Bicycle Priority Route. Land use south of Skye Road is predominantly residential to the east and industrial to the west. Skye Road to the north is also largely residential to the west and road reserve for the Frankston Freeway to the east.

**Station Street** in Bonbeach is a local road that provides a north-south connection within the south eastern suburbs of Melbourne. It is not classified under SmartRoads. Land use in the area is a combination of few retail shopfronts and residential dwellings.

**Station Street** in Carrum is a declared arterial road that connects McLeod Road with the Nepean Highway. Under SmartRoads, it is designated as an Other Traffic Route and Pedestrian Priority Route. The site is located approximately 33 kilometres south east of the Melbourne CBD.

Carrum is an outer bayside suburb which is serviced via the Mornington Peninsula Freeway and Eastlink. Station Street forms the core of the Carrum Activity Centre with small retail shopfronts and professional services. All other land surrounding the crossing is residential. The area has a variety of amenities such as Patterson River Golf Club.

**Balcombe Road, Mentone**

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Details of Reference Option

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Charman Road, Cheltenham	
Details of Reference Option	

Details of Reference Option	
<b>Edithvale Road, Edithvale</b>	
Details of Reference Option	

Eel Race Road, Carrum	
Details of Reference Option	

Seaford Road, Seaford	
Details of Reference Option	

Skye Road, Frankston	
Details of Reference Option	



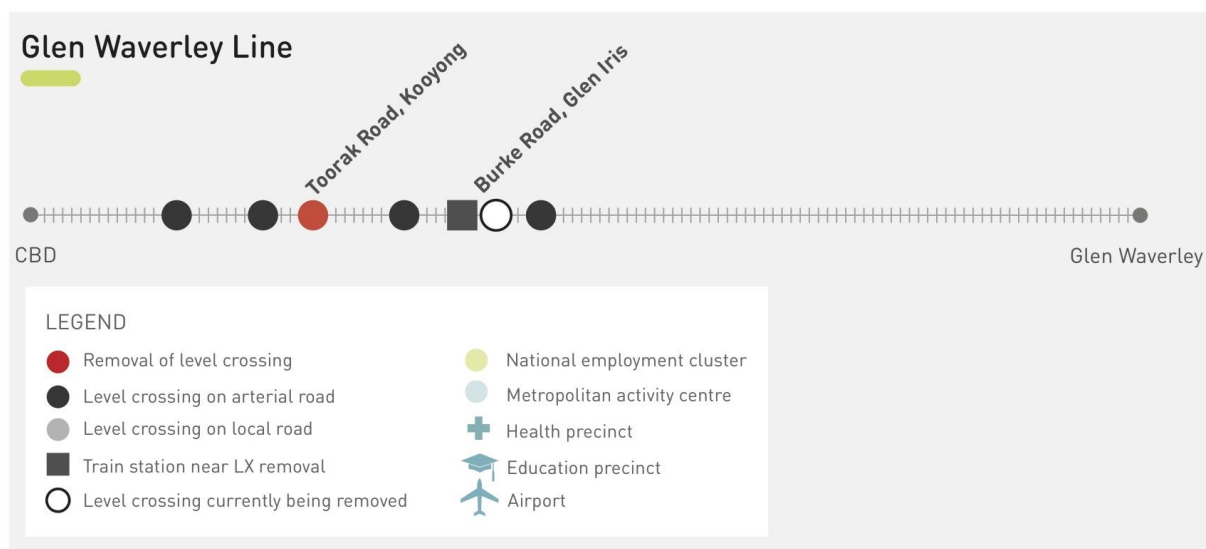
Station Street, Bonbeach	
Details of Reference Option	

Station Street, Carrum	
Details of Reference Option	

### 6.3.5 Glen Waverley Line

The Glen Waverley Line connects to Melbourne’s residential eastern suburbs. The Activity Centres along this line include Mount Waverley (with the Village Shopping Precinct) and Glen Waverley (with The Glen Shopping Centre). There is a neighbourhood activity centre at Glen Waverley station.

There are six level crossings on the Glen Waverley Line. Burke Road, Glen Iris is currently under construction, and Toorak Road, Kooyong will be removed under the Project.



**Toorak Road** in Kooyong is a declared arterial road that provides access to the Monash Freeway and CityLink. It is designated as an Other Traffic Route and Bicycle Priority Route at the level crossing but is a Preferred Traffic Route to the east of the crossing. Kooyong, located within the inner eastern suburbs of Melbourne, has relatively high land values located due to its close proximity to the CBD, amenity and accessibility (rail and road).

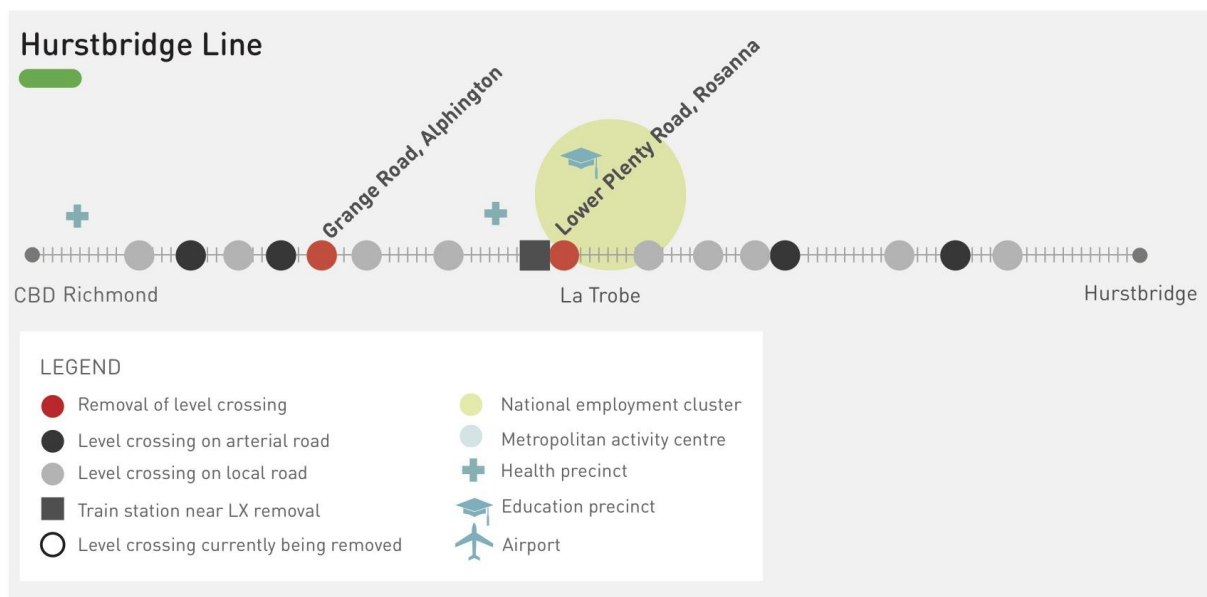
The area surrounding the level crossing is largely residential suburban location with no activity centre within proximity. There are examples of higher density developments provided within the surrounding area, particularly along transport modes (rail and road).

Toorak Road, Kooyong	
Details of Reference Option	

### 6.3.6 Hurstbridge Line

The Hurstbridge Line connects Melbourne’s CBD to the residential suburbs in the north-east of Melbourne and into the La Trobe National Employment Cluster. There are a number of activity centres along the line, including Richmond (Victoria Street), Richmond (Bridge Road), Diamond Creek, Ivanhoe, Heidelberg (Austin Hospital), Eltham and Greensborough.

There are 15 level crossings along the Hurstbridge Line. Two level crossings will be removed under the Project: Grange Road, Alphington and Lower Plenty Road, Rosanna.



**Grange Road** in Alphington is a declared north-south arterial road that connects to the Eastern Freeway via Chandler Highway with Heidelberg Road. Grange Road is considered a preferred traffic route under the SmartRoads Road User Hierarchy, with land use surrounding the level crossing being predominantly low density residential with local community facilities. Alphington is an inner north-eastern suburb located approximately 8 kilometres from the Melbourne CBD, with linkage via the Eastern Freeway. The local area comprises predominately high value low and medium density residential land uses.

**Lower Plenty Road** in Rosanna is a declared arterial road that provides east-west connectivity within Rosanna and Heidelberg Heights. Under the SmartRoads Road User Hierarchy the road is a traffic route and bus priority route, with the nearby shopping strip classified as a pedestrian priority route. Rosanna is located approximately 13 kilometres north-east of the Melbourne CBD and is within proximity to Northland Shopping Centre. The area is characterised by a smaller retail and commercial precinct, and a range of low to medium density residential land uses.

The Rosanna Activity Centre core retail area is located immediately west of the current level crossing. The properties east of the Rosanna Railway Station site comprise older style commercial and community uses.

Grange Road, Alphington	
Details of Reference Option	

**Lower Plenty Road, Rosanna**

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Details of Reference Option

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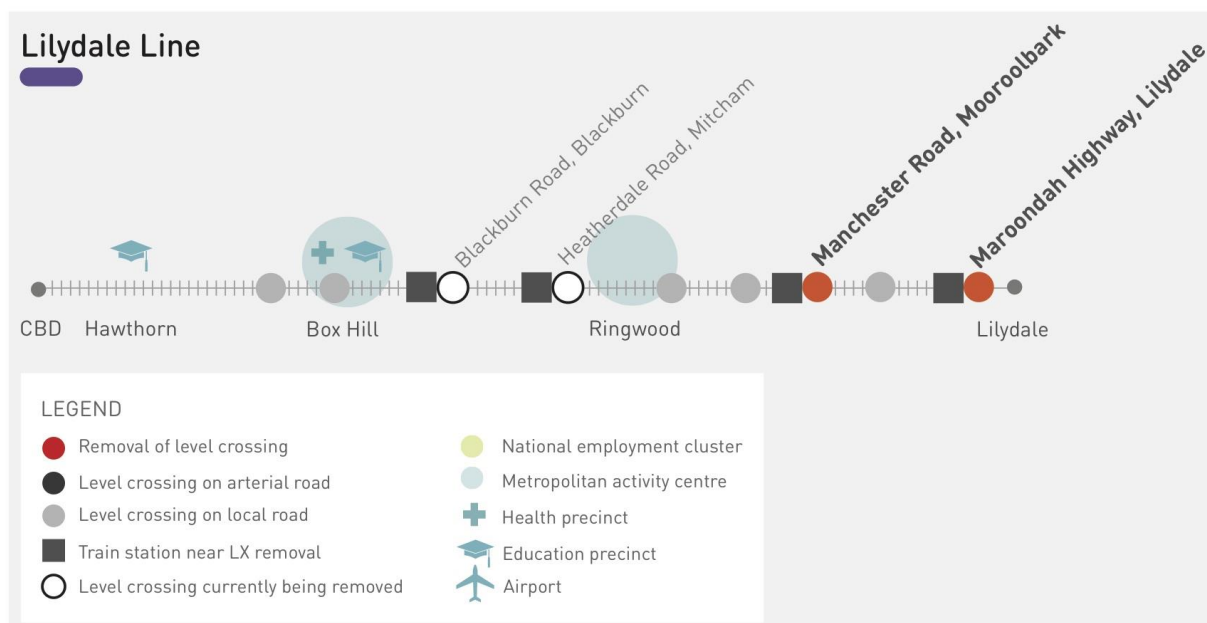
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### 6.3.7 Lilydale Line

The Lilydale Line connects Melbourne CBD to the residential eastern suburbs. Activity centres along the line include Hawthorn (Glenferrie Road), Camberwell, Nunawading, Croydon and Lilydale. There are two Metropolitan Activity Centres in Box Hill and Ringwood and a neighbourhood activity centre in Nunawading station.

There are nine level crossings along the Lilydale Line with two level crossings currently under construction (Blackburn Road, Blackburn and Heatherdale Road, Mitcham). Two level crossings will be removed under the LXR: Manchester Road, Mooroolbark and Maroondah Highway, Lilydale.



**Manchester Road** in Mooroolbark is a local collector road and is classified as a Bicycle Priority Route under the SmartRoads Road Use Hierarchy. Land use is commercial and retail, with low density residential properties interfacing the railway line. Mooroolbark is an outer eastern suburb located approximately 31 kilometres east of the Melbourne CBD. The suburb provides predominately low density residential property types with local activity centres interspersed with commercial and industrial land uses.

**Maroondah Highway** in Lilydale is a declared arterial highway and a key east-west link to the eastern suburbs of Melbourne. It is designated as a traffic, bus and cycle priority route. The level crossing is located approximately 38 kilometres north east of the Melbourne CBD within the Lilydale Activity Centre and is accessible via the Maroondah High and Eastlink Tollway.

The level crossing is located at the western end of the Lilydale Activity Centre commercial and retail precinct. Surrounding land use generally comprises industrial land north west of the railway line, education/commercial and retail precincts to the south-west, and commercial and retail precincts to the north-east and south-east. New residential development within proximity to the level crossing comprises unit and townhouse developments; whilst the industrial use area further north comprises smaller light industrial unit type development (2-3 levels).



Manchester Road, Mooroolbark	
Details of Reference Option	

**Maroondah Highway, Lilydale**

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Details of Reference Option

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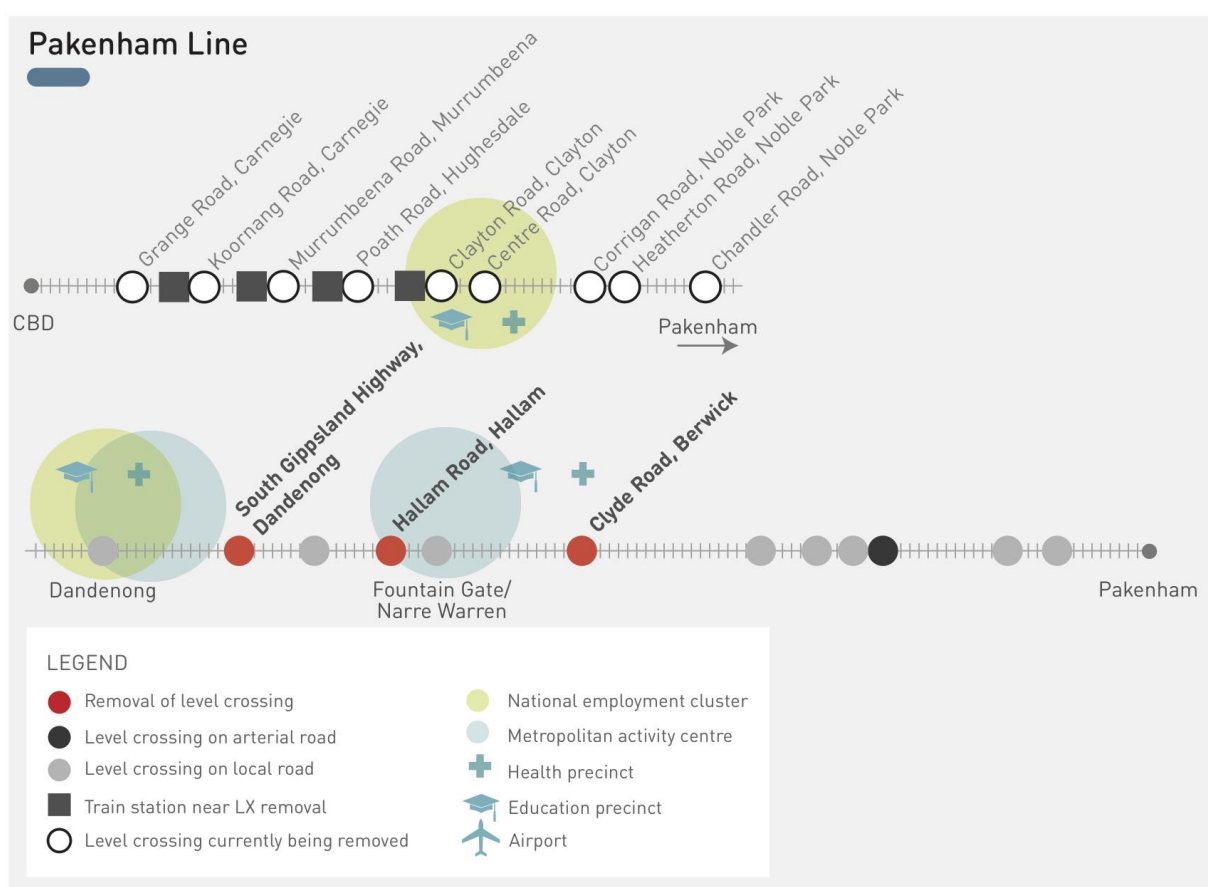
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### 6.3.8 Pakenham Line

The Pakenham Line runs south-east from the CBD and a number of activity centres run along the line, including Pakenham, Officer, Berwick, Noble Park, Springvale, Clayton and Carnegie. There are two Metropolitan Activity Centres at Fountain Gate, Narre Warren and Dandenong.

In addition, there are two National Employment Clusters at Monash and Dandenong South. The line splits at Dandenong into the Pakenham Line into the Pakenham Activity Centre.

There are 21 level crossings along the Pakenham Line. Nine level crossings are being removed under the Caulfield Dandenong 9 (CD9) project and three level crossings – South Gippsland Highway, Dandenong, Hallam Road, Hallam and Clyde Road, Berwick – will be removed as part of the LXR. P.



**Clyde Road** in Berwick is a declared arterial road that is classified as a traffic, bus and bicycle priority route under SmartRoads. The site is surrounded by low density residential and commercial properties with Monash University Berwick Campus located immediately to the southwest of the level crossing. Berwick is a suburb located approximately 45 kilometres south east of the Melbourne CBD. The area comprises of industrial, bulky goods retail, commercial and low density residential land uses.

**Hallam Road** in Hallam is a declared arterial road providing connections to Princes Highway, Monash Freeway and South Gippsland Highway. It is designated as a traffic, bus and bicycle priority route. Land use in the area is largely industrial.

**South Gippsland Highway, Dandenong**, is a declared arterial road. Under SmartRoads, it is classified as a traffic and bus priority route. The surrounding area of the level crossing is predominantly industrial.

Clyde Road, Berwick	
Details of Reference Option	

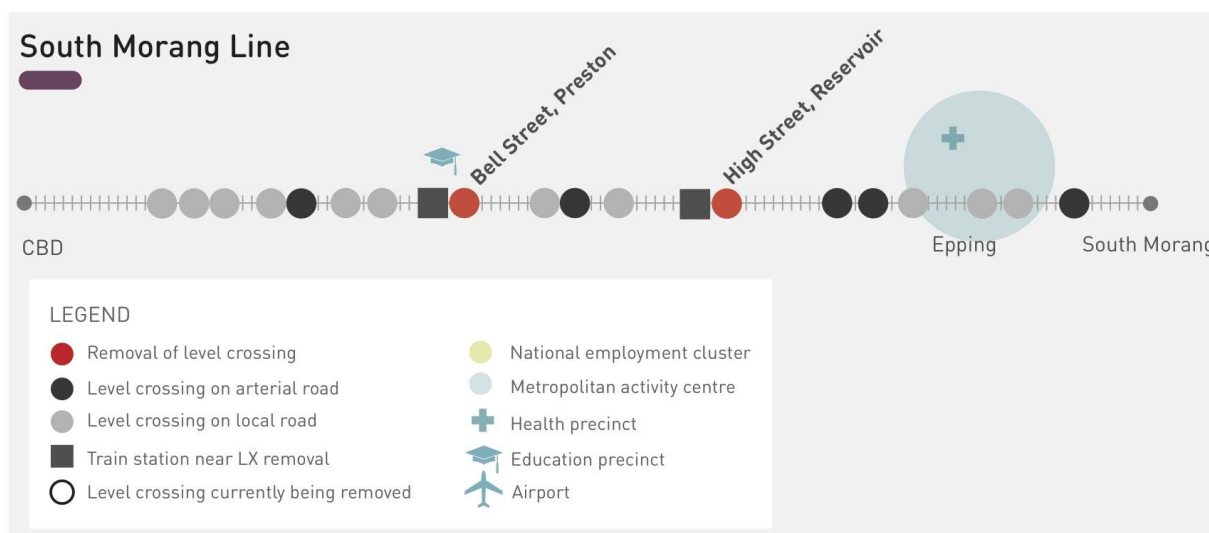
Hallam Road, Hallam	
Details of Reference Option	

South Gippsland Highway, Dandenong	
Details of Reference Option	

### 6.3.9 South Morang Line

The South Morang Line connects to the northern residential suburbs of Melbourne. Activity centres along the line include Northcote, Preston (High Street), Reservoir and South Morang. There is one Metropolitan Activity Centre in Epping.

There are 18 level crossings on the South Morang Line. Two level crossings will be removed under the Project: Bell Street, Preston and High Street, Reservoir.



**Bell Street in Preston** is a declared arterial road that provides east-west connection through Preston to the arterial network including St Georges Road, High Street and Albert Street. Bell Street is a preferred traffic and bus priority route. Preston is an inner northern suburb located approximately 7 kilometres north of the CBD which has strong growth potential due to its proximity to the Melbourne CBD and amenities within the suburb, such as Northland shopping centre. The area comprises a historically industrial area which has benefited from gentrification providing medium to high density mixed use residential developments from large former industrial holdings.

**High Street** in Reservoir is a north-south arterial road that links Reservoir to Thomastown. High Street/Spring Street on the western side of the rail corridor is a preferred traffic route and High Street (on both sides of the rail corridor) is a bus priority route. The land use surrounding the level crossing is commercial and retail, with local community and education facilities located nearby. The site is centrally located to the Reservoir activity centre surrounded by retail, commercial and transport uses.

Bell Street, Preston	
Details of Reference Option	

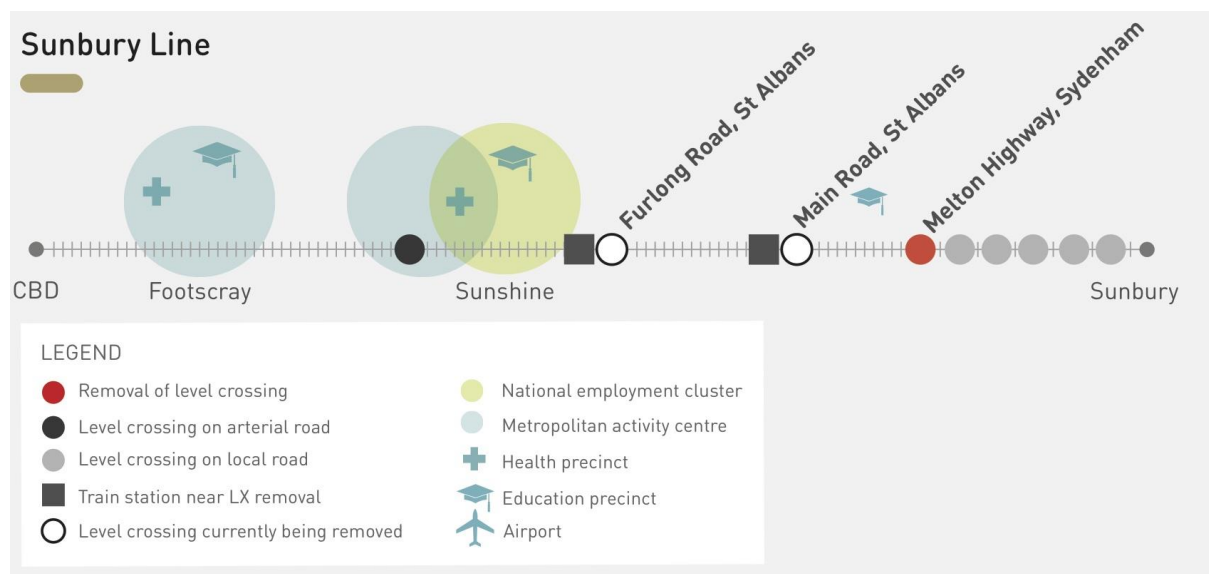


High Street, Reservoir	
Details of Reference Option	

### 6.3.10 Sunbury Line

The Sunbury Line connects to the western suburbs of Melbourne and Sunshine National Employment Cluster. There are a number of activity centres along the line including St Albans, Sydenham and Sunbury. There two Metropolitan Activity Centres: Sunshine and Footscray.

There are nine level crossings along the Sunbury Line with two currently under construction (Main Road and Furlong Road, St Albans). One level crossing – Melton Highway, Sydenham – will be removed under the Project.



**Melton Highway** in Sydenham is a key arterial route that connects Hillside and Taylors Lakes. It is classified as an Other Traffic Route, as well as a Bus Priority Route under SmartRoads. Land use is largely residential, with Watergardens shopping centre located south-east of the crossing and community facilities located nearby.

**Melton Highway, Sydenham**

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Details of Reference Option

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### 6.3.11 Upfield Line

The Upfield Line connects Melbourne’s CBD to residential suburbs in the north of the city and into one of Melbourne’s key industrial precincts. The line is intersected by the M80 Metropolitan Ring Road and runs adjacent to Sydney Road and the Hume Highway, one of the main routes directly to Sydney and one of the key freight routes into Melbourne. Activity centres along the line include Brunswick and Coburg.

There are 22 level crossings along the Upfield Line. Three crossings will be removed under the Project: Bell Street, Coburg, Camp Road, Campbellfield and Moreland Road, Brunswick.



**Bell Street** in Coburg is an arterial east-west highway that connects to Western Link. Bell Street is considered a preferred traffic, bus priority and pedestrian priority route under SmartRoads. Coburg is located approximately seven kilometres north of the Melbourne CBD. Coburg more broadly is currently undergoing significant price growth as the area has strong transport linkages and increasing amenity. Older dwellings have been redeveloped to provide a mix of townhouse/unit developments and apartment developments.

**Camp Road** in Campbellfield is an arterial road that runs east-west, intersecting with the Hume Highway, with the level crossing located approximately 340 metres north-west of the M80 Metropolitan Ring Road. Campbellfield is a predominantly industrial suburb located in Melbourne’s north. Under the SmartRoads Road User Hierarchy, the road is a traffic route and a bus priority route, with surrounding land use being mainly industrial.

Development activity in the broader area comprises predominately industrial subdivision and redevelopment of older style industrial properties. The area immediately around the Camp Road level crossing provides a mix of smaller industrial and commercial use land with some vacant sites.

**Moreland Road** in Brunswick is an east-west arterial road that connects with several key north-south routes including Pascoe Vale Road, CityLink, Sydney Road and Nicholson Street. The route is considered to be a traffic route, bus priority route and cycle priority route west of the level crossing, while to the east the route is also a pedestrian priority route according to SmartRoads. The Moreland Road level crossing is next to the activity area of Brunswick and land use and development is predominantly inner urban and densely developed. East of the corridor is a key employment area and a mix of retail, commercial and light industrial land use, while west of the corridor land use is predominantly residential development.

**Bell Street, Coburg**

Details of Reference Option	

Camp Road, Campbellfield	
Details of Reference Option	

Moreland Road, Brunswick	
Details of Reference Option	

### 6.3.12 Werribee Line

The Werribee Line connects to the western suburbs in Melbourne and to the East Werribee Employment Cluster. There are a number of activity centres along the line including Hoppers Crossing, Point Cook, Williams Landing and Werribee. There is a National Employment Cluster at East Werribee and a Metropolitan Activity Centre at Footscray.

There are nine level crossings along the Werribee Line (excluding the Altona Loop line), with three level crossings to be removed under the Project: Aviation Road, Laverton, Cherry Street, Werribee and Werribee Street, Werribee.



**Aviation Road** in Laverton is a local road that is classified as a bicycle priority route under SmartRoads. Land use around the level crossing comprises small commercial and retail shops and also small scale industrial uses. The operational RAAF Base (Department of Defence) is located to the north of the crossing.

**Werribee Street** in Werribee is a declared arterial road that forms a key access route in the Werribee Activity Centre. It is considered an Other Traffic Route and Bicycle Priority Route at the level crossing. Werribee is a suburb located approximately 32 kilometres west of the Melbourne CBD. The area comprises low density residential of varying age, and major commercial precinct located directly south of Werribee Station. Werribee's major linkage to Melbourne CBD is via the aerial Princes Freeway. Land use to the north of the crossing is predominantly residential with significant public open space areas at Chirnside Park and Wyndham Park to the south.

**Cherry Street** in Werribee is a key local road that connects to the Werribee Activity Centre. It is proposed to be a Bus Priority Route. Property types in the area include the Werribee Activity Centre (located immediately south of the level crossing) which comprises a mixture of older style and newer low density (up to 2 levels) commercial development, some bulk good/ larger format retail to the south, and low density residential is immediately north of the level crossing.



Aviation Road, Laverton	
Details of Reference Option	

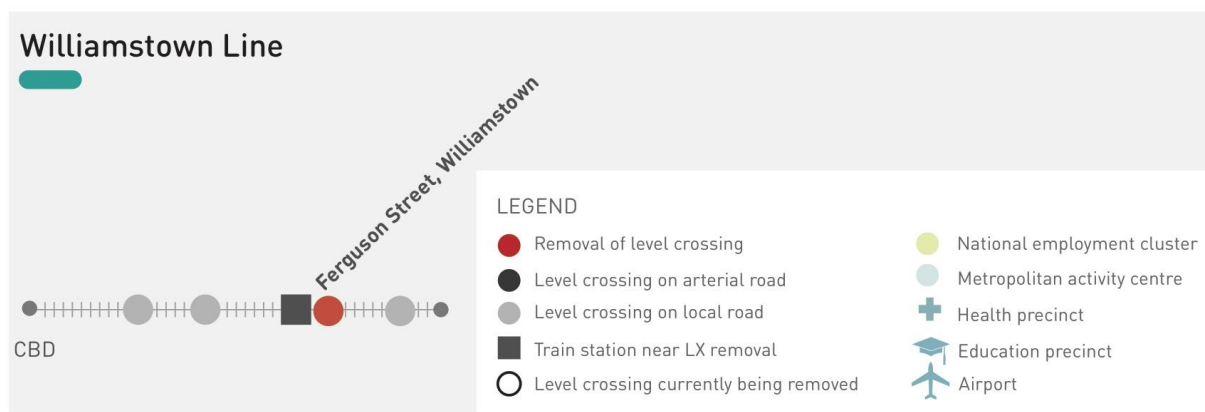
Cherry Street, Werribee	
Details of Reference Option	

Details of Reference Option	
<b>Werribee Street, Werribee</b>	
Details of Reference Option	

## Williamstown Line

The Williamstown Line connects to the Williamstown Activity Centre in Melbourne's south western suburbs. There is one metropolitan activity centre on the Williamstown Line at Footscray.

There are four level crossings on the Williamstown Line, with the crossing at Ferguson Street, Williamstown to be removed as part of the Project.



**Ferguson Street** in Williamstown is an east-west arterial road extension of Kororoit Creek Road. SmartRoads shows Ferguson Street to be an Other Traffic, Bus Priority and Bicycle Priority Route. Williamstown is a high value suburb because of its proximity to the Melbourne CBD and bayside location. Ferguson Street forms the central spine of the Williamstown Activity Centre. The Newport Stabling Yards and Rail Workshops are located to the north west of the crossing.

The suburb is relatively large in land mass and comprises several sub markets varying in property use and value. The area surrounding the level crossing comprises predominantly low density residential with examples of older housing stock being redeveloped to provide townhouses and larger sites for apartments. A small amount of commercial property is located immediately east of the level crossing.

Ferguson Street, Williamstown	
Details of Reference Option	

## 6.4 Project scope summary

The Reference Option for each site presents a solution that may require changes to various assets in conjunction with the grade separations. This includes new stations, improved public transport access, improvements to pedestrian / cycling functions and urban amenity, and potential integrated development opportunities.

Table 6-4 – Project Scope Summary – Reference Options

**Commercial-in-Confidence Table Redacted**

*Commercial-in-Confidence information has been redacted prior to publication*

**Commercial-in-Confidence Table Redacted**

### 6.4.1 Separating Road and Rail (Grade separations)

The LXRPP proposes to remove level crossings by grade separation. Each grade separation option has advantages and disadvantages when evaluated from various perspectives such as road operating efficiency, rail operating efficiency, local amenity, permeability, land-use efficiency, urban design and adaptability to future needs. The Reference Option selected for each site was determined using a multi-criteria analysis that considered the program objectives, benefits and outcomes across a range of areas including environment, community urban design and costs.

The Reference Options and/or Recommended Solutions selected for the 50 sites comprise the following:

While the Reference Options for 30 of the sites have been selected for the Business Case, they are not the final recommended solutions. The Reference Options may change based on the Final Assessment, which will be part of the Project Proposal (Phase 4 of the Options Assessment Framework) and/or the market-based assessment (Phase 5 of the Options Assessment Framework).

### 6.4.2 Implementing the Metropolitan Network Modernisation Program

An important aspect of the LXRPP is the implementation of metropolitan network modernisation improvements where possible. Many level crossings interact with bus networks and interchanges, local pedestrian movements and cyclist movements. The removal of level crossings can provide opportunities to facilitate a range of metropolitan network modernisation improvements with the objective of providing better connections between different modes of transport. These improvements can include the construction of new stations, bus interchanges, relocation of bus stops and upgrades of pedestrian and cycling facilities.

As part of the LXRPP, the Reference Options include the following Metropolitan Network Modernisation Program improvements for the 50 sites:

The improvements to the bus interchanges and bus stops will provide opportunities for changes to bus network routing and timetabling to maximise reliability and efficiency improvements as a result of the level crossing removal. These opportunities will be discussed with Public Transport Victoria (PTV) in the development of Works Package/Project Proposals.

In addition, the improvements to the pedestrian and cyclist accessibility of local areas will provide better connectivity and safety across the rail corridor.

The most significant improvement enabled by the LXRPP is the ability to increase train service frequencies on rail lines without a detrimental impact on road network performance. Certain sites within the LXRPP have more significance than others for enabling these rail improvements, for example the Caulfield-Dandenong corridor level crossings, which have particular significance for both the Cranbourne-Pakenham Line Upgrade rolling stock program and the Metro Tunnel.



### Caulfield-Dandenong level crossing removals<sup>55</sup>

Removal of the nine level crossings on the Caulfield to Dandenong corridor is being undertaken in conjunction with other major works on the Dandenong line under the Cranbourne-Pakenham Line Upgrade (CPLU). This program includes:

- The purchase of 37 next generation, high capacity trains
- New and upgraded rail infrastructure in the corridor including track, power and signalling upgrades
- A new train depot and maintenance facility in Pakenham
- Removal of nine level crossings along the Caulfield to Dandenong section
- Four rebuilt stations at Clayton, Carnegie, Murrumbeena and Hughesdale

The project will boost capacity by up to 42 per cent on the Cranbourne-Pakenham line every day – accommodating an additional 11,000 passengers in the morning peak – and boost capacity across the network by freeing up existing trains.

The level crossing removals are a critical enabler of these additional train services and subsequent increases in rail capacity identified in PTV's Rail Network Development Plan. Removing these level crossings will completely separate the rail corridor between Dandenong and the city from the road network, greatly reducing the risk of incidents and delays on this corridor and permitting the higher service frequencies expected post- Metro Tunnel to be run without impacting road traffic. If these planned services were to occur without removal of the level crossings, by 2031 boom gates on the corridor would be closed for between 60 per cent and 95 per cent of the peak period.

In July 2015, two shortlisted bidders were announced for the package of level crossing removals, station rebuilds and other rail infrastructure (some of which will be delivered at the same time as grade separations to minimise disruption and reduce costs). An Alliance including Lendlease, CPB Contractors, WSP Parsons Brinckerhoff, Aurecon and Metro Trains Melbourne was formally awarded the contract for the project, which is expected to begin in 2016 with all nine crossings removed by 2018.

The rolling stock will be procured separately. An Expression of Interest for the design, construction and maintenance of trains was released to market in June 2015, and in November 2015 three consortia were selected for the next phase. In April 2016 the train order was increased by 28 to 65 to ensure the delivery of trains required for the Metro Tunnel, with this increase funded in the 2016-17 Budget.

### 6.4.3 Improving urban amenity and physical integration of activity precincts and communities along rail corridors

The removal of a level crossing can provide non-transport related benefits to the immediate surrounding land uses. Many level crossings are adjacent to railway stations that are located at the centre of local communities. These stations often have a major impact on the form and amenity of the local area.

Where new stations are provided, DDA compliant access is expected to be provided via lifts, ramps and/or stairs where required to meet standards. Station amenities, including toilets, waiting areas, Protective Services Officers' offices and staff offices will also be provided where required to meet standards.

Each solution has the risk of poor amenity outcomes for the local community. However, with good urban design and landscaping, these risks can be mitigated to enhance the attractiveness and function of the station infrastructure for local communities. Section 9.9.1 details how the LXRA Urban design Framework will be implemented during the Final and Market-Based Assessment phases of the Options Assessment Framework.

### 6.4.4 Development opportunities along rail corridors

As discussed earlier, the option constructed and the land use in the immediate area presents different integrated development opportunities across the Project. The nature of these opportunities depends on a range of factors including local planning controls, land availability, existing land values and types of land use around the site. At some sites, there will be no feasible opportunities present.

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<sup>55</sup> CD9 Project Proposal, May 2015

Further investigation into market demand and supply factors, commercial feasibility and delivery models will be undertaken by Commercial and Property Development advisors during the development of Works Package/Project Proposals at each site.

## 6.5 Interdependencies with other plans and projects

The table below sets out the headline timing interdependencies that must be considered during the development and delivery of the LXR. P.

Interdependency	Effect
PTV Network Development Plan <sup>56</sup> – Capacity targets	The delivery of the Network Development Plan will provide a 50 per cent increase in peak hour capacity within 10 years and a 130 per cent increase within 20 years. Failure to remove network constraints such as level crossings will result in extended boom gate closure times and may effectively shut down the road network.
PTV Network Development Plan – Delivery of stage 2 and stage 3 rail upgrades	These include projects proposed for delivery over the next 15 years including: <ul style="list-style-type: none"> <li>• Melbourne Airport, Rowville and Doncaster lines.</li> <li>• Electrification and duplication of line to Melton.</li> <li>• High capacity signalling upgrades.</li> </ul> Failure to remove existing network constraints such as level crossings will result in increased delays across the road network when the additional lines are in service.
Metro Tunnel	<p>The project will deliver:</p> <ul style="list-style-type: none"> <li>• Two nine-kilometre rail tunnels from South Kensington to South Yarra as part of a new Sunshine to Dandenong line</li> <li>• New underground stations at Arden, Parkville, CBD North, CBD South and Domain</li> <li>• A new transport interchange at Domain</li> </ul> <p>Without level crossing removals providing space for service frequency upgrades, the rationale for investing in the Metro Tunnel infrastructure is also diminished.</p> <p>The Metro Tunnel, due to commence in 2018, will impact on level crossing removal projects due to interface issues, timing of occupations and demand on rail resources.</p> <p>The LXR will complement the Metro Tunnel, as additional services can be run on the Cranbourne-Dandenong Lines following the removal of nine level crossings between Caulfield and Dandenong. In addition, the scope of the nine level crossing removal projects on the Caulfield-Dandenong (CD9) line includes provision for future platform extensions as part of the design in order to accommodate future works as part of the Metro Tunnel.</p> <p>The LXR plays a critical role in enabling the full benefits of the Metro Tunnel to be achieved.</p>

<sup>56</sup> PTV's Network Development Plan is an aspirational plan for the increase of rail capacity based on PTV transport modelling. It is not Government Policy nor is it a committed program of service upgrades.

Interdependency	Effect
Cranbourne-Pakenham Line Upgrade (CPLU)	<p>This project includes delivery of new trains, upgraded signalling, the removal of nine level crossings between Caulfield and Dandenong and the rebuilding of stations at Clayton, Carnegie, Murrumbeena and Hughesdale.</p> <p>This project may impact on the remaining level crossing removal projects in terms of demand on rail resources.</p> <p>By enabling additional services to be run without exacerbating existing road delays, the LXRPP effectively enables the benefits of rail upgrades – additional passenger movements, de-crowding and faster trips, and de-congestion of roads via mode shift – to be achieved. It makes feasible rolling stock procurement programs such as the CPLU, which are necessarily ‘lumpy’ in order to exploit economies of scale in production and realise value for money for the state.</p> <p>The LXRPP plays a critical role in enabling the full benefits of the CPLU Project to be achieved.</p>
High Capacity Metro Trains Project	<p>There are 65 next-generation high capacity trains (HCMTs) being delivered, which will be able to carry around 20 per cent more passengers than existing trains.</p> <p>High capacity metro trains will progressively enter service from mid-2019, operating first on the Cranbourne-Pakenham lines, and will eventually run through the new Metro Tunnel to Sunbury</p> <p>The Level Crossing Removal Authority is working to ensure that key project interdependencies are managed, particularly for the level crossing removals on the Sunbury and Dandenong corridors.</p>
Hurstbridge Rail Line Upgrade	<p>The Hurstbridge Line upgrade will include:</p> <ul style="list-style-type: none"> <li>• Duplication of the single-track section of rail line between Heidelberg and Rosanna</li> <li>• Redesigned timetables for the Hurstbridge and South Morang lines</li> <li>• Addition of a new bus route between Greensborough and Diamond Creek</li> </ul> <p>The Level Crossing Removal Authority will manage delivery of the project, and the duplication works will be coordinated with the Grange Road, Alphington and Lower Plenty, Rosanna level crossing removals.</p>
Mernda Rail Extension	<p>Extending the South Morang line to Mernda includes:</p> <ul style="list-style-type: none"> <li>• A duplicated rail line between South Morang and Mernda</li> <li>• Full grade separations with no new level crossings</li> <li>• A new station at Mernda and provision for additional future stations</li> <li>• One additional station between Mernda and South Morang.</li> </ul> <p>This project may impact on the level crossing removal projects in terms of demand on rail resources.</p>
High Capacity Signalling trial	<p>The trial, on a section of the South Morang line, may require co-ordination with removals on this line (Bell St, Preston and High St, Reservoir).</p>
Chandler Highway Duplication	<p>The project scope is widening of the Chandler Highway between Heidelberg Road and south of Yarra Boulevard.</p> <p>This project is in close proximity to the Grange Road level crossing in Alphington. The timing of the two projects will have significant impacts on the surrounding road network and consideration should be given to coordination of the works.</p>

Interdependency	Effect
Thompsons Road Duplication	<p>Duplication of Thompsons Road between Frankston-Dandenong Road and South Gippsland Highway and between Narre-Warren-Cranbourne Road and Clyde Road has been funded for planning and pre construction.</p> <p>The duplication and removal of the Thompsons Road level crossing will have significant impacts on the surrounding road network and consideration should be given to coordination of the works.</p>
Outer suburban arterial road Program projects	<p>The 2016-17 Budget included a number of initiatives to ease congestion on key arterial roads in Melbourne’s outer suburbs.</p> <p>Delivery options are being investigated for bundling of road upgrades and long term maintenance under a whole of life contracting model.</p> <p>The Program in some instances may benefit from co-ordination with level crossing removals, either to minimise disruption time for residents and road users or to ensure availability of detour road routes during rail line closures. There may also be design interfaces between road and level crossing removal projects.</p> <p>The Level Crossing Removal Authority is working with VicRoads to ensure these interdependencies are considered in planning.</p>
Night Network Trial	<p>A trial of 24 hour public transport on weekends commencing 1 January 2016. This project will occur on public transport routes (tram, train and buses) at the level crossing locations and is likely to be impacted by planned railway occupations as part of some of the level crossing removals.</p>

# Chapter 7

## Financial analysis



## CHAPTER 7: FINANCIAL ANALYSIS - SUMMARY

The cost estimates reflect the state of development for each Reference Option and have been informed by preliminary risk and constructability assessments.

The first 20 level crossings to be removed were grouped into five packages for delivery and the remaining 30 individual sites were grouped into Reference Works Packages for delivery. The development of the packaged costs was based on a Reference Option selected by LXRA for each of the 30 sites (described in Chapter 6).

The cost savings that could be derived from packaging works were identified as:

- A lower sharing of occupation costs including safeworking, occupation support personnel, bussing from sharing occupations and train driver training;
- Reduced Contractor's Overheads including design costs, preliminaries, site and contract project management/supervision, and profit and overheads; and
- Lower Owner's Costs including planning, development, project management, project administration and MTM costs (allowance).

The total estimated savings from packaging is \$387 million (P50 excluding escalation).

A bespoke escalation rate was developed for the project based on the composition of each package.

Further assessment and refinement of options will be undertaken as the LXR progresses, which will assist in identifying cost saving opportunities that can be realised from the synergies in delivering a project of 50 level crossing removals.

The total cost of the identified futureproofing provisions is estimated to be \$148 million, excluding risk and escalation.

The estimated net capital cost for the project (P50) comprises of:

- Removal of 50 Level Crossings: **\$6.6 Billion**
- Metropolitan Network Modernisation Program: **\$1.0 Billion**

\$2.9 billion in funding has already been allocated to the LXR.

## 7 Financial analysis

### 7.1 Methodology

#### 7.1.1 First 20

The detailed cost estimates for the first 20 level crossing sites have been developed previously and are included in full business cases and Project Proposals that have been approved by the Government. All of these estimates were independently reviewed and reflect any packaging savings achieved by grouping them into 5 delivery packages.

#### 7.1.2 Next 30

The preparation of the cost estimates for the remaining 30 level crossing sites involved a two-stage process:

1. Estimating the costs for the 30 *individual* sites (based on the Reference Options); and
2. Estimating the costs of *grouping* the 30 individual sites into Reference Works Packages

Each of these estimates was independently reviewed and verified by a qualified cost estimating team.

The estimated costs of the delivery packages for the 30 level crossing sites were then added to the costs of the committed first 20 sites (including Thompsons Road) to establish the total project cost estimate for the 50 level crossings.

Potential commercial revenue from integrated development opportunities at each individual level crossing site is not reflected in the cost estimates. This is because the recommended solution for the level crossing removal project has a significant impact on the integrated development opportunities. At this stage only a Reference Option<sup>57</sup> has been nominated for each site. During the development of Works Package/Project Proposals the recommended solution will be confirmed and the cost estimate will be reviewed and confirmed. The potential commercial revenue will be examined at the Works Package/Project Proposal stage.

Cost estimates for the options at each site used rates benchmarked<sup>58</sup> against similar past projects. Potential cost savings identified from packaging sites were benchmarked against previous level crossing removal projects including Regional Rail Link, Mitcham Road, Rooks Road, Springvale Road and Middleborough Road level crossing removal projects.

#### **Individual site estimates**

LXRA commissioned a Technical Advisor to prepare designs and P50 and P90 probabilistic cost estimates<sup>59</sup> for the various shortlisted options of the 30 sites. These costs were based on the design documentation prepared for the Detailed Assessment phase of the Options Assessment Framework, with the assistance of design workshop reviews with LXRA and designers.

A standard schedule of rates was used across all sites to provide consistency for comparison purposes. Specific major cost items have been quantified, where possible, and allowances have been made for works that have not been designed, but are anticipated to be required.

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<sup>57</sup> Reference Options were selected following the Detailed Assessment phase of the Options Assessment Framework for the purpose of describing how the program might be delivered, generating a cost estimate, and conducting the program appraisal. This process was undertaken in February 2016.

<sup>58</sup> Benchmarking is a point of reference against which the cost estimates are compared. The point of reference for these cost estimates are similar previous road/rail projects.

<sup>59</sup> These estimates aim to provide a statistical level of confidence in the expected cost of a project (or package of projects). The P50 value is an estimate of the project cost based on a 50 per cent probability that the cost will not be exceeded. The P90 value is an estimate of the project cost based on a 90 per cent probability that the cost will not be exceeded. P50 is considered to be a middle range value or the 'most likely' estimate. P90 is considered to be a high range estimate, as it includes a number of contingencies on top of the base estimate to ensure that there is a 90 per cent chance the estimate will not be exceeded. The base estimate is an estimate of all project costs, excluding all risk and escalation.

The cost estimates for the Reference Options described in Chapter 6 are presented to provide information about the likely cost to deliver each site as an individual project under the LXP. These cost estimates were reviewed and verified by LXRA's Independent Estimator.

The general assumptions adopted in developing the individual site estimates are:

- The cost estimate reports have used the design documentation prepared for the Detailed Assessment phase of the Options Assessment Framework as a basis, but have also used updated information that has been supplied by LXRA.
- Online<sup>60</sup> construction methodologies have been assumed for all sites. Where requested by LXRA to consider an offline<sup>61</sup> construction methodology instead, adjustments have been made to the cost estimate.
- New track facilities, power, signalling and other rail infrastructure have been allowed for to replace rail assets being directly impacted by level crossing removals.
- Hard landscaping<sup>62</sup> has been assumed at 20 per cent of the new track length at a 5m wide section.
- Soft landscaping<sup>63</sup> has been assumed at 80 per cent of the new track length at a 5m wide section.
- An allowance for noise walls and architectural treatments has been made at 15 per cent of the total bridge costs.
- New traffic signals have been allowed for, where required.
- New premium and host stations (including platforms) have been allowed for where the existing station building requires demolition.
- An allowance has been made for works to car parking (partial upgrade or replacement of existing) where new stations are required.
- All elevated bridge structures are either retaining walls or viaduct type structures.
- All below ground structures are generally retaining walls comprising soldier piles with shotcrete walls (drained). An allowance has been made to upgrade to a tanked solution where the water table is estimated by online mapping<sup>64</sup> to be above 5m below natural ground level.
- Extent of structural components (i.e. bridge) has been assumed based on design documentation provided or as advised otherwise by LXRA.
- Where applicable, costs associated with heritage listed structures have been included.
- Sundry<sup>65</sup> allowances have been included for items over and above those covered by the schedule of rates.
- Contaminated material (e.g. soil, groundwater) removal has been included as Category C type material only. The extent of this allowance is limited to existing track ballast, which will be removed.

### ***Project packaged estimates***

The packaging of individual sites is the favoured delivery model as there are many potential cost savings that can be achieved. Packaging sites for delivery can provide efficiencies in construction and minimise disruption to commuters. For the purposes of cost estimation, the 30 individual sites have been grouped into Reference Works Packages, which represent likely packages for delivery. Details of the Reference Works Packages are provided in Appendix G (*redacted*).

The LXRA Independent Estimator assessed these Reference Works packages to identify potential cost savings as a result of grouping individual sites together for delivery. These identified savings were subtracted from the total cost of delivering the individual sites separately within each package to calculate the estimated packaged cost.

The independent review of the packaged cost estimates was undertaken by a separate in-house peer review team from LXRA's Independent Estimator.

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<sup>60</sup> Online construction methodology assumes majority of works will be constructed on the existing rail alignment, requiring rail occupations to undertake the works.

<sup>61</sup> Offline construction methodology assumes majority of works can be constructed adjacent to the existing rail alignment, minimising rail occupations and disruption to the train line. Therefore trains can be run while construction works are occurring. Offline construction depends on the availability of land adjacent to the rail corridor.

<sup>62</sup> Hard landscaping represents the use of construction materials (e.g. brick, pavement) to improve a landscape

<sup>63</sup> Soft landscaping represents the use of vegetation (e.g. garden beds) to improve a landscape

<sup>64</sup> GHD LXRA WebGIS

<sup>65</sup> Sundry allowances can include allowance to protect heritage structure, dewatering, sump, base slab for to tanked structure, additional allowance for utilities etc.



Potential cost savings from packaging various sites were identified based on the experiences of previous level crossing removal projects. Generally, cost savings have been identified across all of the packages as follows:

- rail occupations including:
  - bussing, safe working (5 per cent);
  - support personnel (10 per cent); and
  - driver and maintenance training (\$1,000,000) where it is assumed that this would only be required once for every rail line.
- contractor's design cost and preliminaries (0.25 per cent)
- site and contractor management/supervision (2.5 per cent)
- lower Owner's Costs including planning, development, project management, project administration and MTM costs (allowance).

### ***Additional Program savings***

Further assessment and refinement of options will be undertaken as the LXP progresses. This will assist in identifying cost saving opportunities that can be realised from the synergies in delivering a project of 50 level crossing removals. These opportunities relate to identifying and capturing design and procurement synergies across projects to mitigate project and delivery risks, as well as early intervention to alleviate supply and delivery risks. Opportunities will depend on aspects of the packages, such as their timing and sequence, the type of solution at each site and the construction method.

The economies of scale anticipated through the larger packages may generate savings over the average price paid for individual level crossing removal projects in recent years.

The potential opportunities that will be investigated at the Works Package/Project Proposal stage have been grouped into three categories:

- **Managing demand:** LXRA will standardise requirements and specifications for the works and require contractors to use them during construction. This not only ensures quality and consistency but also minimises the complexity of managing an array of specifications and requirements during the operation and maintenance phase. This could include innovative procurement strategies for integration of supply chain logistics across projects that share common interfaces. Supply chain management can be described as different organisations, linked upstream and downstream in a chain, aiming to produce quality and value in the services and products for the end consumers through integrated processes.
- **Novated enabling works:** for materials or activities with long lead times e.g. utility service relocation, combined services route, Myki ticketing gates, LXRA could establish a contract with a chosen supplier and order from it. Once the head contractor is appointed, LXRA can novate the contract to the head contractor.
- **Other opportunities:** including streamlining rail occupations to take advantage of efficiencies.

The following table explains in more detail how these opportunities could be implemented.

Table 7-1 – Methods of implementing opportunities at the Works Package/Project Proposal stage

Opportunity	Methods of implementation
<b>Manage demand</b>	<ul style="list-style-type: none"> <li>• Develop a comprehensive Scope and Technical Requirements document in consultation with key operators, such as VicRoads, MTM, PTV and VicTrack covering design standards, future proofing requirements, traffic management and occupation planning procedures during construction, as well as maintenance requirements during and post-construction.</li> <li>• Obtain approval to waivers and any deviation from standards at the Works Package/Project Proposal stage</li> <li>• Develop a cost-effective, functional and attractive standard design for prefabricated construction of station buildings and fit-out in consultation with PTV and other stakeholders; this would need to be balanced with each site’s planning context and public realm ambitions.</li> <li>• Opportunity to gain efficiencies in the Signalling Design and Operational Control System (OCS) solutions by integrating with other projects that are delivering corridor-wide solutions</li> <li>• Benefits in integrating with other projects that are delivering Computer Based Interlocking (CBI) design solutions</li> <li>• Integrated development opportunities at some sites could be similar and could potentially be tackled as a package</li> <li>• Create an approved suppliers list, thereby having potentially greater buying power for materials required at all sites, e.g. lifts, prefabrication and fit-outs of station building, station furniture, ticketing gates, coping stones, sleepers, track, etc. These could be purchased in bulk and free issued to the contractor. Storage of these items would need to be considered.</li> <li>• Secure land to offset any loss in car parking and/or for storage of materials, e.g. fill material, other items purchased in advance of the head contract</li> <li>• Potential savings in communications and stakeholder engagement costs by coordinating all projects together</li> </ul>
<b>Novate enabling works</b>	<ul style="list-style-type: none"> <li>• Packaging of service relocations, however there is a risk of delays to works and claims by utilities if the site is not ready at the programmed time. Design and construction of Combined Services Route once the final solution is known</li> <li>• Relocate overhead stanchions and power where required</li> <li>• Substation upgrades where required</li> <li>• Purchase of a fleet of buses to assist with bussing during occupations which can be re-sold at the end of the project life. This will assist with the availability of buses during occupations, and therefore help alleviate project risks and potentially reduce the costs of bussing.</li> </ul>
<b>Other</b>	<ul style="list-style-type: none"> <li>• Coordinate occupations and bussing strategy across all projects.</li> <li>• Investigate likely areas where excavated fill material could be temporarily stored or deposited/received in relative proximity to the site at Works Package/Project Proposal stage, e.g. VicRoads road projects requiring embankment fills, etc. This would depend on the likely contamination level of the fill and whether treatment or capping is required in accordance with EPA requirements. This would reduce haulage costs and minimise the impact of having different haulage routes on the road network.</li> <li>• Create a Joint Coordination Committee (JCC) (already established) which would make ‘best for project’ decisions across all projects, to resolve coordination issues</li> </ul>

Whilst implementing some or all of the above will assist in de-risking the project and also result in reduced costs (e.g. contractor’s margin not being applied to activities managed by LXRA or materials free issued by LXRA), there may be associated risks with LXRA assuming responsibility for certain items of work and managing interfaces. These issues and any associated risks will be worked through as the project progresses

### Owner’s Costs (LXRA)

The delivery of a large project to remove 50 level crossings over eight years presents a significant and complex challenge. LXRA will be responsible for developing, procuring and delivering works for the Project as well as the Mernda rail extension and Cranbourne-Pakenham Line Upgrade Works.

To determine the Owner’s Costs for LXRA to deliver the Project, an analysis of the budgets for previous level crossing removals, Regional Rail Link Authority (RRLA) and the 10 projects already in construction was undertaken. The RRLA delivered the \$4 billion Regional Rail Link Project over six years and therefore serves as a reasonable benchmark for the LXRP.

## Escalation

DEDJTR escalation rates to be used for road infrastructure and rail infrastructure projects are shown in Table 7-2. This project sits at the interface between road and rail. Therefore the bespoke escalation rates that have been devised were based on the type of Reference Options that made up each delivery package.

Table 7-2 – Escalation rates (per annum) as provided by DEDJTR

Capital costs	2014/15 – 2017/18 Escalation Rate %	2018/19 onwards Escalation Rate %
Road		
Rail		

A delivery package that comprised a predominantly rail solution would adopt the escalation rate for rail, and a delivery package that comprised a predominantly road solution would adopt the road escalation rate.

The escalation rates were proportioned and applied in each package to produce a mixed escalation rate to better reflect the proposed infrastructure. The escalated individual packages were added together to provide the total project costs.

Table 7-3 – Escalation rate mix calculation Example

Capital costs	Reference option type in package Escalation Rate %	2014/15 – 2017/18 Escalation Rate %	2018/19 onwards Escalation Rate %
Road	20 (=1/5)	0.76 (=0.2x3.80)	0.80 (=0.2x4.00)
Rail	80 (=4/5)	2.08 (=0.8x2.60)	2.56 (=0.80x3.20)
	100 (=5/5)	<b>2.84 (=0.76+2.08)</b>	<b>3.36 (=0.80+2.56)</b>

Table 7-4 – Escalation rate mix for the packages (P50)

Name	Reference Works Package	2014/15 – 2017/18. Escalation Rate %	2018/19 onwards. Escalation Rate %
<b>Packages 1-5</b>	First 20 Sites		
<b>Melton Hwy</b>	Melton Hwy		
<b>Frankston 8</b>	Charman-Balcombe-Edithvale-Station-Station-Eel Race-Seafood-Skye		
<b>North Eastern</b>	Grange		
	Lower Plenty- Bell-High		
<b>North Western</b>	Camp-Buckley-Bell-Moreland-Glenroy		
<b>Western</b>	Kororoit Ck		
	Ferguson-Aviation-Cherry- Werribee		
<b>Remaining</b>	Abbotts		
	Manchester-Maroonah		
	Toorak Rd		
	Hallam-Clyde-Sth Gippsland		

A number of scenarios were developed for the LXP to test the sensitivity of the escalation rates applied to each package and then totalled. The results in Table 7-5 show that the bespoke escalation rate developed produces a P50 estimate for the LXP that is in between the total using a road only escalation rate and the total using a rail only escalation rate.

Table 7-5 – Sensitivity analysis of escalation rates

Scenario	2014/15 – 2017/18 %	2018/19 onwards %	P50 Escalated \$M
Road only			
Rail only			
50/50 mix of Road and Rail			
Low escalation rate e.g. 2% and 2.5%			
High escalation rate e.g. 4% and 3%			
LXRP bespoke escalation			7,608* * incl. Level Crossings \$6,588m and Metropolitan Network Modernisation Program \$1,020m

## 7.2 Capital costs

### 7.2.1 Project Costs for 20 Sites

The P50 estimate, excluding escalation for the first 20 sites is \$2,823,270,365. The P50 estimate for the first 20 sites including escalation is \$2,960,196,065. These totals are the sums of the P50 estimates (unescalated and escalated) from previously approved Business Cases and Project Proposals.

The total unescalated P50 amount has been used in the preparation of the total LXRP cost. When escalated using the bespoke escalation rate for LXRP, the total for the first 20 sites is \$2,994,190,674.

### 7.2.2 Individual Project Estimates for 30 Sites

The cost estimates have been informed by preliminary risk and constructability assessments. Owner's Costs, Contractor Profit, Overheads and Preliminaries are included. The Owner's Costs are the costs associated with the running of LXRA, managing the project and MTM input:

- Planning (3% of Total Construction Cost)
- Development (2% of Total Construction Cost)
- Project Management (4 % of Total Construction Cost)
- Project Administration (5 % of Total Construction Cost)
- MTM Costs (approx. 2 % of Total Construction Cost).

The percentages of total construction cost have been benchmarked against similar past projects. The cost estimates for the individual sites were not escalated to maintain flexibility for packaging and sequencing over the course of the Project. A Reference Option, selected for each of the 30 sites forms the basis of the development of the packaged costs for the project. Reference Options for each site are described in Chapter 6 and a breakdown of the Reference Option cost estimate for each individual site is provided in Appendix G (*redacted*).

Figure 7-1 shows the individual P50 (unescalated) site cost estimates for the remaining 30 sites compared to some of the first 20 sites. The graph shows that the costs of the remaining sites are comparable to the first 20 sites. The Rail over Road and Rail under Road solutions are typically higher than the road based solutions. One reason could be the assumptions used to calculate the Direct Costs<sup>66</sup>; in particular, a viaduct type structure was often assumed for Rail over Road options. This type of structure is typically significantly more expensive than a retaining wall structure.

In addition, the Owner's Costs were calculated using the same percentage applied to the Direct Costs across all types of solutions. Therefore, an increase in the Direct Cost would increase the Owner's Cost proportionally. This can increase the individual site cost estimate although in reality, it is unlikely the Owner's Cost would change proportionally, depending on the different types of solutions.

<sup>66</sup> Direct Costs are the costs that can easily be directly attributed to the works, such as materials, plant, labour, etc., versus Indirect Costs which include, for example, insurance, power consumption, management costs, etc.

As the options are developed and refined during development of Works Package/Project Proposals, further work will be undertaken to identify efficiencies and savings.

**Figure 7-1 – Reference Option Site Cost Estimates for the remaining 30 sites compared with the cost estimates of the first 20 sites, including Thompsons Road (P50 Unescalated)**

**Commercial-in-Confidence Figure Redacted**

### 7.2.3 Project packaged estimates for 30 sites

The Reference Options for each individual site have been aggregated into Reference Works packages.

The total cost of the Reference Works Packages is less than the sum of the individual cost estimates for sites in that package.

Similar to the individual sites, the cost estimates for the packaged works were not escalated to maintain flexibility for packaging and sequencing over the course of the project. The detailed breakdown regarding specific cost savings for each package is provided in Appendix G (*redacted*).

A comparison of the individual site project costs added together and packaged project costs is set out in Table 7-6.

Table 7-6 – Costs and packaging savings (Reference Options, excluding first 20 sites)

Name	Reference Works Package	Site Costs P50 (excl. escalation) \$M	Packaged Project Costs P50 (excl. escalation) \$M	Savings	
				\$M	%
<b>Melton Hwy</b>	Melton Hwy				
<b>Frankston 8</b>	Charman-Balcombe-Edithvale-Station-Station-Eel Race-Seafood-Skye				
<b>North Eastern</b>	Grange				
	Lower Plenty- Bell-High				
	<i>Sub-Total</i>				
<b>North Western</b>	Camp-Buckley-Bell-Moreland-Glenroy				
<b>Western</b>	Kororoit Ck				
	Ferguson-Aviation-Cherry- Werribee				
	<i>Sub-Total</i>				
<b>Remaining</b>	Abbotts				
	Manchester-Maroonah				
	Toorak Rd*				
	Hallam-Clyde-Sth Gippsland				
<b>P50 Estimate Total</b>		<b>4,389</b>	<b>4,002</b>	<b>387</b>	<b>-9%</b>

\* Refer to Appendix G (*redacted*) for further information on the project packaging methodology.

The total estimated savings from packaging is \$387 million (P50 excluding escalation).

### 7.2.4 Total project cost estimate

The tables below show the P50 cost estimates for the total project of 50 level crossings, reflecting savings from packaging multiple sites together.

Commercial-in-Confidence information has been redacted prior to publication

Table 7-7 – Total project cost estimate – based on Reference Options / Packaging

Name	Reference Works Package	Total (M)	Level Crossings (\$M)		Metropolitan Network Modernisation Improvements		
			Level Crossings (\$M)	Risk (incl. packaging benefits)	Improvements (eg. Stations) (\$M)	Future proofing (M)	Risk (incl. Packaging benefits)
<b>Packages 1-5*</b>	(20 Sites)						
<b>Melton Hwy</b>	(Melton Hwy)						
<b>Frankston 8</b>	(Charman-Balcombe-Edithvale-Station-Station-Eel Race-Seafood-Skye)						
<b>North Eastern</b>	(Grange)						
	(Lower Plenty- Bell-High)						
	<i>Sub-Total</i>						
<b>North Western</b>	(Camp-Buckley-Bell-Moreland-Glenroy)						
<b>Western</b>	(Kororoit Ck)						
	(Ferguson-Aviation-Cherry- Werribee)						
	<i>Sub-Total</i>						
<b>Remaining</b>	(Abbotts)						
	(Manchester-Maroonah)						
	Toorak Rd						
	(Hallam-Clyde-Sth Gippsland)						
<b>Total</b>			<b>5,313</b>	<b>598</b>	<b>678</b>	<b>148</b>	<b>89</b>
<b>P50 Estimate Total (excl. escalation)</b>			<b>5,911</b>		<b>915</b>		
<b>Escalation</b>			677		105		
<b>P50 Estimate Total (incl. Escalation)</b>			<b>Level Crossing Removals 6,588</b>		<b>Metropolitan Network Modernisation Program 1,020</b>		

\* P50 estimates from approved business cases and project proposals

The P50 estimate aims to provide a statistical level of confidence in the expected cost of the project (or package of projects). The P50 value is an estimate of the project cost based on a 50 per cent probability that the cost will not be exceeded. P50 is considered to be a middle range value or the 'most likely' estimate and includes a number of inherent and contingent risks.

Inherent risks are the cost uncertainties represented by the range of possible cost rates and quantities in each line item of a risk-based estimate. Contingent risks are additional cost uncertainties, due to risk events that may occur as a result of the planned scope of the project, such as unknown utility services encountered during construction, delays in obtaining permits, etc. Contingent risks are usually represented by the probability of their occurrence, combined with the cost value if they do occur. Should an event have a probability of occurrence of 100%, the event is certain to occur and does not represent a contingent risk – these items are therefore included in the Base Estimate.

The Base Estimate is an estimate of all project costs, excluding all risk and escalation. The P50 estimate includes allowance for inherent and contingent risks, based on preliminary investigations and assessment on the current level of certainty on those risks at the time the estimates were prepared. As the projects are developed further (either during Project Proposal /Works Package stage or during procurement), the level of certainty around the risks increases and so does the certainty associated with the cost value of these risks.

## 7.2.5 Total Project Cost Profile

The project package cost estimate for the 30 level crossing sites added to the cost of the first 20 sites forms the total project cost. For the purposes of providing a cost profile for the business case, this has been profiled over the eight year project schedule to establish the cash flow for the Project. Table 7-8 shows the profiled cash flow for the P50 unescalated total project cost estimate.



Commercial-in-Confidence information has been redacted prior to publication

Table 7-8 – P50 Cash flow (Based on Reference options/ Packaging)

Name	Reference Works Package	Total \$	Previous Years up \$	Year 1 \$	Year 2 \$	Year 3 \$	Year 4 \$	Year 5 \$	Year 6 \$	Year 7 \$
<b>Packages 1-5</b>	First 20 Sites									
<b>Melton Hwy</b>	Melton Hwy									
<b>Frankston 8</b>	Charman-Balcombe-Edithvale-Station-Station-Eel Race-Seafood-Skye									
<b>North Eastern</b>	Grange									
	Lower Plenty- Bell-High									
	<i>Sub-Total</i>									
<b>North Western</b>	Camp-Buckley-Bell-Moreland-Glenroy									
<b>Western</b>	Kororoit Ck									
	Ferguson-Aviation-Cherry-Werribee									
	<i>Sub-Total</i>									
<b>Remaining</b>	Abbotts									
	Manchester-Maroonah									
	Toorak Rd									
	Hallam-Clyde-Sth Gippsland									
<b>P50 Estimate Unescalated Total</b>		<b>6,825,808,100</b>	<b>76,504,700</b>	<b>623,190,300</b>	<b>1,077,873,300</b>	<b>1,516,248,500</b>	<b>1,153,658,900</b>	<b>1,231,514,900</b>	<b>717,960,400</b>	<b>428,857,400</b>
<b>PERCENTAGE CASH FLOW</b>		<b>100%</b>	<b>1%</b>	<b>9%</b>	<b>16%</b>	<b>22%</b>	<b>17%</b>	<b>18%</b>	<b>11%</b>	<b>6%</b>
<b>P50 Estimate Escalated Total</b>		<b>7,607,535,201*</b>	<b>76,504,690</b>	<b>639,832,768</b>	<b>1,137,070,417</b>	<b>1,643,301,739</b>	<b>1,290,589,896</b>	<b>1,428,019,926</b>	<b>863,111,331</b>	<b>529,104,434</b>

\* incl. Level Crossings \$6,588m and Metropolitan Network Modernisation Program \$1,020m

### 7.3 Operating costs

The indicative operating and maintenance costs have been obtained from the previous level crossing removal business cases. These costs were provided by the relevant authorities that will be maintaining the assets including MTM for the rail infrastructure and VicRoads for the road infrastructure. Operation and maintenance costs will be subject to separate bids for funding and are not included as part of this Business Case. Operation and maintenance costs are provided in Table 7-9 for information only and will need to be refined based on the final solution at each site.

Table 7-9 – Indicative operation and maintenance costs for various options

Option	Rail, Power, Maintenance, Operation & Renewal Costs p.a. \$	VicRoads Bridge & Traffic Signal Maintenance Costs p.a. * \$	Total Maintenance Costs p.a. \$
Rail Under Road with station**			
Rail Under Road without station			
Road Over Rail			
Rail Over Road with station**			
Rail Over Road without station			
Road Under Rail			

\*

\*\*The LXR is upgrading providing many new stations, in which case there might be slightly increased maintenance costs associated with the new stations e.g. new power for lifts

### 7.4 Real options to ‘future proof’ the transport network

Real Option methods place an option premium on the flexibility to respond to uncertainty. This means that in the presence of uncertainty, a real option valuation will place a higher value on project designs with greater flexibility to respond to uncertainty than those with inflexible designs.

Real Options is valuable where there is both uncertainty and flexibility (or scope to create flexibility) to better adapt to the way that the uncertainties start to play out through time. It may justify incurring upfront costs that would not seem justified under more traditional project planning models.

These costs could include greater investment in planning and obtaining selective approvals earlier than might otherwise be justified, where these heightened costs create significant scope for either:

- Reducing the forward costs of delivering a functional infrastructure development; or
- Better aligning the structure and cost of the delivered infrastructure with real future needs and constraints, delivering heightened net value from the investment

In accordance with DTF guidelines consideration has been given to real options as part of the development of the business case.

There are at least two complementary approaches to ‘real options thinking’. These include:

- *Combining real options theory with scenario planning techniques.*

This is an effectively qualitative rather than quantitative approach. It involves a series of interviews and/or workshops to assist project planners to structure their thinking on future uncertainties and to consider the real options that may better enable management to adapt to future uncertainty. A more simplified qualitative evaluation framework can be used to sift through the real options that are identified.

- *Quantitative (real options analysis) methods.*

These focus on estimating the option premium associated with project design flexibility and generally employ mathematical and computational techniques which augment a traditional valuation analysis with varying levels of sophistication.

The DTF approach envisages a combination of qualitative and quantitative methods, initially informed by a project workshop involving a selection of key decision makers from within the project agency and other key government stakeholders.

Section 6.0 describes how provision for future proofing of the transport network has been allowed for at each site, such as track duplication, road widening, installation of new railway station or train maintenance facilities, and train platform extensions etc.<sup>67</sup>

These futureproofing provisions are considered to represent a form of real option, which are recommended to be explored under the DTF guidelines. Under this approach, real option methods place an option premium on the flexibility to respond to uncertainty, so that in the presence of uncertainty, a real option valuation will place a higher value on project designs with greater flexibility to respond to uncertainty than those with inflexible designs.

In the case of the LXP, the uncertainty driving the consideration of real options relates less directly to the level crossings and other upgrades planned under the project, and more to uncertainty around the potential for future network upgrades that would alter the functional requirements for the infrastructure elements of the LXP.

The details of the futureproofing provisions currently planned are identified in Chapter 6 and include a range of active and passive measures.

An example of active provision is at Melton Highway in Sydenham where wider bridge abutments and longer bridge spans will be constructed to allow for the future tracks along the Sunbury railway line.

An example of passive provision is at Clyde Road in Berwick, where the design will ensure the duplication of the Pakenham railway line can be constructed in the future.

Cost estimates have been identified for these provisions from within the site-by-site cost estimates developed for the Reference Option and are summarised in the table below.

The cost estimates are indicative and has been estimated for the main physical components of the project related to futureproofing and includes an allowance for overheads, profits, ancillaries, design, risk and other minor physical works etc.

The total cost of the identified futureproofing provisions is estimated to be \$148 million, excluding risk and escalation.

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<sup>67</sup> Impacts of the reference option, any associated future proofing works, and integrated development opportunities were developed in February 2016. They are based on preliminary investigations to date, are not exhaustive, and are subject to change as options are developed further during the Project Proposal / Works Package stage and beyond.

Table 7-10 – Cost allowance for futureproofing provisions (Base estimate)

Site No.	Description	Cost Estimate \$M	Site No.	Description	Cost Estimate \$M
1	Abbotts Road, Dandenong South		26	Heatherdale Road, Mitcham	
2	Aviation Road, Laverton		27	Heatherton Road, Noble Park	
3	Balcombe Road, Mentone		28	High Street, Reservoir	
4	Bell Street, Coburg		29	Koornang Road, Carnegie	
5	Bell Street, Preston		30	Kororoit Creek Road, Williamstown North	
6	Blackburn Road, Blackburn		31	Lower Plenty Road, Rosanna	
7	Buckley Street, Essendon		32	Main Road, St Albans	
8	Burke Road, Glen Iris		33	Manchester Road, Mooroolbark	
9	Camp Road, Campbellfield		34	Maroondah Highway, Lilydale	
10	Centre Road, Bentleigh		35	McKinnon Road, McKinnon	
11	Centre Road, Clayton		36	Melton Highway, Sydenham	
12	Chandler Road, Noble Park		37	Moreland Road, Brunswick	
13	Charman Road, Cheltenham		38	Mountain Highway, Bayswater	
14	Cherry Street, Werribee		39	Murrumbeena Road, Murrumbeena	
15	Clayton Road, Clayton		40	North Road, Ormond	
16	Clyde Road, Berwick		41	Poath Road, Hughesdale	
17	Corrigan Road, Noble Park		42	Scoresby Road, Bayswater	
18	Edithvale Road, Edithvale		43	Seaford Road, Seaford	
19	Eel Race Road, Seaford		44	Skye Road, Frankston	
20	Ferguson Street, Williamstown		45	South Gippsland Highway	
21	Furlong Road, St Albans		46	Station Street, Bonbeach	
22	Glenroy Road, Glenroy		47	Station Street, Carrum	
23	Grange Road, Alphington		48	Thompsons Road, Lyndhurst	
24	Grange Road, Carnegie		49	Toorak Road, Kooyong	
25	Hallam Road, Hallam		50	Werribee Street, Werribee	

## 7.5 Funding requirements

### 7.5.1 Committed Funds

In May 2015, the Victorian Government announced \$2.4 billion to commence the removal of 50 level crossings as part of its Level Crossing Removal Project.

Total funding of \$2.928 billion (including the \$2.4 billion mentioned above) has already been allocated to the LXR. This funding is derived from a number of sources, such as

. As the level crossing removal projects are in different phases of their development and delivery, this figure includes a mixture of the Total Estimated Investment (TEI) (as included in the project proposals or previous business cases for projects in the planning and pre-construction stage) and actual contract values for projects in the delivery stage.

## 7.5.2 New Project Funding Required

Table 7-11 shows the allocated funding profile and the additional funding required to deliver the LXR, based on the Reference Options and Reference Packaging. This is based on the P50 estimated cost of delivering the program of 50 level crossings and includes escalation.

Table 7-11 – Cash flow for additional funding request (based on Reference Options/ Packaging)

	Prev. Yrs up to 2014/15 \$M	2015/2016 \$M	2016/2017 \$M	2017/2018 \$M	2018/2019 \$M	2019/2020 \$M	2020/2021 \$M	2021/2022 \$M	Total including esc. \$M
Total Project Cash Flow**									
Less Existing Funding***									
<b>New Funding Required</b>									

\* incl. Level Crossings \$6,588m and Metropolitan Network Modernisation Program \$1,020m

\*\* P50 escalated estimated cost

\*\*\* Existing funding received as of February 2016 (when Reference Options and Reference Package were identified).

The funding required outlined in the above table does not include funding required for integrated development or enabling works for other projects, such as the Metro Tunnel.

## 7.5.3 Funding Sources

*Commercial-in-Confidence information has been redacted prior to publication*

# Chapter 8

## Program appraisal



## **CHAPTER 8: PROGRAM APPRAISAL - SUMMARY**

The appraisal uses cost-benefit analysis (CBA) as the main quantitative tool for evaluating the merit of the program, with other appraisal tools used to estimate economic, spatial, local, distributional and land use impacts in order to present key economic, social and environmental impacts in line with the program ILM and the identified benefits of the LXP.

Undertaking CBA requires the comparison of monetised economic costs and benefits that are realised over different timeframes. For the LXP (like many transport projects), this involves comparing large upfront capital expenditures with a stream of economic benefits over a longer horizon based on discounting.

Typically, transport projects require a rate of return of 7 per cent, while social projects require a rate of return of 4 per cent. In recognition of the current levels of market rates, and practice in other jurisdictions around the choice of an appropriate discount rate for similar large projects, there are good reasons to consider that a real discount rate of approximately 4% is appropriate for the LXP. However, to keep in step with the approach adopted by other major transport investments being undertaken by the Victorian Government, the appraisal results for the LXP are shown using the standard discount rate of 7% (real), and also present a sensitivity impact using a lower discount rate of 4% (real).

The standard ("Reference Case") approach to the modelling and appraisal of transport projects in Victoria has been applied to provide the main CBA results for the LXP. This involves comparing future year 'base' and 'project' cases, using the Reference Case defined by DEDJTR as a starting point for all 'project' cases. A combined appraisal of the LXP, Cranbourne-Pakenham line upgrade and Metro Tunnel is also included to demonstrate the combined value of this integrated investment program.

The strategic transport model represents the most significant sources of induced demand associated with most transport projects: changes of route, changes of destination and mode switching. All of the traffic modelling and CBA results reported in this document reflect the impacts of these sources of induced demand. The benefits of the LXP have been derived using transport model results.

The core benefits anticipated as a result of the program, include travel time savings, reduced vehicle operating costs, road travel reliability benefits, public transport user benefits and avoided collisions. As a standalone program, the LXP is expected to deliver a net benefit of -\$1.3 billion and Benefit Cost Ratio (BCR) of 0.78 using a 7 per cent discount rate. Using a discount rate of 4%, the net benefit is \$2.2 billion and the BCR is 1.34.

The BCR has been calculated using a standard appraisal methodology. This excludes other significant benefits that the LXP can be expected to deliver, including Wider Economic Benefits, Additional Benefits (such as improved network resilience to incidents, reduced perceived congestion benefits and the related benefits and costs of land use changes occurring as a result of the project). Also excluded are local amenity benefits, increased activity centre connectivity/consolidation, and benefits for emergency services.

The LXP plays a critical role in enabling the full benefits of subsequent projects, such as the CPLU and the Metro Tunnel, to be achieved. The Victorian Government's integrated investment program of the LXP, CPLU and Metro Tunnel will in combination, provide a net benefit of \$5.1 billion and BCR of 1.2 using a discount rate of 7%. When using a 4% discount rate, the net benefit is \$21 billion and BCR is 2.2

Through the construction period, economic modelling predicts the short term stimulus effect of construction to add moderate amounts to Victorian GSP. In each year between 2015-16 and 2019-20 the size of the economy will be around \$200-300 million (up to 0.08 per cent) larger than in the absence of the project.

There is expected to be a temporary boost to employment arising from the stimulus effects of additional construction expenditure. During the first three construction years, between 1500 and 1750 more people are expected to be employed (across the economy as a whole) than would have been employed in the absence of the project. By the later construction years (2017-18 to 2021-22) average real wages are expected to grow to levels around 0.15% higher than they would have otherwise been.

The LXP will create additional on-going incremental benefits to the Victorian economy via improved productivity. By the end of the evaluation period in 2065, real GSP is expected to be around \$275 million (or 0.02 per cent) higher than it would otherwise have been.



## 8 Program appraisal

### 8.1 Introduction

Removing 50 level crossings over the next eight years as part of the LXR is expected to deliver significant benefits for the community, including:

- Better travel conditions around Melbourne for train users, pedestrians, cyclists and drivers, with faster and more reliable journeys enabling people to better predict their travel times and spend more time at home, work or play
- Safety improvements for drivers and pedestrians
- Revitalising local communities, with many areas benefiting from station rebuilds
- Enabling more trains to run more often and on time, especially where the Government is investing in major network upgrades including on the Cranbourne-Pakenham corridor and the Metro Tunnel.
- Direct economic activity through planning and construction employment during the delivery of the project, which will also have indirect flow-on impacts for the local economy

This chapter presents a comprehensive appraisal of the LXR to enhance Government's and the community's understanding of the costs, benefits and impacts of the Program.

The LXR has been conceptualised as a coherent single 'program' of level crossing removals. While alternative approaches that could be adopted to assess economic value for money and other impacts have been considered (such as preparing an appraisal for each individual site or examining bundles of related sites), the approach deemed best suited to assessing the merits of the overall program is to treat it as a single investment. This is consistent with the program approach adopted in the business case and avoids technical and conceptual problems with conducting accurate site-by-site (or bundle-by-bundle) appraisals.

The appraisal assesses the case for a Reference Program of 50 level crossing removals, at locations defined by the Government and based on site-specific solutions selected by LXRA with the support of its technical advisors.<sup>68</sup> The appraisal does not consider the merits of alternative program configurations (such as those involving alternative level crossing removals); nor does it aim to support LXRA and stakeholders in determining the most suitable solution at each location. Accordingly, it does not include a project options analysis (as has been undertaken for previous business cases for level crossing removals).

The LXR forms a critical enabler of major rail network upgrades, including the Cranbourne-Pakenham line upgrade and the Metro Tunnel. To enhance the understanding of the LXR and the additional value it provides by enabling these projects, a combined appraisal of these three city-shaping investments is also included. This additional analysis, undertaken using cost-benefit analysis, contributes to the overall economic value for money assessment of the LXR, and includes an assessment of the benefits that these rail network upgrades will provide by encouraging households and businesses to locate in areas closer to Melbourne's rail corridors.

A more detailed program appraisal report is provided in Appendix H (*redacted*), with a report on the combined appraisal of the program, Cranbourne-Pakenham line upgrade and the Metro Tunnel also provided in Appendix M (*redacted*).

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<sup>68</sup> See Chapter 6 for details of the Reference Option for each selected site.

## 8.2 Methodology

The overarching objective of the program appraisal is to assess the impact of the level crossing removal program across economic, social and environmental dimensions, as envisaged by the *Transport Integration Act 2010*. It provides information for the Government and stakeholders beyond dollar-value benefits and benefit/cost ratios, with the cost-benefit analysis (CBA) just one element of a broader assessment that aims to represent the impacts of the program in terms that are meaningful to stakeholders and decision-makers. This is consistent with the comprehensive approach to transport project appraisal envisaged by BITRE in its *Overview of project appraisal for land transport* (2014).

While the appraisal uses CBA as the main quantitative tool for evaluating the merit of the program, this is supported by analysis of other impacts via:

- Computable General Equilibrium (CGE) modelling to illustrate macroeconomic impacts
- Analysis of spatial impacts to describe transport and accessibility improvements by area
- Analysis of local amenity and project impacts in the immediate vicinity of the proposed level crossing removals
- A basic distributional analysis, which illustrates the diversity of local areas impacted by the program
- Land use modelling in connection with the combined appraisal of the LXR, Cranbourne-Pakenham transformation and the Metro Tunnel, to show potential impacts of these interdependent projects on patterns of employment and residential population.

The appraisal methodology and presentation of key economic, social and environmental impacts has been developed around the program ILM<sup>69</sup> and the identified benefits of the LXR, where the Program is designed to deliver:

- More efficient and reliable transport networks to improve connectivity
- Better connected, liveable and thriving communities
- Safer communities.

The appraisal methodology adheres to the best practice approach outlined in relevant guidance materials, including:

- The revised Australian Transport Assessment and Planning (ATAP) Guidelines, which outline best practice for transport planning and assessment in Australia. They have replaced the previous National Guidelines for Transport System Management in Australia (NGTSM)
- BITRE's *Overview of Project Appraisal for Land Transport* (November 2014), which preceded the most recent revision of the NGTSM
- DTF's *Investment Lifecycle and HV/HR Guidelines: Stage 2* (February 2015)
- DTF's *Economic Evaluation for Business Cases Technical Guidelines* (August 2013)
- Infrastructure Australia's *Assessment Framework – Detailed Technical Guidance* (January 2016), *Better infrastructure decision-making* guidelines (August 2014) and *Solution Evaluation: Transport Infrastructure* guidelines (December 2013).

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<sup>69</sup> The ILM for the LXR is shown in Section 2.2 of the business case.

## 8.2.1 Key assumptions for the CBA

The project and parameter assumptions used in the CBA are summarised in Table 8-1.

Table 8-1: Key assumptions for the LXR cost benefit analysis

Item	Assumption / value	Source / rationale
<b>Appraisal and modelling framework</b>		
Evaluation period	50 years, commencing from the start of the project's operations phase.	ATAP
Prices and values	Prices and values expressed in FY16 dollars. Historical benefit unit prices escalated to 2016 dollars, based on ABS's consumer and wage price weighted index of capital cities	Project assumption
Construction period	July 2015 to December 2022	LXRA
Operation start date	Staggered – starting April 2016 to December 2022	LXRA
Traffic model years	2015, 2021 and 2031	Victorian Integrated Transport Model (VITM)
Interpolation between modelling years	Straight line, based on the average annual change between key model years.	Project assumption
Benefits extrapolation	Benefits extrapolated in line with population growth after the final model year	Project assumption
Discount rate (real)	LXR adopts the standard discount rate of 7% (real), and also presents a sensitivity impact using a lower discount rate of 4% (real). There is a further sensitivity test at 10%	DTF Economic Evaluation guidelines (2013) IA (Dec 2013)
Annualisation factor	321	Project assumption
<b>Economic benefits</b>		
Values of time per person hour	Personal car: \$15.54 Business car: \$49.71 Trucks: \$31.35 Public transport (private trips): \$13.99 Public transport (business trips): \$43.79	ATAP values escalated to 2016 dollars
Value of time growth	Real per capita wage growth (1.5%)	ATAP
Occupancy	Personal car: 1.6 Business car: 1.4 Light Commercial Vehicle (LCV): 1.3 Heavy Commercial Vehicle (HCV): 1.0	Austrroads Guide to Project Evaluation Part 4, 2012
Average casualty costs per person	Fatal crash = \$8,780,578 Serious injury crash = \$435,881 Other injury crash = \$25,886	ATAP escalated to June 2016 prices

Item	Assumption / value	Source / rationale
Asset life and depreciation method for calculating project residual value	Road pavements: 50 years (15% of project cost) Earthworks: 125 years (30%) Bridges/Structures: 120 years (50%) Signals/Communications: 30 years (5%) Weighted average: 106.5 years Depreciation method: straight line (53% of asset value remaining after evaluation period)	ATAP
<b>Project costs</b> <sup>70</sup>		
Capital costs	P50 cost estimates including real escalation. P90 costs are included as a sensitivity test.	Technical Advisor / project assumption
Operating costs	P50 cost estimates including real escalation. P90 costs are included as a sensitivity test.	Technical Advisor / project assumption

Source: EY CBA assumptions

## 8.2.2 Selection of an appropriate discount rate

Undertaking CBA requires the comparison of monetised economic costs and benefits that are realised over different timeframes. For the LXP, as for many transport projects, this involves comparing large upfront capital expenditures with a stream of economic benefits over a longer horizon. Discounting future cost and benefit profiles to their present values enables a like-for-like comparison of current and future costs and benefits in determining the net present value of a project.

There is considerable debate between different jurisdictions regarding the choice of an appropriate discount rate for use in the appraisal of public infrastructure projects.

DTF Guidelines for Victoria, recommend an approach that is based on the assumption that the choice of discount rate should broadly reflect a market-based cost of capital for similar investments (measured using historic returns in equity markets using the Capital Asset Pricing Model framework). This is similar to the approach applied in other states and adopted by Infrastructure Australia in its *Assessment Framework – Detailed Technical Guidance* released in January 2016.

To simplify the application of discounting, DTF provides default discount rates and sensitivity tests, where different kinds of projects are categorised by risk to apply a relevant standard rate.

Like other transport projects, the LXP is considered a ‘Category 2’ project under the DTF *Economic Evaluation for Business Cases Technical guidelines (August 2013)* given the risk profile of the project and the extent of monetised transport user benefits. As such, the standard real discount rate of 7% is the starting point for the LXP,

However, there is a particular challenge for large scale infrastructure investments to generate net benefits using standard discount rates, given the tendency for these projects to create longer term benefit profiles with very high upfront costs. This is particularly the case for major transport projects that apply a real discount rate of 7%. In recognition of this, the Commonwealth Government recently used a real rate of 4% for the Inland Rail and High Speed Rail projects.<sup>71</sup>

A number of other jurisdictions overseas also apply lower discount rates that are measured on a different basis. These approaches are based on the view that the opportunity cost of investing in infrastructure relates to forgone

<sup>70</sup> Note that the P50 and P90 cost estimates used in the economic appraisal will be preliminary figures. These costs estimates should be treated as indicative, with some highly susceptible to change depending on a range of factors such as option identification, order of completion, bundling of projects etc.

<sup>71</sup> [https://infrastructure.gov.au/rail/trains/high\\_speed/files/HSR\\_Phase\\_2\\_Chapter\\_8.pdf](https://infrastructure.gov.au/rail/trains/high_speed/files/HSR_Phase_2_Chapter_8.pdf); <http://inlandrail.artc.com.au/business-case>

consumption instead of private investment, or that government bond rates are a better reflection of available returns. For example, in the UK the real discount rate is 3.5%.

There are good reasons for considering an alternative discount rate for the LXR of 4%, in line with DTF Guidelines, as follows:

- While the DTF Guidelines provide default discount rates for different categories of projects, the principle underpinning the DTF approach is that the discount rate should be based on the opportunity cost of investing in a particular project given investment returns that are available elsewhere for projects with a similar risk profile.
- Current Developments that suggest the default discount rate is significantly out of step with the market's current assessment of the opportunity cost of capital for road transport projects (non-toll), with analysis suggesting the current real rate is 4.2-4.9%, with the upper end of the range taking into account longer term risks to bond yields.<sup>72</sup>

There are challenges in estimating the full range of user and social benefits that can be attributed to level crossing removals, particularly road network reliability and neighbourhood amenity values. It could be legitimate to apply the current market rate and adjust it down by 1% to account for benefits that could not be robustly modelled. This suggests a real discount rate of approximately 4% is appropriate for the LXR.

An alternative discount rate of 4% would also be consistent with wider recommended practice, as:

- Recent analysis by the Bureau of Infrastructure, Transport and Regional Economics (BITRE) confirmed that it recommends discount rates for use in cost-benefit analysis within the range of 4% and 7%, with 5% to be used if a single discount rate is desired.<sup>73</sup>
- The Commonwealth Government's recent use of 4% for the Inland Rail and High Speed Rail projects.
- Lower discount rates are widely adopted in other jurisdictions, such as UK (3.5% over 30 years), Japan (4%), and US (2.5%, 3% and 5%)

There is a good basis for applying a 4% real discount rate for the LXR. However, to align with the approach adopted by other major transport investments being undertaken by the Victorian Government, the appraisal results for the LXR adopts the standard discount rate of 7% (real), and also presents a sensitivity impact using a lower discount rate of 4% (real).

### 8.2.3 Modelling and appraisal scenarios

#### ***The 'Reference Case' approach***

The standard approach to the modelling and appraisal of transport projects in Victoria involves comparing future year 'base' and 'project' cases, using the Reference Case defined by DEDJTR as a starting point for all 'project' cases.

The Reference Case defines the specification of a range of inputs and variables such as land use projections, and network changes (i.e. projects and service parameters) that are already committed or expected to be provided under a 'business as usual' approach to the provision of new or improved transport infrastructure.

This approach asks what value the LXR adds by posing a counterfactual scenario under which all other planned projects proceed, despite level crossings not yet being removed from the network. In effect, the base case scenario is defined as DEDJTR's Reference Case excluding the project that is being modelled and appraised, and the project case is equivalent to the full Reference Case. The comparison of base and project cases enables the calculation of the 'marginal benefit' of the project.

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<sup>72</sup> EY analysis of market rates and returns for road transport projects (Appendix H (*redacted*))

<sup>73</sup> Bureau of Infrastructure, Transport and Regional Economics BITRE *review of the social discount rate for economic evaluation of nation Building infrastructure projects (2014)*

The Reference Case approach has been used as the main modelling and appraisal scenario for the LXR, as this provides the best basis for a 'like for like' comparison with other projects in the Victorian Government's investment portfolio.

### ***Combined Appraisal: An alternative scenario that recognises the critical role of LXR in supporting interdependent city-shaping projects***

As noted throughout this business case, the LXR is not a typical stand-alone road or rail project with transport network benefits existing independently of other projects. Rather, there are significant interdependencies between the LXR and other concurrent projects that make the benefits of each contingent on the others, particularly in relation to the CPLY and the Metro Tunnel. As the LXR provides for the removal of a majority of level crossings on the CPLY and Metro Tunnel corridors, (including all level crossings between Watergardens and Dandenong), both of these projects rely on the LXR in order to realise the extent of planned service upgrades and transport network benefits.

PTV's *Network Development Plan* anticipates a 130 per cent increase in rail capacity within 20 years. Without certain level crossing removals, this would result in boom gate closures on the Cranbourne-Pakenham line rising from an average of 60 per cent of the morning peak hour at present up to 95 per cent in future. Community concern about extended boom gate closures and the need for network managers to maintain a level of road network efficiency mean that these service upgrades are unlikely to occur with level crossings still in place. At best, only a constrained form of service upgrade with less extreme increases in closure times could be implemented while level crossings remain in place. A more pessimistic assessment is that the system is already stretched to 'breaking point' and that the presence of level crossings means that no increase in service frequency is practically possible on some rail lines.

By enabling additional services to be run without exacerbating existing road delays, the LXR effectively enables the benefits of these major rail upgrades – additional passenger movements, less crowding and faster trips, along with reduced road congestion due to mode shift – to be achieved.

Because of these critical interdependencies, a meaningful and comprehensive picture of the LXR, CPLY and Metro Tunnel can only be ascertained by considering them as one large investment program rather than through their standalone project assessments. If the LXR is a key precursor project to both the CPLY and the Metro Tunnel, such that the benefits of each relies on the successful delivery of the program, then it is important to account for the interdependent impacts between these investments, and the critical contribution of the LXR towards the Government's long term transport vision.

In light of this issue, a Combined Economic Appraisal of these three major and critically interdependent transport projects has been completed and is presented in this business case, summarised as follows.

- This approach recognises that the benefits of each project are interconnected to and in some cases overlap with the other projects.
- This program of major projects can be expected to have a significant impact on Melbourne's city structure by encouraging households and businesses to locate in areas that will benefit from the significant accessibility improvements that these projects will provide
- The cost-benefit analysis used for the combined appraisal includes an assessment of the additional 'city-shaping' benefits and costs linked to potential land use changes induced by these investments.
- In so doing, this study is an application of a detailed land use and transport interaction (LUTI) analysis for Melbourne, and shows the significant impact that such a major metro style infrastructure program will have on where people chose to live and businesses choose to locate.
- These methods to measure city shaping impacts and economic benefits and costs have recently been used in NSW and ACT in the last two years to support major transport investments in those jurisdictions.

The results of this analysis are presented in section 8.4.6, separately from the core 'Reference Case' results, with both sets of results summarised and compared in section 8.4.7. This approach provides a more comprehensive view of the value of the Government's program of major transport projects, although it does not replace or amend

the stand alone business cases and economic appraisals, which remain as legitimate means with which to assess the merits of those projects and support the Government’s investment decisions. It provides additional context to the appraisal of these projects as part of an overall integrated program.

Table 8-2: Major projects in the base case and project case – standard and alternative approaches

Scenario	2021	2031	2046
<b>Standard (Reference Case) approach including enabled rail projects</b>			
<b>Base Case</b>	LXRP CPLU	LXRP CPLU Metro Tunnel	LXRP CPLU Metro Tunnel
<b>Project Case</b>	LXRP CPLU	LXRP CPLU Metro Tunnel	LXRP CPLU Metro Tunnel
<b>Combined Appraisal: Alternative modelling approach without enabled rail projects</b>			
<b>Base Case</b>	<del>LXRP</del> <del>CPLU</del>	<del>LXRP</del> <del>CPLU</del> <del>MM</del>	<del>LXRP</del> <del>CPLU</del> <del>MM</del>
<b>Project Case</b>	LXRP CPLU	LXRP CPLU Metro Tunnel	LXRP CPLU Metro Tunnel

Source: EY

## 8.2.4 Treatment of induced demand

When forecasting the impacts of road and other transport projects, it is important to consider potential sources of induced demand, as these may change the overall impact of the project on user journey times and other expected benefits.

There are several sources of induced demand that have the potential to affect a road project, including:

- Changes of route – where road users make the same journey in terms of their mode and destination, but decide to take an improved route
- Changes of destination – where road users decide to alter their trip destination (i.e. lengthen or shorten their journeys) because of changed traffic conditions
- Mode switching – where road improvements cause public transport users to switch to using their car or where freight is moved by commercial vehicles instead of rail
- Time shifting – where road users move within or across time periods
- Additional trip making – where people and businesses make additional trips because of improvements to the road system
- New trips linked to land use changes – where transport system changes encourage people and businesses to relocate, changing the patterns of travel across the network.

VITM represents the most significant sources of induced demand associated with most transport projects: changes of route, changes of destination and mode switching. All of the traffic modelling and CBA results reported in this document reflect the impacts of these sources of induced demand.

A limitation of the Reference Case analysis is that VITM has not been developed to support the testing of users’ time of travel and propensity to travel; nor has it been used to test the project under different degrees of demand response, including testing changes in routing behaviour only (i.e. by fixing demand modes and destinations). However, the combined appraisal scenario also presented in this chapter provides an explicit consideration of the

impact of new trips linked to land use changes, with detailed land use modelling used to determine the potential impact of the LXR, CPLU and the Metro Tunnel on household and business location decisions.

## 8.3 Transport modelling and analysis

### 8.3.1 Modelling approach

The LXR is a city-wide project of sufficient scale to generate network-wide impacts and to induce shifts between transport modes; yet equally, it is composed of a series of local projects with particular impacts that will depend on the precise layout of each level crossing, local road network and availability of alternative routes.

To fully represent the impacts of the LXR, transport modelling needs to reflect the idiosyncrasies of boom gate closures and the variability in road speeds and travel times this generates. Reducing this variability may be a significant benefit arising from the program, but estimating this requires a robust approach to modelling traffic behaviour over short time intervals.

Accurately modelling a transport project that is unusual in many respects – that will affect travel patterns and road performance on both a local and metropolitan-wide level, and for which many benefits are measurable only with information at high-frequency time intervals – is a major challenge. In principle, an ideal approach to modelling transport impacts and quantifying project benefits would involve multiple models: a network model to describe city-wide changes, and small-scale models to capture impacts only visible when junction geometry, localised traffic behaviour, and the variability in traffic outcomes over small intervals are accurately represented.

The LXR appraisal uses outputs from the State's main transport model, the Victorian Integrated Transport Model (VITM). VITM is a strategic model that can predict changes in overall transport demand and mode choice and provide a picture of project impacts across the entire city. The cost-benefit analysis results in section 8.4 are based on VITM outputs.

VITM features a broad representation of the network, but does not include specific representation of intersections, and aggregates trips into four large time periods per day. For the reasons noted above, in theory this could be expected to under-represent both variability in delays and spillover impacts of boom gate closures on adjacent junctions and road links, hence downplaying the extent of road user benefits from the program.

Recognising this, LXRA also investigated the potential for two alternative models with more accurate junction geometry and more granular time intervals to inform the appraisal:

- **VISUM, a mesoscopic model developed by VicRoads.** This model, which relies on transport demand information from VITM, features detailed intersection geometry, potentially providing an enhanced ability to represent delays, queueing and the interaction between boom gates and nearby signalised intersections. VISUM remains under development at the time of preparation of this business case.
- **Microsimulation models for selected sites developed by Veitch Lister Consulting (VLC).** VLC prepared local area models for selected sites which provided second-by-second simulations of the localised road network, thus providing more granular detail on how boom gate operations affect traffic and travel times than VITM or VISUM (which use longer time intervals).

As these alternative models are still in development, the impacts of the project on transport outcomes and the monetised benefits in the CBA as described below have been based solely on VITM. While the alternative models have not been used to inform the CBA, they may prove valuable in the ongoing assessment of project options.



### 8.3.2 Base and project cases

Assessing the impact of the LXR requires a precise specification of a base case transport (where level crossings remain) and a project case (where the LXR proceeds).

In accordance with standard practice in Victoria, base and project cases have been defined using DEDJTR's 'Reference Case', which lays out a future scenario for the road network, public transport networks and service levels, population and employment projections, and demand parameters. The Reference Case includes:

- The removal of all 50 level crossings in all three future model years (2021, 2031 and 2046)
- The more frequent rail services resulting from purchase of new rolling stock under the Cranbourne-Pakenham Line Upgrade (CPLU) in all three future model years
- The service changes implemented under the Metro Tunnel in 2031 and 2046 only
- Other public transport and road network upgrades as agreed across government<sup>74</sup>.

The base case is defined by excluding the level crossing removal program from the Reference Case while retaining all other elements (including the CPLU and Metro Tunnel, as well as the other specified network upgrades).

The project case re-introduces the program of level crossing removals to the base case, and thus corresponds almost exactly to DEDJTR's Reference Case.<sup>75</sup>

### 8.3.3 Transport analysis

VITM base case projections under the standard scenario (with enabled rail projects) and alternative scenario (ie. Combined Appraisal Base Case without enabled rail projects) are displayed in Figure 8-1 and Table 8-3.

In the standard base case, road traffic measured by vehicle kilometres travelled (VKT) grows at around 1.5 per cent per annum from 2015 to 2031, average speeds decline and total hours travelled increase at a faster rate of 1.6-1.9 per cent per annum. Average speeds across the city fall by around 2km/h from now to 2031.

In the Combined Appraisal base case scenario without the CPLU or Metro Tunnel, the share of trips provided by public transport is lower and road outcomes deteriorate more quickly. Vehicle hours travelled grow at 0.1-0.3 percentage points per annum faster than in the standard base case and the city-wide average speed in 2031 is almost 1km/h slower than if the CPLU and Metro Tunnel services had been delivered.

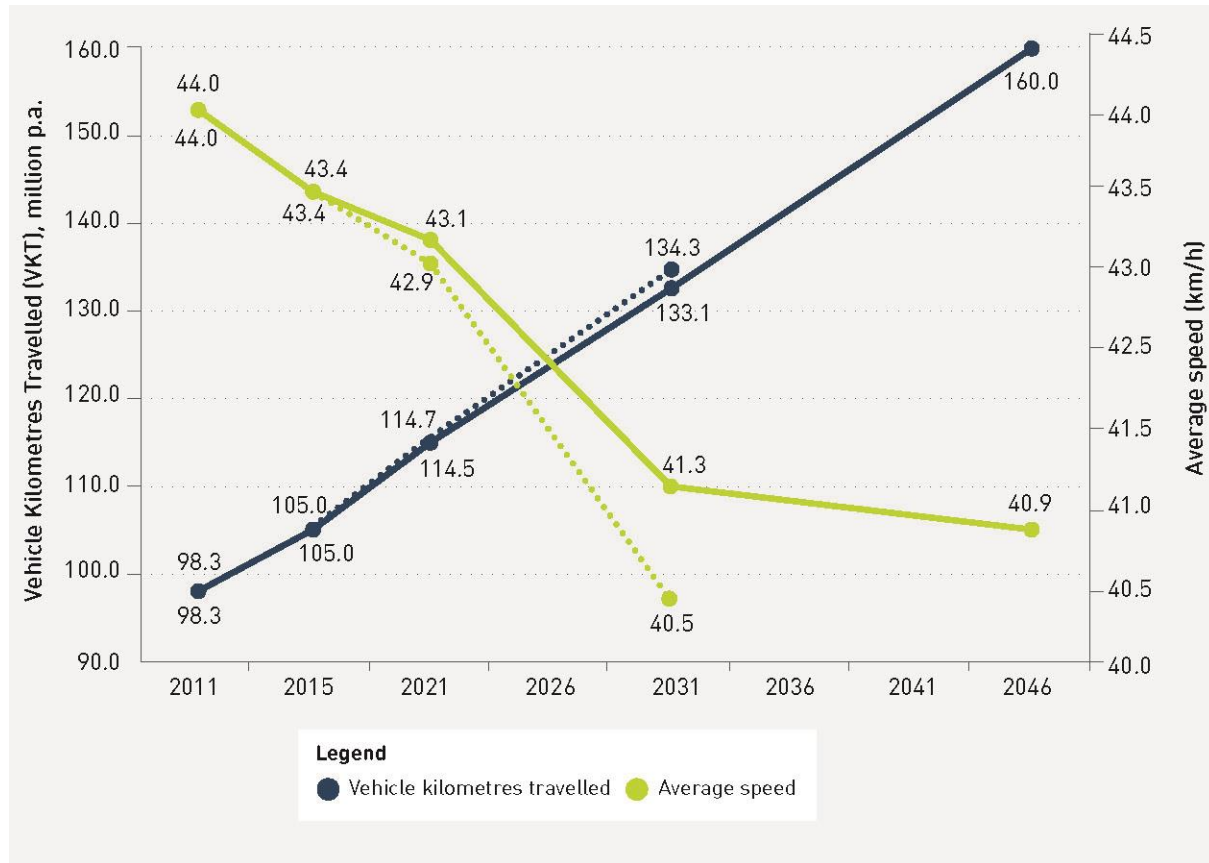
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<sup>74</sup> Development in consultation with DEDJTR, PTV and VicRoads

<sup>75</sup> One minor difference arises from the timing of the LXR in relation to modelling run years. The Victorian Government has committed to removing 50 level crossings by 2022 and expects under current timelines to deliver the first 23 level crossing removals by 2018.

Hence, for the purposes of estimating a more accurate benefit profile between now and 2022, rather than assume removal of 50 crossings in the 2021 modelling run, two modelling runs have been combined to produce a more representative profile of benefits. A 'project case A' run forecasts 2021 outcomes assuming that 23 crossings have been removed, then de-escalates 2021 benefits by three years' growth to define a 2018 benefit figure. A 'project case B' modelling run forecasts 2021 outcomes assuming that 50 crossings have been removed, then escalates the 2021 benefits by one year's growth to define a 2022 benefit figure. Intermediate years are interpolated between the 2015, 2018 and 2022 figures.

Figure 8-1: VITM vehicle kilometres travelled and average speed – standard and Combined Appraisal base cases



Source: VITM model projections: Reference base case (solid line) and Combined Appraisal base case (dashed line)

Table 8-3: VITM outcomes – Reference Base Case and Combined Appraisal base cases

Global (daily average) statistics	2011	2015	2021	2031	2046
<b>Reference base case</b>					
Public transport trips (million)	1.85	2.06	2.86	3.98	5.73
Public transport mode share	9.5%	9.8%	11.5%	13.3%	15.6%
VKT – growth p.a.	-	1.7%	1.5%	1.5%	1.2%
VHT – growth p.a	-	2.0%	1.6%	1.9%	1.3%
Average speed (km/h)	44.0	43.4	43.1	41.3	40.9
<b>Combined Appraisal base case (ex. CPLU/MM)</b>					
Public transport trips (million)	as above	as above	2.80	3.74	N/A
Public transport mode share	as above	as above	11.3%	12.7%	N/A
VKT – growth p.a	-	as above	1.5%	1.6%	N/A
VHT – growth p.a	-	as above	1.7%	2.2%	N/A
Average speed (km/h)	as above	as above	42.9	40.5	N/A

Source: VITM model projections: reference and alternative base cases. Alternative base case not modelled for 2046. VKT = Vehicle Kilometres Travelled. VHT = Vehicle Hours Travelled.

Table 8-4 presents the expected transport outcomes for the LXP in 2031.

Under standard project case assumptions, the LXP is forecast to lead to a small increase in average road speeds (0.2 km/h) and a small (-0.6 per cent) decrease in vehicle hours travelled (VHT). There is predicted to be a small shift away from public transport and an increase in Vehicle Kilometres Travelled (VKT), but the overall magnitude of these changes is minor.

Table 8-4: Transport outcomes for the LXP – standard project cases, 2031

Global (daily average) statistics	2031			
	Reference project case	Base	Project	BC->PC
Public transport trips (million)		3.98	3.98	-0.00 -0.1%
Public transport mode share		13.3%	13.2%	-0.0%
VKT		133,091,449	133,131,317	39,868 (+0.0%)
VHT		3,183,647	3,171,783	-11,864 (-0.4%)
Average speed (km/h)		41.3	41.5	0.2

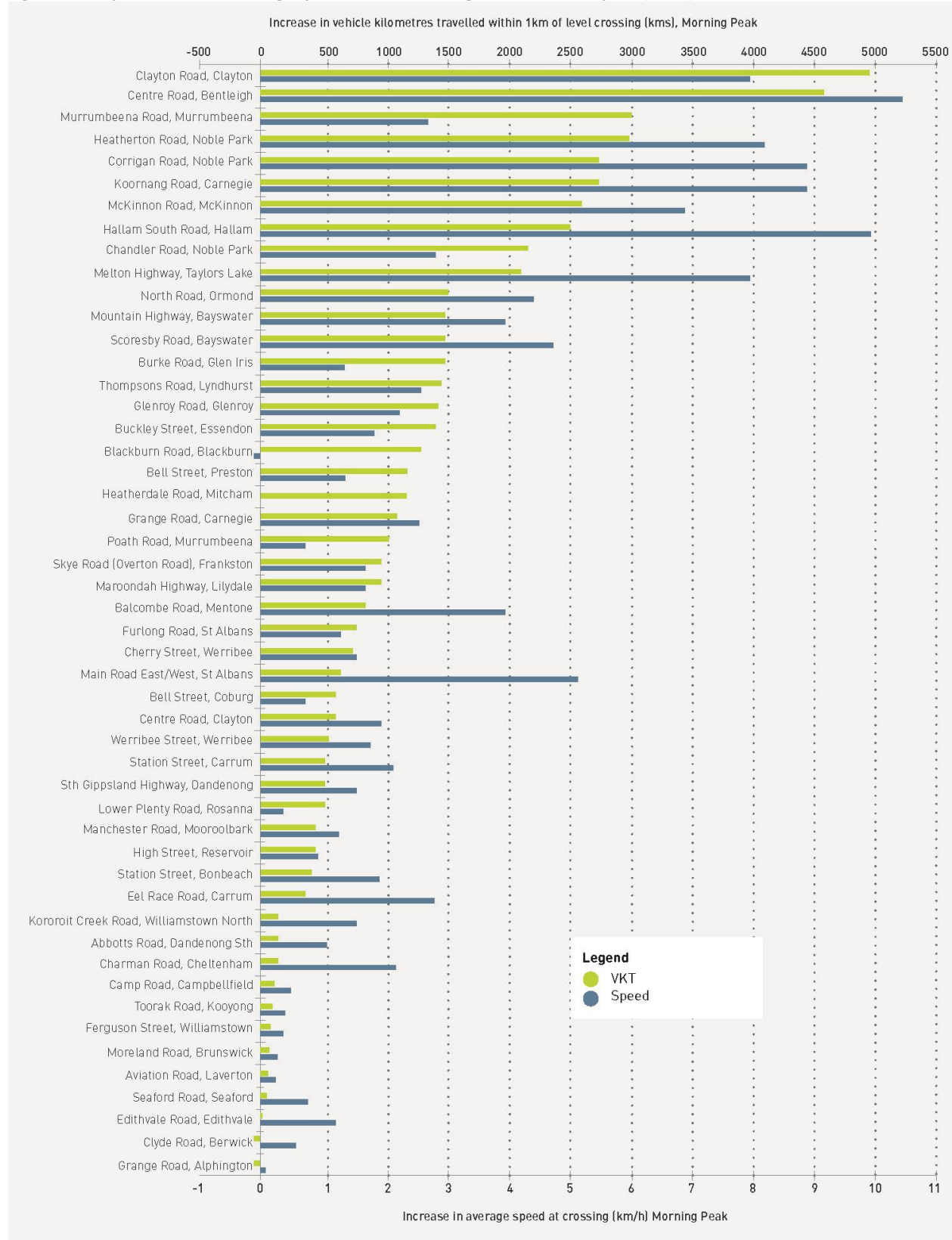
Source: VITM. VKT = Vehicle Kilometres Travelled. VHT = Vehicle Hours Travelled.

The expected benefits from the LXP vary significantly across the 50 sites that make up the program of works.

Figure 8-2 shows the 2031 AM peak changes between the base and project cases in VKT and average road speeds resulting from the project, calculated for travel on all roads within a 1km radius of each level crossing site.

Figure 8-3 shows how these local improvements impact speeds on the wider network across the city, providing an illustration of the view that the 50 level crossing removals are of sufficient scale collectively to generate network-wide impacts and underpin city shaping benefits when delivered with other major rail projects. As discussed further in the spatial impact analysis (see Section 8.5.2), a notable impact emerging from the VITM projections is the apparent deterioration of speeds on some roads around the Dandenong corridor (particularly north-east of the corridor) even while the immediate crossing links show improved speeds.

Figure 8-2: Impact of LXR on average speeds at level crossing sites – 2031 AM peak (VITM)



Source: VITM model projections: base case to project case (reference) change in speed, 2031 AM peak

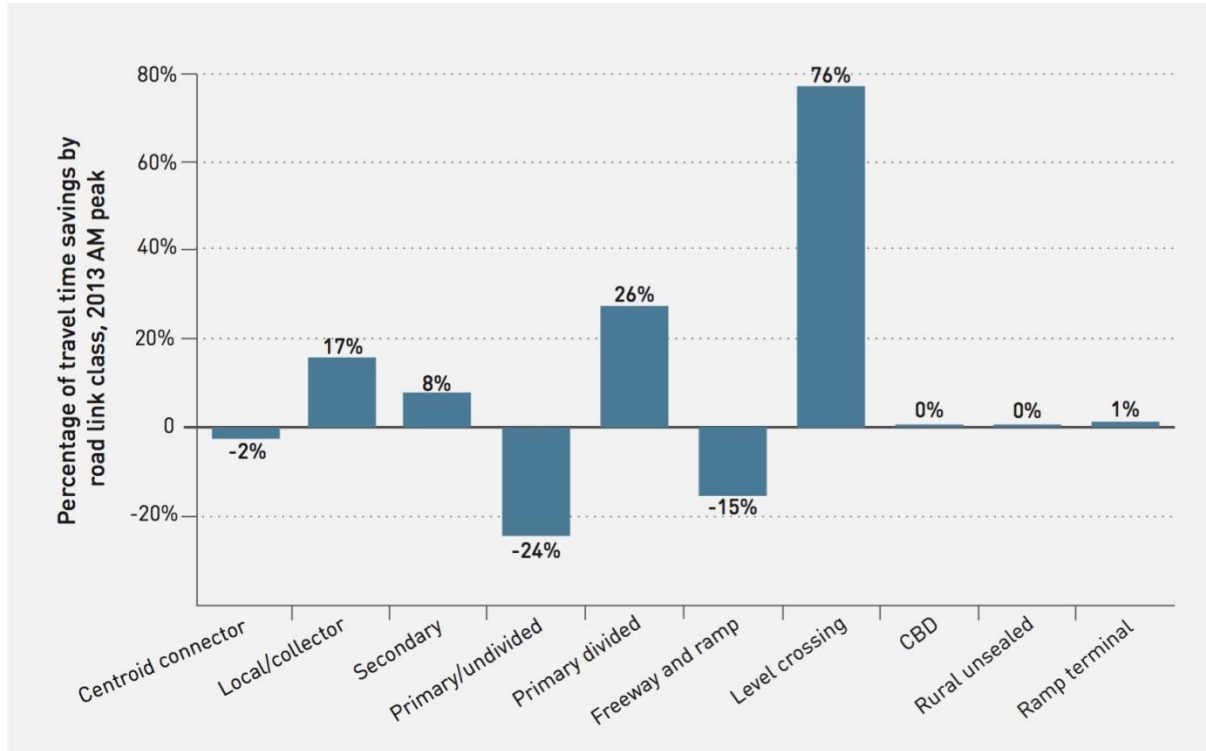
Figure 8-3: Base case to project case change in AM peak average speed – 2031 (VITM)



Source: VITM model projections: base case to project case (standard) change in speed, 2031 AM peak

Figure 8-4 shows the total travel time savings (2031 AM peak) by classes of road link featured in the VITM model.<sup>76</sup> While the majority of travel time benefits accrue on the level crossing links themselves, there are notable broader network impacts. Time savings on non-level crossing links collectively contribute around two thirds as much as on the level crossing links, and there are travel time increases on freeways and primary undivided roads which offset around one third of the total savings experienced elsewhere.

Figure 8-4: Time travel savings by VITM road link class – 2031 AM peak



Source: VITM model projections: base case and project case (standard).

<sup>76</sup> Links in VITM refer to sections of road (of unequal length) for which volume/speed statistics are generated in each scenario. Different classes of link have different characteristics which impact the relationship between traffic volumes and speeds. Level crossing links are those sections of road which include a level crossing (they are not of equal length across length crossing sites). To represent the impact of boom gate closures, level crossing links are coded with a different delay function to roads of equivalent characteristics that do not have level crossings. The delay function for each level crossing link is calculated according to the frequency of train services.

## 8.4 Cost-benefit analysis

### 8.4.1 CBA framework

Cost-benefit analysis (CBA) is the key appraisal metric for evaluating the quantitative economic merit of the program.

The objective is to provide a single, dollar-value summary of the welfare benefits of the project, quantifying both market and non-market social and environmental benefits as fully as possible. As noted, the CBA should not be considered in isolation but rather will support the overall project appraisal process and the broader value-for-money assessment.

There are a wide set of examples of prior cost-benefit analyses for transport projects. Historical cost-benefit analyses have developed an established methodology with a core list of quantified costs and benefits, which can collectively be referred to as the 'core' CBA approach. This approach provides a good basis for determining costs and benefits for most projects.

The Benefit Cost Ratio (BCR) is an economic measure of value for money for public expenditure and is of principal value when Government considers spending scarce funds. Governments also consider public policy outcomes and other benefits when assessing value for money.

Some larger projects, however, are fundamentally different given the broader impacts they have on the economy, land use and communities. These projects may warrant a different and more specialised approach to the quantification of costs and benefits.

Utilising both core and additional benefit frameworks can allow for a fuller picture to be drawn in terms of the impact the LXRP will have, especially due to the unique and complex nature of level crossing removals.

The key differences in benefits are outlined in Table 8-5. Because the additional benefits rely on methodologies and transport models that are not yet commonplace, the core and additional benefits have been presented separately throughout the chapter for purposes of transparency.

Included amongst the additional benefits in Table 8-5 are three that have not been quantified in this iteration of the CBA due to limitations of the analysis, the contingency of benefit realisation on other policy choices, or sufficiently reliable or applicable outputs from mesoscopic or microsimulation transport modelling not being available. In principle, these additional benefits could be added to the quantified benefits to better reflect the impact of the project.

Also shown in Table 8-5 are another group of benefits which, owing to more extensive difficulties in sourcing data or establishing suitable proxies, have not been investigated in detail for quantification. Several of these were noted in Chapter 4. They include travel time savings for pedestrians and cyclists at level crossings (for which data is unavailable), the value of amenity improvements for properties near level crossings, and the benefits of better connecting communities on a local scale wherever rail corridors and level crossings currently form a barrier that impedes local connectivity. That these are not readily quantifiable does not imply they are insignificant in scale (particularly the local amenity impacts).

Table 8-5: Different cost-benefit analysis approaches

Core CBA approach	Additional project benefits
<p><b>Merits and drawbacks:</b></p> <ul style="list-style-type: none"> <li>Enables like for like comparisons with other projects</li> <li>Sets a floor for potential project benefits</li> <li>Suited for initial project cost and benefit assessment process</li> <li>May ignore project specific factors (positive or negative)</li> <li>Less suitable for very large or very complex projects (which might result in step change impacts on other sectors or valuation approaches)</li> </ul>	<p><b>Merits and drawbacks:</b></p> <ul style="list-style-type: none"> <li>Sophisticated whole of project assessment of costs and benefits</li> <li>Requires the application of specialised methodologies for unique project specific factors</li> <li>More applicable for very large or very complex projects – but requires valuing longer dated or harder to predict effects</li> </ul>
<p><b>Core quantifiable benefits:</b></p> <ul style="list-style-type: none"> <li>Travel time savings</li> <li>Vehicle operating costs</li> <li>Road travel reliability benefits (strategic model based)</li> <li>Public transport user benefits</li> <li>Accident costs</li> <li>Resource cost corrections</li> <li>Externalities (pollution)</li> <li>Residual value</li> <li>Construction disruption</li> <li>Wider economic benefits (WEBs)</li> </ul>	<p><b>Additional quantifiable benefits:</b></p> <ul style="list-style-type: none"> <li>Reduced incident disruption benefits</li> <li>Road travel reliability benefits (meso-/micro-simulation based)*</li> <li>Reduced perceived congestion benefits</li> <li>Real option value</li> <li>Additional travel time savings (meso-/micro-simulation based)*</li> <li>Public transport timetabling benefits*</li> <li>Benefits/costs of changes in land use**</li> </ul>
<p><b>Unquantified benefits:</b></p> <ul style="list-style-type: none"> <li>Pedestrian travel time savings</li> <li>Cyclist travel time savings</li> <li>Local amenity improvements</li> <li>Local community connectivity</li> </ul>	

Source: EY

\*Not quantified in the LXRPA CBA

\*\* Quantified as part of the combined CBA for the LXRPA, CPLU and the Metro Tunnel

## 8.4.2 Core CBA

The assessment of the economic merits of the LXRPA using the well-established categories of benefit for transport projects – travel time savings, avoided accidents and so on – has been undertaken in accordance with the relevant guidelines outlined in Section 8.2. These guidelines provide standard parameter values to ensure ready comparisons between projects.

Assessment of wider economic benefits is a relatively new addition to CBA practice. While the conceptual basis for measuring WEBs is generally accepted, methodologies and parameter values are only just becoming standardised in Australia, and issues encountered during the recent development of a possible interim approach for Victoria suggest it may not be available for the project. Appendix H (*redacted*) discusses this topic and the approach to measuring WEBs for the LXRPA appraisal in more detail. In developing estimates of WEBs for the LXRPA, and addressing concerns raised by DEDJTR and other project stakeholders, care has been taken to ensure the level of agglomeration and other benefits are commensurate with the scale and nature of the project. The results below



demonstrate how WEBs have been estimated to represent a relatively minor proportion of the total benefits of the LXR. <sup>77</sup>

CBA results for the core benefits are shown below. Appendix H (*redacted*) discusses the calculation of these benefits in detail.

### **Travel time savings**

The principal transport benefits from the project are changes in the journey times for private, business and freight vehicles across Melbourne's road network.

The strategic modelling provides an estimate of the extent to which the LXR can be expected to alleviate delays and congestion along Melbourne's road network. While it is anticipated that the project will encourage some users to switch mode from public transport to road, the removal of level crossings will create more time-efficient journeys overall, generating valuable additional leisure time or hours worked in productive activity.

These savings are valued at around \$3.5 billion using a discount rate of 4% and around \$1.9 billion using a discount rate of 7%, with the majority accruing to non-business users.

Table 8-6: LXR travel time savings

Travel time savings	\$2016 m, NPV (4% discount rate)	\$2016 m, NPV (7% discount rate)
Non-business vehicle trips	\$2,628	\$1,440
Business vehicle trips	\$571	\$313
Freight vehicle trips	\$256	\$145
<b>Total travel time savings</b>	<b>\$3,455</b>	<b>\$1,898</b>

Source: EY using VITM model outputs

### **Vehicle operating costs**

A reduction in the kilometres travelled on the network will reduce vehicle operating costs (VOCs), which are a function of the length of a journey, traffic volume, vehicle speed and road conditions. Total VOCs include all running costs of the vehicle: depreciation, fuel, repairs and maintenance (but not taxes and duties, which are transfers from a social perspective).

Road users base their travel decisions on perceived costs, which represent only a portion of total costs. The table below shows perceived VOC savings only, with a resource cost correction for the difference between social cost and perceived private cost added as a further benefit below.

Road users are expected to perceive VOC savings of \$636 million using a discount rate of 4% and \$346 million using a discount rate of 7%, over the appraisal period, as a result of shorter overall travel time which helps to reduce fuel consumption and general vehicle wear and tear.

<sup>77</sup> This issue was also recently raised by the Victorian Auditor General in its report on the East West Link (December 2015): <http://www.audit.vic.gov.au/publications/20151209-East-West-Link/20151209-East-West-Link.pdf>

**Table 8-7: LXR vehicle operating cost reductions**

Vehicle operating cost savings	\$2016 m, NPV (4% discount rate)	\$2016 m, NPV (7% discount rate)
Non-business vehicle trips	\$489	\$266
Business vehicle trips	\$50	\$27
Freight vehicle trips	\$97	\$53
<b>Total VOC reductions</b>	<b>\$636</b>	<b>\$346</b>
Toll savings – all users*	\$37	\$16
<b>Total VOC and toll reduction</b>	<b>\$673</b>	<b>\$362</b>

Source: EY using VITM model outputs.

\*Note higher toll expenditure is a cost from the users' perspective but a transfer from a social perspective and hence is offset in the resource cost corrections benefit line.

### Road travel reliability benefits (strategic model-based)

A typical analysis of road user journey time savings focuses primarily on valuing predicted changes in average journey times, which are typically modelled using strategic or other simulation models. However, in reality, road users face a distribution of journey times around the average, related to day-to-day variability and other non-recurrent incidents such as accidents that disrupt traffic flows or bad weather). These variations from the average can form a significant proportion of journeys undertaken by road users, imposing additional travel costs in the form of delays and higher vehicle operating costs.

The presence of level crossings adds an additional signalised constraint to an often already complex and congested road network. The unpredictable nature of boom gate closures at level crossings means that in planning their trips, road users must account for this unpredictability if they are to reach their destinations at their desired time. Unpredictable trip durations cause frustration and inconvenience for drivers experiencing unexpected delays, as well as creating additional personal and business costs as road users build in precautionary time to their journeys. While some degree of unpredictability is inherent in every journey, the removal of level crossings helps to eliminate a significant source for those who travel along these particular roads.

The LXR is expected to have a significant impact on travel time reliability for road users. Based on the strategic transport model, using methodologies from the UK and New Zealand, the reduced variability in travel times is expected to deliver an economic benefit of over \$950 million using a discount rate of 4% and \$540 million using a discount rate of 7% for road users over the appraisal period.

**Table 8-8: LXR reliability benefits – strategic model-based**

Reliability benefits	\$2016 m, NPV (4% discount rate)	\$2016 m, NPV (7% discount rate)
Travel time reliability savings	\$956	\$546

Source: EY using VITM model outputs

### Public transport user benefits

An improved road network and associated reductions in congestion will improve travel times and reliability for bus passengers, as well as causing some potential rail users to drive instead and thus alleviate crowding on train services. A number of new train stations will be built, or existing ones upgraded, as part of the LXR. This is expected to deliver a significant amenity benefit for all passengers and in particular interchange passengers at some of these stations depending on the nature of the interchange improvement.

The LXR is expected to generate \$1.5 billion using a discount rate of 4% and \$899 million using a discount rate of 7% in PT user benefits over the appraisal through these travel time savings, reduced crowding and improved station amenity.

Table 8-9: LXR public transport user benefits

Public transport user benefits	\$2016 m, NPV (4% discount rate)	\$2016 m, NPV (7% discount rate)
PT network benefits (time savings and reduced crowding)	\$245	\$141
Station improvement benefits	\$786	\$466
Interchange improvement benefits	\$494	\$292
<b>Total PT user benefits</b>	<b>\$1,525</b>	<b>\$899</b>

Source: EY using VITM model outputs

### Collision costs

In addition to their personal and family impacts through injury or loss of life, collisions between trains, road-based vehicles and pedestrians create substantial physical and service costs (e.g. destruction of property and ongoing health service delivery) in addition to their human impacts through injury or loss of life. To fairly account for these costs in the project appraisal, their impacts must be valued in dollar terms.

The removal of level crossings will eliminate a number of dangerous locations from Melbourne’s road network and reduce the likelihood of risk-taking behaviour along these roads. The LXR is expected to deliver an economic benefit of \$266 million using a discount rate of 4% and \$145 million using a discount rate of 7% over the appraisal period in avoided incidents across the 50 level crossing sites. This benefit is partially offset by an estimated increase in other road-related incidents due to higher numbers of road users and vehicle kilometres travelled over the appraisal period.

Table 8-10: LXR collision reduction benefits

Accident reduction benefits	\$2016 m, NPV (4% discount rate)	\$2016 m, NPV (7% discount rate)
Direct LX-related collision reduction	\$266	\$145
VKT related collisions	-\$21	-\$11
<b>Total accident reduction benefits</b>	<b>\$245</b>	<b>\$134</b>

Source: EY using VITM model outputs

### Resource cost corrections

Resource cost corrections (RCCs) represent the difference between the overall social and user-perceived costs of travel. Travel decisions are made on the basis of a perceived (generalised) cost of travel options, but this is generally less than the full social resource cost. For example, motorists perceive some of the costs of operating a vehicle, such as fuel, but do not necessarily perceive other expenses like depreciation.

The LXR is expected to generate an additional benefit of \$1.4 billion using a discount rate of 4% and \$797 million using a discount rate of 7% in avoided resource costs that are not perceived by users and hence not valued in the core VOCs. The majority of these resource corrections are from vehicle operating costs, which is expected due to road users’ tendency to underestimate their cost of travel associated with fuel consumption and general vehicle wear and tear.

**Table 8-11: LXR resource cost corrections**

Resource cost corrections	\$2016 m, NPV (4% discount rate)	\$2016 m, NPV (7% discount rate)
VOC resource correction	\$1,464	\$797
Tolls resource correction	-\$17	-\$8
PT fares resource correction	-\$75	-\$38
<b>Total resource correction</b>	<b>\$1,373</b>	<b>\$751</b>

Source: EY using VITM model outputs

### Externalities (pollution)

All transport modes cause environmental externalities, which should be accounted for in a social CBA. As different transport modes result in different production of environmental emissions, such as air pollution and greenhouse gas emissions, changes in travel patterns will cause changes in network-wide emissions.

The LXR is expected to make the road network more attractive to users and, as a result, there will be more vehicles on the road, increasing the cost of emissions by \$0.05 million using a discount rate of 4% and \$0.03 million using a discount rate of 7% over the appraisal period.

**Table 8-12: LXR externalities (pollution)**

Externalities (pollution)	\$2016 m, NPV (4% discount rate)	\$2016 m, NPV (7% discount rate)
Air pollution	\$0.06	\$0.03
Greenhouse gas emissions	-\$0.00	-\$0.00
<b>Total externalities</b>	<b>\$0.05</b>	<b>\$0.03</b>

Source: EY using VITM model outputs

### Residual value

A 50-year evaluation period has been used to calculate benefits derived from transport model predictions of road and public transport use and travel patterns across the city. Beyond this period, however, the LXR assets will continue providing services to transport users – just as 19<sup>th</sup> century infrastructure is used in the present-day transport system.

The residual value of the benefits to be derived from level crossing removals at the end of the 50-year evaluation period has been estimated as the discounted value of the assets at the end of the period. Based upon assumptions made in terms of breakdown of material used in the construction of the project, it is estimated that the life of the asset is 106.5 years.

The present value of the future stream of net benefits at the end of the evaluation period is \$531 million using a discount rate of 4% and \$128 million using a discount rate of 7%.

**Table 8-13: LXR residual value**

Residual asset value	\$2016 m, NPV (4% discount rate)	\$2016 m, NPV (7% discount rate)
Residual value – replacement cost	\$531	\$128

Source: EY using LXRA cost figures

## Construction disruption

Construction of transport infrastructure is often disruptive to users of the transport system, particularly in brownfield construction environments, which is the case for many of the level crossings in the LXR. During construction of the LXR, there will be occasions when some roads and rail lines are required to be closed. Road diversions and/or replacement bus services will be provided during these times and this may mean that journey times are longer for affected road and rail users. At other times, roads or rail lines may operate with reduced levels of service.

These interruptions generate some disbenefit as replacement bus services are often slower, less convenient, and not as frequent as normal rail services. In addition, the road network will require local route diversions during any road link closures. Roads may be busier than normal during construction due to some public transport users choosing to drive and the addition of rail replacement buses.

Analysis of proposed construction packages and available road and rail patronage data shows that the construction impacts of the LXR could result in a disbenefit for rail users of around \$42 million using a discount rate of 4% and \$39 million using a discount rate of 7% over the construction period, while the cost to road users is estimated to be around \$19 million using a discount rate of 4% and \$18 million using a discount rate of 7% during the construction period, in net present value terms. This equates to a total estimated disruption cost of \$61 million using a discount rate of 4% and \$57 million using a discount rate of 7%.

Table 8-14: Construction disruption

Construction disruption	\$2016 m, NPV (4% discount rate)	\$2016 m, NPV (7% discount rate)
Disruption to rail passengers	-\$42	-\$39
Disruption to road users	-\$19	-\$18
<b>Total construction disruption</b>	<b>-\$61</b>	<b>-\$57</b>

Source: EY analysis using PTV rail patronage information and VicRoads traffic counts

## Wider economic benefits

Wider economic benefits (WEBs) are productivity impacts from a project that are not adequately covered by a standard CBA calculation. The analysis of wider economic impacts attempts to capture the broader impacts of a project including the effects of connectivity, land development and business logistics improvement on productivity and output. These impacts are categorised in the LXR appraisal under agglomeration benefits, imperfect competition and additional tax revenue from increased labour supply.

The LXR is expected to generate WEBs worth \$983 million using a discount rate of 4% and \$554 million using a discount rate of 7% in net present value terms over the appraisal period.

Table 8-15: LXR Wider economic benefits (WEBs)

Wider economic benefits	\$2016 m, NPV (4% discount rate)	\$2016 m, NPV (7% discount rate)
Agglomeration benefits	\$737	\$420
Increased labour supply	\$151	\$82
Imperfectly competitive markets	\$95	\$52
<b>Total wider economic benefits</b>	<b>\$983</b>	<b>\$554</b>

Source: EY using VITM model outputs

### 8.4.3 Additional costs and benefits

As the LXR is a unique project, the core CBA may overlook some of the important benefits provided by the project. A more comprehensive approach may be required to provide a fair and thorough assessment of the LXR, including giving consideration to:

- Network resilience gains (risk events)
- Road travel reliability impacts (meso-micro-simulation based)
- Disutility of congested travel
- Perceived frustration at level crossings
- Real option value.

#### **Reduced incident disruption benefits**

Level crossings have the potential to shut down road and rail networks for extended periods of time either due to incidents (collisions and near-misses) at level crossing sites or through signal faults that trigger extended boom gate closures as well as precautionary action by train drivers (slower speeds through crossings). These incidents delay rail passengers and road users alike.

Removing level crossings from a rail corridor reduces the risk of incidents (accidents or signal faults) and the consequent delays to rail and road passengers. The benefit in avoided rail passenger delays amounts to around \$6 million using a discount rate of 4%, and \$4 million using a discount rate of 7%, in present value terms.

Table 8-16 LXR network resilience impacts (risk events)

Reduced incident disruption benefits	\$2016 m, NPV (4% discount rate)	\$2016 m, NPV (7% discount rate)
Reduced incident disruption – rail passengers	\$6	\$4
Reduced incident disruption – road users	Unable to quantify	

Source: EY using VITM model outputs

#### **Road travel reliability benefits (meso-/micro-simulation based)**

As discussed in Section 8.3, VITM forecasts average traffic flows over the peak and interpeak time periods. Boom gate closures are represented as a percentage average closure rate – such as 56 per cent of the 2-hour AM peak on the Caulfield-Dandenong corridor.

This level of aggregation makes it impossible to observe the potentially significant variation in travel times for trips within these broad time intervals, and the reliability benefit calculated above therefore relies on a simple ratio-based approach.

Because boom gate closures often impose sporadic interruptions on the road network, not predictable or regular interruptions, there is reason to expect travel times to be more variable (a higher standard deviation) through and near level crossings than on other sections of the road network. The method of applying an average boom gate closure percentage to the peak period in VITM may be under-estimating the costs of unpredictability in travel times on the current road network, and the benefits associated with improving reliability.

There is potential to undertake microsimulation modelling or to collect data, such as Bluetooth data, that shows travel times in 15-minute intervals or less to more accurately forecast variability and reliability benefits of the LXR. This may be explored in future iterations of the CBA.

### Reduced perceived congestion benefits

There is evidence that road users' value relief from congested traffic conditions over and above their value of travel. Road users' higher willingness to pay to avoid an hour of travel time on congested roads reflects the additional frustration, difficulty and stress associated with driving in stop-start traffic.

In principle, as the social value of time saved is higher, the valuation of travel time savings in CBA should be sensitive to the disutility of time spent in congested traffic and should apply higher values to time saved on heavily congested roads.

While not traditionally used in transport appraisals in Australia, the practice of applying 'congestion multipliers' to reflect more difficult driving conditions is followed in other jurisdictions and has been gaining support in the appraisal of recent projects in Australia.

The additional value of travel time savings calculated using a 'congested value of time' approach is \$274 million using a discount rate of 4% and \$171 million using a discount rate of 7%. That this additional benefit is relatively minor is perhaps not unexpected for level crossing removals. The level crossings that are part of the LXR are in urban areas, in complex road network environments and many have nearby signalised intersections. Congested values of time benefits would generally be higher for projects involving freeway or major arterial upgrades, where the uninterrupted flow of traffic conditions created by the project are compared to conditions on alternative routes with higher levels of congestion.

Table 8-17: LXR reduction in disutility of congested travel (value of congested time approach)

Reduction in perceived congestion benefits	\$2016 m, NPV (4% discount rate)	\$2016 m, NPV (7% discount rate)
Travel time savings – value of congested time approach standard approach	\$3,730	\$2,069
Travel time savings – standard approach	\$3,455	\$1,898
Additional benefit from recognising value of congested time	\$274	\$171

Source: EY using VITM model outputs

### Real option value

Real options analysis involves placing an option premium on the flexibility to respond to uncertainty, so that the value of retained flexibility is accounted for in assessing and selecting options.

Real options have been examined in relation to the LXR primarily in the context of procurement approaches and futureproofing the transport network given the potential for near term network upgrades, including road or rail corridor widening, lengthening of trains on certain corridors, and upgrading stations.

The approach taken to the development of real options in consultation with project stakeholders is detailed in Section 7.4; the real options that are embedded in the reference program options are provided in Chapter 6; and the estimated costs of those options are set out in Chapter 7.

A typical real options analysis would include an assessment of the feasibility of future project upgrades or expansions. For example, for different infrastructure projects, common real options relate to the ability to scale the project to meet future demand requirements that were sufficiently uncertain at the time of construction that the required functionality was not included in the year 1 design. In this context, the real options analysis would consider the probability that these future expansions are required and the feasibility of the project given the net benefit streams attributable to the real options, taking into account the probability of different uncertain events taking place.

In the case of the LXR, the considerations are more related to the possible need for broad network upgrades and how the level crossing removals should be designed and constructed to accommodate those future investments.

Given the limited information available to LXP on the needs, costs and benefits of those upgrades, the CBA has focused on the treatment of the additional costs they are creating for the LXP, which is estimated to be equivalent to approximately \$148 million excluding risk and escalation.

The approach adopted in this CBA is to subtract those costs from the total program capital costs in calculating NPVs and BCRs. An alternative approach would be to estimate a net benefit for those other projects made possible by the investments in flexibility built in to the level crossing removal infrastructure, and add that to the benefit side of the CBA. For example, at a minimum, the projects could be assumed to deliver a marginal net benefit which cancels out the additional costs.

### ***Additional travel time savings (meso-/micro-simulation based)***

As outlined in Section 8.3.3, the mesoscopic transport model forecasts a sharper decline in road network performance between 2015 and 2031, and therefore a more significant improvement as a result of the project.

The mesoscopic transport model is still being developed and the outputs used in comparison to VITM outputs are preliminary. There may be scope in future to refine the CBA using outputs from the mesoscopic model once this model has been developed, reviewed and accepted.

### ***Public transport timetabling benefits***

Travel time savings for bus passengers, who benefit from faster average speeds, are already reflected in the public transport user benefits in the core CBA. Easier interchange between buses and trains resulting from better designed stations may improve the time taken and ease of bus/rail interchanges. The value of this benefit for existing passengers is also included in the public transport user benefits.

A further potential benefit arising from the program stems from the fact that faster and more reliable bus journey times create opportunities to either redesign bus routes or optimise timetables by running additional services or improving bus/train co-ordination. In certain locations where, at present, punctuality and patronage are negatively impacted by the rail corridor or by local road and station precinct layouts that do not support efficient mode interchange, more consistent journey times may permit routes to be redesigned. For example, this could mean that routes presently terminating at stations because of the unreliability of level crossing travel times are run as through-routes, avoiding the need for passengers to disembark and cross the tracks, making more single-leg bus journeys possible and making certain trips more attractive by bus.

While this is a distinct benefit that ought in principle to be included in the CBA, insufficient data is available to support a reliable calculation for the present iteration.

### ***Land use changes and related benefits and costs***

Traditionally, cost-benefit analyses have not considered how land use changes as a result of infrastructure projects. Costs and benefits are typically evaluated assuming land use remains constant, which is an inaccurate representation of the different future conditions with and without the infrastructure and, in many instances, assumes away some of the intended outcomes of the project. For example, many public transport projects incorporate transit-oriented development activities, but the uplift in land values and other changes generated by these activities are not reflected in traditional CBA.

This can bias CBA results in several ways. First, it means CBA ignores how land use spurred by transport improvements can induce additional demand that can re-crowd transport networks and obviate some de-congestion/de-crowding benefits. Secondly, it means the CBA ignores a raft of potentially-significant social costs and benefits that materialise not from the transport improvements per se, but from the land use changes that it generates.

Such impacts include wider economic benefits – agglomeration gains leading to productivity improvements – driven by increasing population/business density, as opposed to the increase in *effective* density that the transport improvement generates. They can also include changes in the cost of providing public infrastructure and services



to dwellings: for instance, it is typically cheaper for governments to supply necessary infrastructure to facilitate development activity and accommodate residents or businesses within established areas than on the urban fringe.

Both of these effects tend to favour – that is, increase the BCR of – projects that increase the attractiveness of dense urban areas: the former by counting productivity gains from agglomeration and the latter by counting the lower cost of infrastructure and services per dwelling in built up areas.

As the spatial analysis in Section 8.5.2 further explains, the LXP itself is not expected to have substantial impacts on geographic patterns of urban development and industry. Although the infrastructure works are associated with rail corridors, travel time improvements do not primarily accrue to public transport users but rather to road users spread over a large area. No distinct bias towards inner urban or urban fringe development is to be expected from this project.

However the LXP ‘unlocks’ several key rail projects: on the Caulfield-Dandenong corridor it permits the higher service frequencies resulting from the CPLU rail procurement to be realised without crippling the already-strained level crossing links on this corridor, and in the longer-term it will allow further frequency increases following delivery of the Metro Tunnel to be accommodated. These rail projects, alongside supportive urban planning policies to encourage denser land-use around stations, can be expected to stimulate economically significant land-use changes and the land-use-change benefits described above.

As these benefits arise from a number of contingent policies and projects, not directly from the LXP itself, the present iteration of the LXP CBA does not quantify land use benefits. There are strong grounds, however, for conducting a fuller investigation into how land use patterns are likely to evolve in response to the suite of rail projects and to understand the policy contingencies (such as required planning changes) and magnitude of social benefits achievable from the portfolio of transport projects as whole.

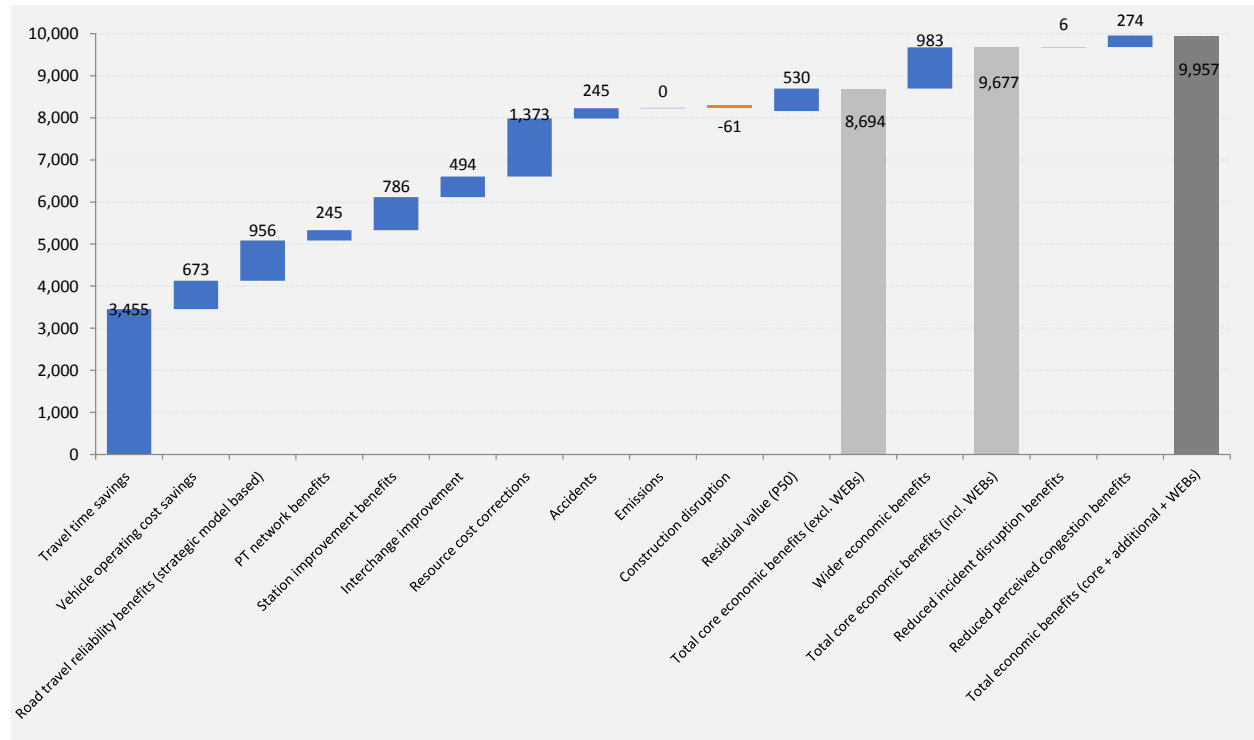
### ***Benefits summary***

Figure 8-5 provides a build-up of core benefits, wider economic benefits and additional benefits that have been quantified for the LXP using a real discount rate of 4%. The build-up using a discount rate of 7% is shown in Figure 8-6.

The forecast travel time savings make the most significant contribution to overall project benefits. Improved road travel reliability, rail station and interchange improvements and the unused or ‘residual’ value of the assets at the end of the appraisal period will also provide significant benefits.

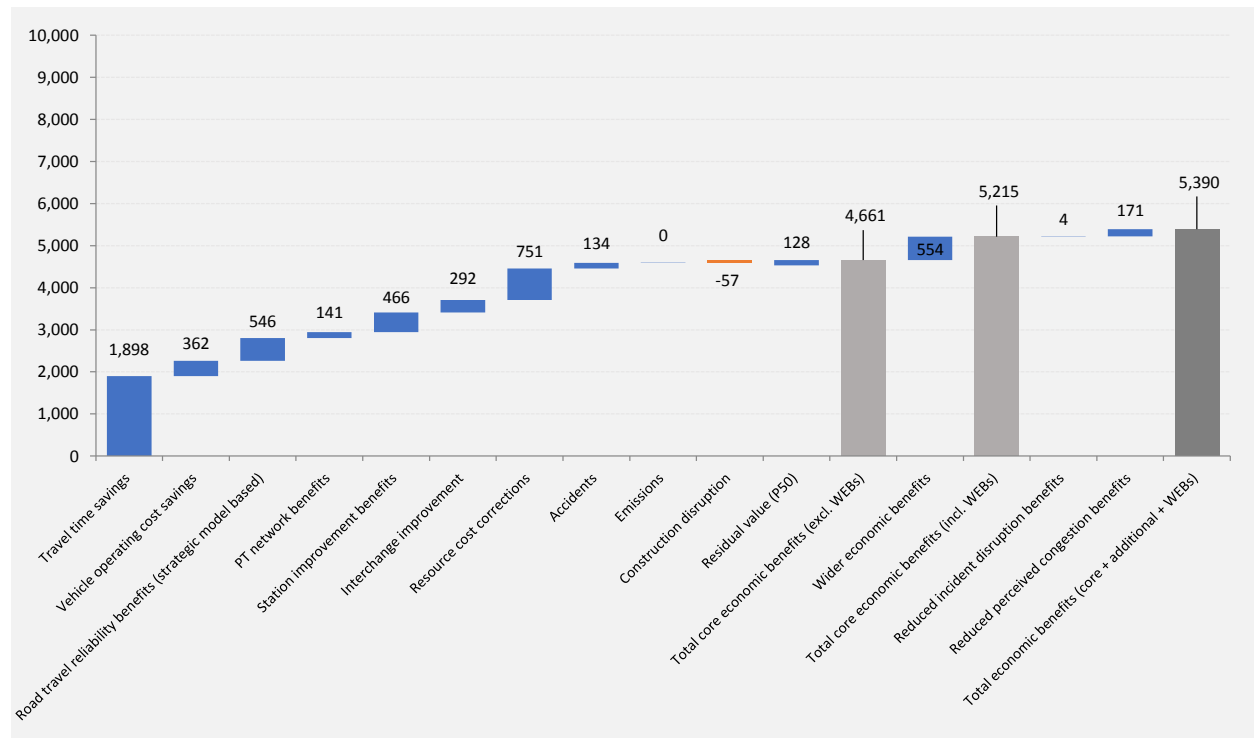
Wider economic benefits provide a modest increase in benefits, and additional benefits including reduced perceived congestion are minor. Overall, the core benefits provide almost 90% of total benefits, which is expected for a project such as the LXP given the way it differs from other major road and rail network projects.

Figure 8-5: Benefit summary bridge (\$ million, NPV, 4% discount rate)



Source: EY CBA

Figure 8-6: Benefit summary bridge (\$ million, NPV, 7% discount rate)



Source: EY CBA

## 8.4.4 Project costs

The projects costs described within the economic appraisal refer to the packaged costs developed by LXRA's Technical Advisor and Independent Estimator, which include savings generated through bundling of projects to take advantage of project synergies, plus the detailed cost estimates developed for the first 20 level crossing removal sites (outlined in their respective full business cases and project proposals).

As noted in Chapter 7, cost projections were provided in nominal terms, with these figures then being adjusted to account for inflation (assumed to be 2.5 per cent) to provide real P50 and P90 cost profiles.

The Table below summarises the LXR project costs with nominal costs split by cost type, as well as showing the real (inflation-adjusted) total cost and the present-value total costs used for the CBA.

Table 8-18: LXR project costs

Cost Type	P50 (\$m)	P90 (\$m)
Level crossing removals	\$6,588	n/a
Metropolitan Network Modernisation Program	\$1,020	n/a
<b>Nominal project capital costs</b>	<b>\$7,608*</b>	<b>\$7,674</b>
	* incl. Level Crossings \$6,588m and Metropolitan Network Modernisation Program \$1,020m	
<i>Less inflation</i>	<i>\$498</i>	<i>\$515</i>
Real project capital costs	\$7,110	\$7,159
<b>PV (4%)</b>	<b>\$6,396</b>	<b>\$6,435</b>
<b>PV (7%)</b>	<b>\$5,940</b>	<b>\$5,972</b>

Source: LXRA with the support of technical advisors.

## 8.4.5 Reference Case CBA results

The summary CBA results presented below show that the LXR is expected to deliver significant transport system, wider economic and additional benefits for the community.

At a 7 per cent discount rate the present value of the core transport system benefits is equivalent to \$4.7 billion in today's dollars. Wider economic benefits including agglomeration benefits are expected to contribute around \$0.6 billion and additional transport system benefits a further \$0.2 billion.

Once the real cost of the LXR is taken into account, the net present value (NPV) of the project, excluding WEBS and additional benefits, is estimated to be -\$1.3 billion with a benefit-cost ratio (BCR) of 0.78.

At a 4 per cent discount rate the present value of the core transport system benefits is \$8.7 billion in today's dollars. Wider economic benefits contribute around \$1.0 billion and additional transport system benefits a further \$0.3 billion. Using this discount rate and after accounting for the real cost of the LXR, the NVP of the project, excluding WEBS and additional benefits, is estimated to be \$2.2 billion with a BCR of 1.34.

Table 8-19: Summary results – cost-benefit analysis

Reference Case analysis	\$2016 millions, PV (4% discount rate)	\$2016 millions, PV (7% discount rate)
<b>Project costs (P50)</b>		
CapEx	\$6,396	\$5,940
OpEx	\$229	\$153
Real options (savings)	-\$139	-\$129
<b>Total Project Costs</b>	<b>\$6,487</b>	<b>\$5,964</b>
<b>Core Benefits</b>		
Road user benefits	\$5,083	\$2,806
PT user benefits	\$1,525	\$899
Resource cost corrections	\$1,373	\$751
Externalities	\$245	\$134
Construction disruption	-\$61	-\$57
Residual value	\$531	\$128
<b>Total core benefits</b>	<b>\$8,695</b>	<b>\$4,661</b>
Wider economic benefits	\$983	\$554
<b>Total core benefits + WEBs</b>	<b>\$9,678</b>	<b>\$5,216</b>
Additional benefits	\$280	\$175
<b>Total economic benefits (core + WEBs + additional)</b>	<b>\$9,958</b>	<b>\$5,391</b>
<b>Economic indicators</b>		
Net present value (core benefits)	\$2,208	-\$1,303
<b>BCR (core benefits)<sup>78</sup></b>	<b>1.34</b>	<b>0.78</b>
Net present value (core + WEBs)	\$3,191	-\$749
<b>BCR (core + WEBs)</b>	<b>1.49</b>	<b>0.87</b>
Net present value (core + WEBs + additional)	\$3,471	-\$574
<b>BCR (core + WEBs + additional)</b>	<b>1.54</b>	<b>0.90</b>

Source: EY using VITM model outputs and LXRA costs.

<sup>78</sup> The BCR is calculated by dividing the present value of monetised benefits by the present value of costs. BCRs greater than 1.0 indicate that an investment is economically efficient and represents value for money. However, there may also be cases where investments are value for money but have BCRs less than 1.0. For example, for some projects it may not be possible to monetise all significant benefits and costs.

## 8.4.6 Combined economic appraisal of the LXR, CPLU and Metro Tunnel

This section presents the results of a combined economic appraisal for the three major and critically interdependent transport projects currently being planned and delivered by the Victorian Government, including the LXR, CPLU and the Metro Tunnel

Together, these projects can be expected to have a significant impact on Melbourne's city structure by encouraging households and businesses to locate in areas that will benefit from the significant accessibility improvements that these projects will provide. These induced land use changes can create benefits and costs in addition to traditional transport user and non-user benefits (including wider economic benefits or WEBs) that are usually included in transport cost-benefit analysis (CBA). Depending on the patterns of accessibility and induced land use changes, there could be additional benefits associated with urban consolidation, particularly in relation to changing employment location and industry mix, and the efficiency of urban development and the provision of infrastructure and services.

The combined economic appraisal has therefore been completed in the form of a cost-benefit analysis or CBA, including an assessment of city-shaping benefits linked to potential land use changes induced by these investments. In doing, this study is an application of a detailed land use and transport interaction (LUTI) analysis for Melbourne, and shows the significant impact that such a major metro style infrastructure program will have on where people chose to live and businesses chose to locate.

### ***Rationale for a combined appraisal and assessment of city-shaping benefits***

The removal of nine level crossings on the Caulfield-Dandenong corridor and three level crossings on the Sunbury corridor provides the full separation of road and rail networks required to allow the service increases planned under both the CPLU and Metro Tunnel.

The CPLU will increase services from 16 to 19 per hour in the AM peak on the Caulfield-Dandenong corridor, and the Metro Tunnel will increase frequencies further to 24 per hour. However, the nature of rail operations and level crossings is such that, when service frequencies are already at high levels like those currently experienced on the Cranbourne-Pakenham Line, even a small increase in the number of hourly services will have a relatively large impact on the extent of boom gate closures.

Available traffic data shows that level crossings on the Caulfield to Dandenong section of the Cranbourne-Pakenham Line are currently experiencing closure rates of between 40-70%, with a median closure rate of just over 50%.

Analysis of the relationship between service frequencies and boom gate closures suggests that the provision of CPLU could increase median boom gate closures to around 60-95% of the AM peak, with maximum rates higher again at levels that would mean that these roads would become closed to commuters for a number of hours in the day.

This problem would only be compounded with the delivery of the Metro Tunnel, and the move to 'turn-up-and-go' style services under PTV's future rail operating plan that will see these issues spill into other times of the day. Current expectations are that implementation of the full Metro Tunnel program, under PTV's Network Development Plan aim of a 130 per cent capacity increase in 20 years, will see the extent of AM peak boom gate closures for a number of level crossings on the Caulfield-Dandenong corridor increase to around 95%.

This analysis suggests that it would not be feasible to progress with the CPLU and Metro Tunnel without having first completed all nine level crossing removals between Caulfield and Dandenong (and the three level crossings on the Sunbury corridor that would also be affected by Metro Tunnel). In this regard, both projects critically depend on the delivery of the LXR. In the Metro Tunnel business case, the LXR has been identified as 'major precursor' for the project (along with the other elements of the CPLU).

Because of these critical interdependencies, a meaningful and comprehensive picture of the LXP, CPLU and Metro Tunnel can only be ascertained by considering them as one large investment program rather than through their standalone project assessments. If the LXP is a key precursor project to both the CPLU and Metro Tunnel, such that the benefits of each relies on the successful delivery of the program, then it is important to investigate and account for the interdependent impacts between these investments, and the important contribution that precursor projects like the LXP are making to the Government's long term transport vision.

Given the scale of the projects and the increased capacity they will provide along critical rail corridors, the combined program can be expected to significantly influence where people choose to live and where businesses locate. This suggests that there is also a strong case for estimating the city-shaping potential of the combined program, where there could be additional benefits from urban consolidation and greater employment in major employment centres served by the projects, including the CBD and other parts of central Melbourne.

Guidance material recently published by Infrastructure Australia provides the most relevant reference for the inclusion of city-shaping benefits in a transport CBA. IA states that depending on the merits of a project in being able to drive material land use changes, the separate consideration of urban consolidation benefits is justified. This effectively recognises that excluding these benefits when the impacts could be large, risks creating an incomplete or distorted view of major transport investments.

So far each of the projects has considered user and non-user benefits and costs typically considered in transport CBA, such as the potential for travel time savings and reliability improvements, vehicle operating and other travel cost savings, changes in environmental and social externalities, and WEBS. For the Metro Tunnel, this has also included an assessment of benefits related to the potential for the project to support additional employment in central Melbourne, which is a key element of an overall city-shaping benefits framework.

A comprehensive city-shaping benefits framework also recognises that more efficient city structures may also reduce the costs for government in providing infrastructure and services, and increase the potential for people to take advantage of walking and cycling to improve physical and mental health. It should also recognise that changing patterns of population and employment will change the use of the transport system, which can enhance or erode the transport benefits of a project by changing levels of congestion and crowding across the network. This must be taken into account in a CBA that includes city-shaping benefits.

To support infrastructure decision-making, spatial change models and benefits frameworks have been developed that enable this type of analysis in Australia. These models have supported explicit measurement of city-shaping benefits in economic appraisals. More recently and in line with the IA guidelines, UrbanGrowth NSW has developed a 'Benefits Catalogue', which enables the quantification of such 'urban consolidation benefits'. Based on this work, the NSW government has recently adopted a set of new Treasury guidelines on how to quantify the benefits of urban renewal.

Over the last three years, land use transport interaction (LUTI) modelling and benefits frameworks have been used to measure 'city shaping' effects of infrastructure and urban renewal projects in New South Wales and the ACT. This includes modelling the potential for transport investments to influence the location of future industries and jobs, and changes in population density for whole cities linked to the accessibility changes estimated by strategic transport models.

These tools provide the basis for expanding the analysis of potential city-shaping impacts of the integrated program as part of estimating its overall value for the community, enabling the development of an overarching narrative of the program and how it will benefit and shape Melbourne.

### ***Employment location impacts analysis***

This section presents the analysis of expected changes in business and employment location of the combined LXP, CPLU and Metro Tunnel scenario.

The land use modelling completed for this study highlights the potential for the combined program of LXP, CPLU and the Metro Tunnel to drive significant employment growth along rail corridors in the south-east, north and

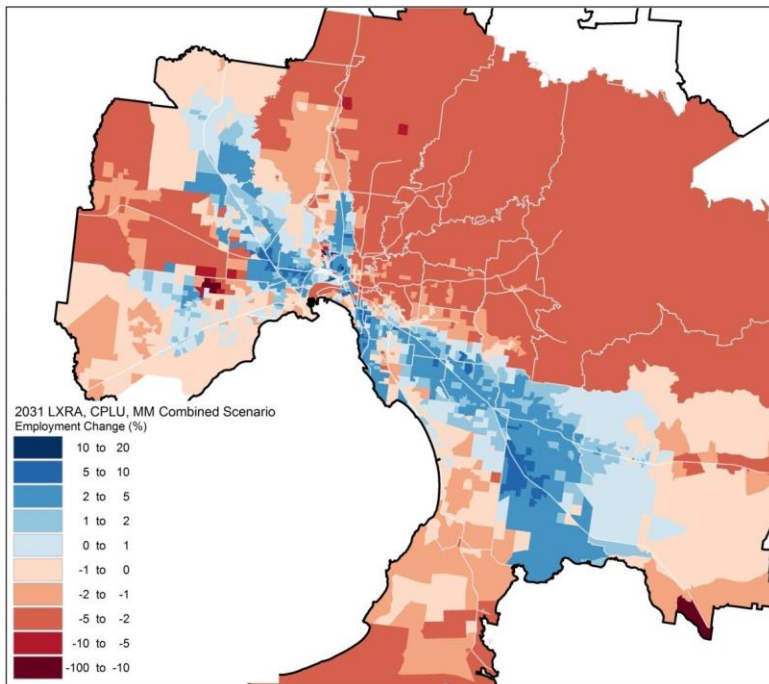
west, particularly along the Caulfield corridor and Cranbourne-Pakenham Line and the Sunbury corridor, but also along other corridors that will see large rail service increases.

Analysis of incremental project scenarios showed that the combined projects would also be expected to underpin positive uplift in employment and business, most notably in and around the Dandenong Central Activity District (CAD) and Melbourne CBD. The analysis shows that consolidation around these centres and along the rail corridors is facilitated by the reduction in employment borne by the wider Melbourne region.

Together these projects support the creation of a strong 'economic spine' that links three National Employment Clusters (NECs), including Dandenong in the south-east and Sunshine in the north-west, with the central Melbourne NEC at its heart.

Figure 8-7 illustrates the range of employment changes that could be expected under the combined scenario. Employment increases range up to 10-20% in some locations along the affected corridors as the projects reinforce the concentration of labour in Melbourne's most productive economic regions. This can be expected to drive significant urban densification benefits as greater agglomeration provides the potential for productivity gains and encourages workers to join our more productive industries that prefer to locate in those areas.

Figure 8-7: Impact of the combined scenario on employment location (2031)



Source: EY

### **Household location impacts analysis**

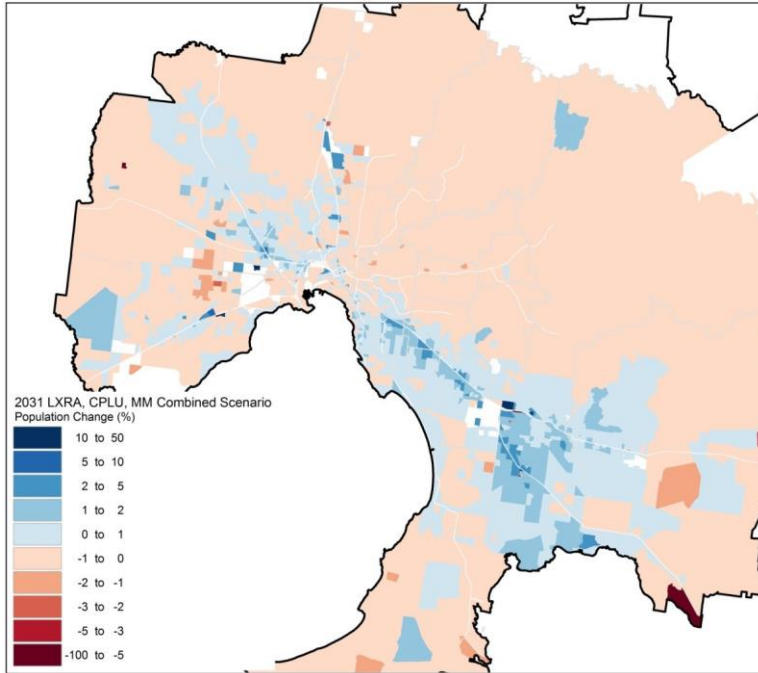
The land use modelling highlights the extent to which the projects could underpin population growth along the same corridors, as household location moves hand-in-hand with accessibility improvements and proximity to employment opportunities. However, the magnitude of the changes is generally smaller than the expected employment redistribution.

The population modelling predicts the projects could be expected to drive gains in inner, middle and outer areas along the affected corridors. In effect there is both urban consolidation in some inner/middle areas, and dispersal of households to some outer suburban areas that become more attractive given the way the projects enhance access to the CBD and other employment centres for some of Melbourne's important growth areas. This would be

expected to create both positive and negative city-shaping benefits in relation to infrastructure efficiencies and sustainability benefits.

Figure 8-8 illustrates the changes in population location that have been modelled for the combined scenario. While the changes are relatively small compared to the employment changes, they support the consolidation of land use along the same economic spine and will support growth in employment in the NECs, catered by additional residents in relatively close proximity to those centres.

Figure 8-8: Impact of the combined scenario on household location (2031)



Source: EY

### Combined Cost-Benefit Analysis Results

The combined appraisal of the LXR, CPLU and Metro Tunnel was completed using a cost-benefit analysis that includes the analysis of the combined transport benefits of the program, and the analysis of wider city-shaping and productivity benefits associated with employment and household consolidation along the corridors most affected by the program.

The analysis concluded that the overall combined program is expected to deliver significant transport benefits of around \$13.8 billion in today's values when using a discount rate of 7%. However, this represents only the 'first round' impacts of these major projects that are expected to drive significant land use changes.

The inclusion of city-shaping benefits adds around \$2.6 billion in economic value, suggesting that the BCR for the combined program is around 1.1 (7% discount rate). This suggests the program will deliver a net present value to the community of \$1.3 billion, highlighting the importance of undertaking these major investments in the state's economic infrastructure.

When also taking into account the wider productivity benefits of the program, the net present value increases to \$5.1 billion, with a BCR of 1.2 when using a discount rate of 7%.

When using a discount rate of 4%, the net benefits to the community of the Victorian Government's integrated program are very large. The present value of total transport, city-shaping and productivity benefits, is estimated to be in the order of \$39 billion, which is around \$22 billion higher than the present value of costs, and yields a benefit-cost ratio of 2.2.



Table 8-20: Combined CBA of the LXR, CPLU and Metro Tunnel

Reference Case analysis	\$2016 millions, PV (4% discount rate)	\$2016 millions, PV (7% discount rate)
<b>Costs (P50)</b>		
CapEx	\$15,659	\$14,027
OpEx	\$2,163	\$1,116
<b>Total Costs</b>	<b>\$17,821</b>	<b>\$15,142</b>
<b>Benefits</b>		
Transport benefits	\$30,780	\$13,805
City-shaping benefits	\$4,876	\$2,604
Productivity benefits	\$3,791	\$3,846
<b>Total economic benefits</b>	<b>\$39,448</b>	<b>\$20,255</b>
<b>Economic indicators</b>		
BCR (transport benefits)	1.7	0.9
BCR (transport and city-shaping benefits)	2.0	1.1
Net Present Value (total economic benefits)	<b>\$21,627</b>	<b>\$5,113</b>
BCR (total economic benefits)	<b>2.2</b>	<b>1.2</b>

Source: EY using VITM model outputs

## 8.4.7 Reference Case sensitivity testing

A series of sensitivity assessments were undertaken in the Reference Case CBA model to give greater confidence around some of the key areas of risk and uncertainty to the benefits and costs. This is consistent with the approach recommended in the Austroads Guide to Project Evaluation, as well as by Infrastructure Australia.

### Cost estimation

The results of the economic appraisal assume P50 costs, under which the program BCR is 0.78 (7% discount rate) or 1.34 (4% discount rate). Using P90 cost estimates, the program BCR is 0.74 or 1.32.

The economic appraisal also currently includes capital cost estimates at the concept and detailed stages of development and therefore actual costs are likely to differ from those currently provided. In order to test the impact of cost savings or overruns on the robustness of the program, sensitivity tests were undertaken assuming over/under estimation of costs by 20%. Within these intervals the BCR ranges from 0.65 to 0.98 (7% discount rate) or 1.12 to 1.68 (4% discount rate).

Table 8-21: Sensitivity tests - costs

Sensitivity test	\$2016m, NPV (4% discount rate)	BCR	\$2016m, NPV (7% discount rate)	BCR
Central estimate*	\$2,208	1.34	-\$1,303	0.78
P90 capital costs	\$2,095	1.32	-\$1,629	0.74
Costs (-20%)	\$3,505	1.68	-\$111	0.98
Costs (+20%)	\$911	1.12	-\$2,496	0.65
Low escalation rate	\$2,447	1.39	-\$1,084	0.81
High escalation rate	\$2,036	1.31	-\$1,796	0.72

Source: EY

\*Central estimate: core benefits only, P50 costs

### Demand and benefits analysis

There are various sources of risk and uncertainty with respect to the demand and benefits analysis, including the potential for different population growth scenarios to eventuate, the extent of induced demand, and around key assumptions used about value of time escalation rates.

The first sensitivity test uses a high-level approach of scaling up or down the gross benefits by +/- 20%. This range is used as a proxy for the impacts of varying the underlying transport demand parameters that feed through into benefit calculations. With this variation in gross benefits the BCR varies from 0.57 to 0.86 (7% discount rate) or 1.07 to 1.61 (4% discount rate).

A second test assumes no escalation of value-of-time (VOT) over time, consistent with either zero real wage growth or a zero wage-VOT elasticity. That is, an hour of time savings is worth the same real amount over the evaluation period. Under this assumption the BCR dips to 0.52 (7% discount rate) or to 0.79 (4% discount rate).

The third test incorporates the 2046 transport modelling run, and instead of extrapolating the benefit profile in line with population growth beyond 2031, it uses the growth profile between 2031 to 2046 to extrapolate growth beyond 2046. The rationale for this test is that to determine the impact of using the 2046 transport modelling run has on the economic appraisal given there is significant uncertainty about the validity of transport modelling forecasts over such a long horizon. Incorporating the 2046 run reduces the BCR to 0.72 (7% discount rate) or 1.08 (4% discount rate).

Table 8-22: Sensitivity tests – benefits

Sensitivity test	\$2016m, NPV (4% discount rate)	BCR	\$2016m, NPV (7% discount rate)	BCR
Central estimate*	\$2,208	1.34	-\$1,826	0.72
Benefits (-20%)	\$469	1.07	-\$2,758	0.57
Benefits (+20%)	\$3,947	1.61	-\$894	0.86
Without benefit escalation	-\$1,335	0.79	-\$3,095	0.52
Incorporating the 2046 model year	\$281	1.04	-\$2,007	0.66
30 year appraisal period	\$502	1.08	-\$1,651	0.72
Residual value – net benefits approach	\$2,748	1.42	-\$1,283	0.78

Source: EY

\*Central estimate: core benefits only, P50 costs

### Discount rates

In line with DTF and IA guidance, project performance is shown under discount rates of 4 per cent, 7 per cent and 10 per cent. This generates a BCR between 0.46 and 1.04.

Table 8-23: Sensitivity tests – discount rate

Sensitivity test	\$2016 millions, NPV	BCR
4% discount rate	\$2,208	1.34
7% discount rate	-\$1,303	0.78
10% discount rate	-\$3,041	0.46

Source: EY

The internal rate of return (IRR) of the project is 5.5 per cent. Typically, transport projects require a rate of return of 7 per cent, while social projects require a rate of return of 4 per cent.

### Other traffic modelling uncertainties

There are a number of uncertainties with regard to the transport modelling, particularly in relation to the representation of level crossings in both the strategic and mesoscopic transport models.

In VITM, a specific delay function has been implemented across level crossings within the strategic model to represent the impact they have on local delays; however it remains uncertain as to how realistic these assumptions are and whether it represents an appropriate way to model level crossings within a strategic model.

Similarly, while the mesoscopic model contains more detailed junction geometry, it is typically used for smaller scale projects. The model is still being developed and is not yet ready to be used reliably in a project context.

## 8.5 Impacts analysis

A broader analysis of program impacts provides information to enable a better assessment of the program against its objectives. The impacts analyses employed in this appraisal include:

- **Macroeconomic impacts analysis:** where Computable General Equilibrium (CGE) modelling is used to provide a picture of aggregate (and high-level regional) macroeconomic impacts
- **Spatial impact analysis:** to describe travel time, labour market deepening, and accessibility improvements by geographical area
- **Analysis of local amenity and project impacts** in the immediate vicinity of the proposed level crossing removals
- **Distributional analysis:** to describe how project impacts vary by socioeconomic status, across businesses/individuals, and users of different transport modes

### 8.5.1 Macroeconomic impacts

Significant investments such as the LXRP can be a major contributor to economic activity, with impacts resulting from both the initial boost in construction sector activity over the life of the project and from ongoing improvements in business productivity due to lower transport costs and closer business-to-business links (agglomeration).

These impacts can be modelled via CGE analysis to provide a more tangible view of the benefits of the project as they manifest in employment and Gross State Product (GSP).

A CGE model consists of a system of equations that represent sectors within the domestic economy (in this instance, the Victorian economy), as well as links with other states and the rest of the national economy. The behavioural relationships in the model are informed by micro and macroeconomic theory, and national and state accounting systems form the model database.

It is important to note that positive macroeconomic impacts estimated via CGE modelling do not constitute additions to the welfare benefits described in the CBA. They should be seen as supplementary information about economic flows and broad sectoral changes, not as inputs to the CBA or as separate benefits.

EY was commissioned by the LXRA to conduct a CGE study examining the impact of the program as an incremental addition to the present transport network. The analysis considers the impact of the LXRP alone; it does not include additional economic impacts due to the CPLU and Metro Tunnel.

#### ***Modelling approach and assumptions***

In the basic CGE framework, the steady state growth paths of the Australian and Victorian economies to 2065 are derived from a '3 Ps' approach (population, participation and productivity).

Key demographic and labour market assumptions (mostly from ABS statistics) are used to develop the baseline. Based on patterns of migration, fertility and life expectancy (mortality), Australia's population is projected to grow at 1.3 per cent per year, slightly below the average growth rate of the past 40 years. Victoria's population is projected to grow at 1.2 per cent per year over next four decades. Net overseas migration is assumed to be similar to the Commonwealth Treasury's Intergenerational Report (2015).

Commonwealth and State Treasury economic projections to 2017-18 are assumed to apply in the short run, with macroeconomic aggregates after that converging to long-term growth rates. Long run productivity growth of 1.5 per cent per annum is assumed for Australia and 1.3 per cent per annum for Victoria. These assumptions, along with the population projections, provide real GDP growth for Australia and real GSP growth for Victoria.

Based on the CBA results, two types of direct impact calculations are estimated and used as inputs into the CGE model to estimate the flow-on impacts associated with level crossing removals:

- Capital and operating expenditure stimulus
- Ongoing efficiency (labour productivity) improvements.

Capital and operating expenditure assumptions are consistent with the cost estimates applied to the CBA. Flow-on effects to the broader economy are calculated by assuming the expenditure adds to investment levels in the Road Transport industry.

In relation to the efficiency improvements, removing level crossings provides a number of benefits in terms of time savings, reliability improvements, vehicle operating cost savings and toll savings to businesses. These direct savings are converted into a one-off (level shift) productivity improvement assumed to apply to selected industries, according to the ratio of total business benefits to these industries' collective value added (that is, their collective output). These productivity gains are applied as shocks to the CGE model to provide indirect impacts of these efficiency measures on the Victorian economy.

The table below shows the model-calibrated shocks based on the CBA analysis.

Table 8-24: CGE model – key LXRП assumptions

Assumption	Detail
Construction phase shock – road transport industry investment	\$6.9 billion (2016 \$) between 2015-16 and 2021-22
Labour productivity growth – road freight transport industry	0.4 per cent
Labour productivity growth – other industries*	0.01 per cent

Source: EY analysis

\*Trade, communication services, financial services, business services, public services and other services industries only.

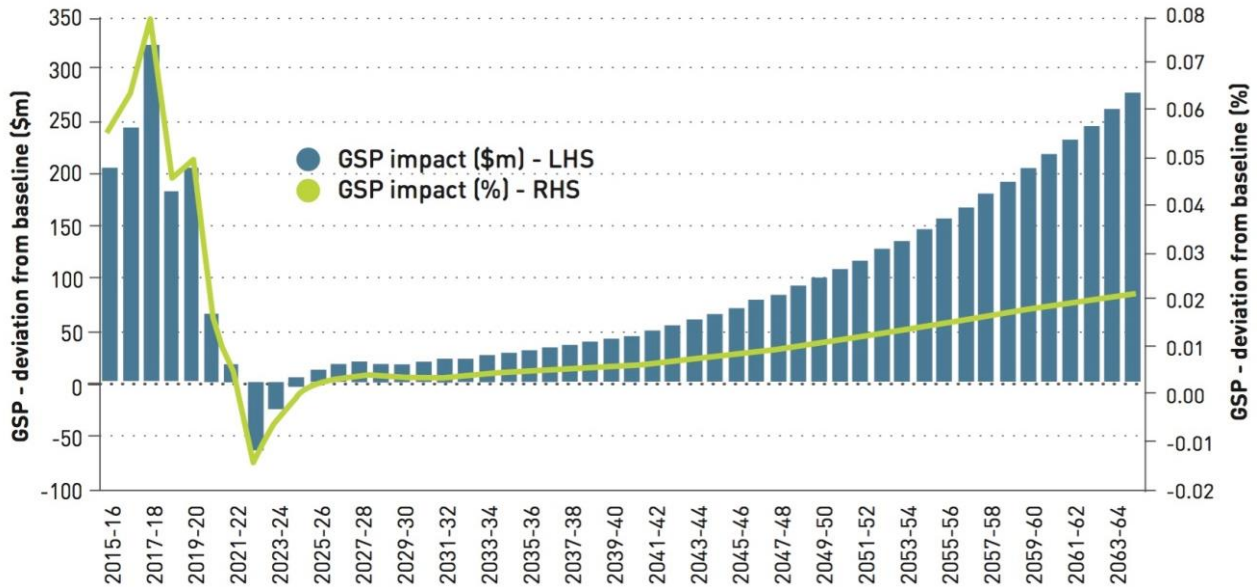
### Real GSP impacts

Through the construction period, the CGE model predicts the short term stimulus effect of construction to add moderate amounts to Victorian GSP. In each year between 2015-16 and 2019-20, the size of the Victorian economy will be around \$200-300 million (up to 0.08 per cent) larger than in the absence of the project.

In the final construction years, the rate of GSP growth will be relatively slower and the net macroeconomic impact of the project commensurately lower, with the net GSP impact becoming slightly negative for the first three post-construction years, as shown in Figure 8-9. This occurs for two reasons: the additional labour demand during construction years stimulates higher wage growth, which has some detrimental effect on Victoria's relative competitiveness, and the draw on private sector capital to finance the project 'crowds out' some other private sector investment opportunities that would otherwise have proceeded and added to Victoria's productive capacity.

In the longer run, the LXRП will create additional ongoing incremental benefits to the Victorian economy via improved productivity. By the end of the evaluation period in 2065, real GSP is expected to be around \$275 million (or 0.02 per cent) higher than it would otherwise have been.

Figure 8-9: Estimated impact of the LXR on real Victorian GSP



Source: EY analysis

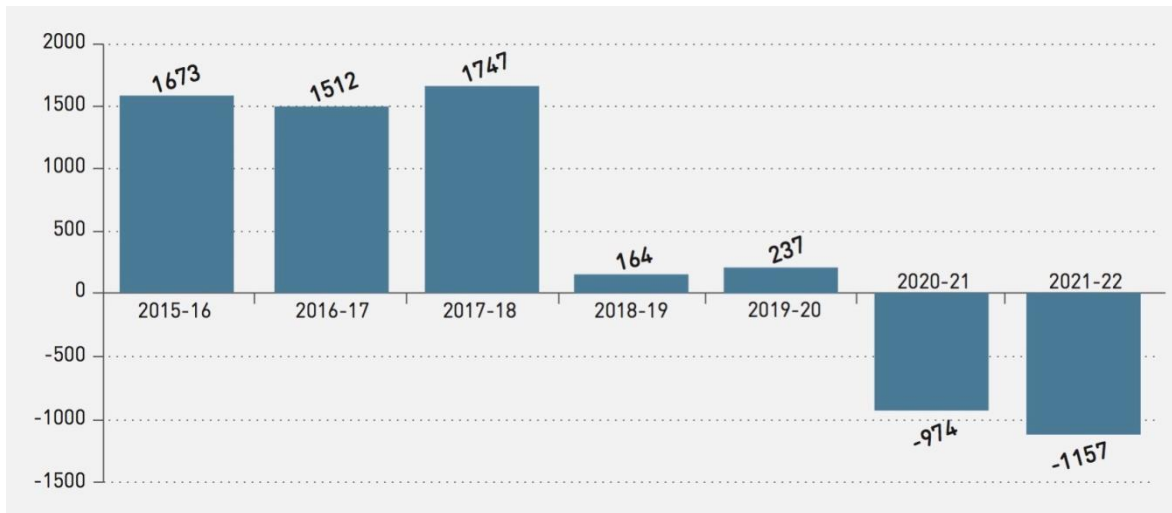
### Labour market effects

In the short term, the LXR will drive job growth through the stimulus effects of additional construction expenditure, as shown in Figure 8-10 below. During the first three construction years, between 1500 and 1750 more people are expected to be employed (across the economy as a whole) than would have been in the absence of the project.

This job growth drives real wage increases; by the later construction years (2017-18 to 2021-22) the project is expected to increase average real wages to levels around 0.15% higher – over the whole economy, not just the road transport industry – than they would have been.

For the same reasons that GSP is expected to be temporarily lower post-construction than it would have been in the absence of the project (crowding out of private sector investment and higher real wages), net employment impacts are expected to be negative during the final construction and post-construction years. Over the 50-year evaluation period, the increase in jobs during construction is fully offset by the net decrease during later construction years and post-construction years.

Figure 8-10: Estimated impact of the LXR on employment during construction phase (persons employed, deviation from baseline)



Source: EY analysis

### 8.5.2 Spatial impact analysis

The CBA benefits and CGE results presented above relate to Melbourne as a whole, masking differences in impact across the city. Analysis of spatial differences using VITM corridor and small area forecasts highlights that for the road network around rail corridors, the LXR is expected to deliver both volume and speed improvements that vary significantly from corridor to corridor.

The most significant increases in traffic volumes are expected along the Caulfield-Dandenong corridor, where the road network is projected to carry almost 40,000 (7.4 per cent) additional trips daily as a result of the LXR, while simultaneously raising the average speed of those trips by 20 per cent. Along other rail lines with high traffic volumes (such as the Upfield and Sunbury lines, which by 2031 will each see more than 0.5 million trips daily within 1km of the line), level crossing removals are expected to generate speed improvements of 7 to 8 per cent while accommodating higher volumes of traffic. The most significant road speed improvements are expected along the Altona Loop, the South Morang line and between Mordialloc and Frankston.

These impacts are summarised below.

Table 8-25: Impact of LXR on vehicle volumes and travel speeds along rail corridors (1km radius), 2031

Rail corridor	LXs removed	Average speed (km/h)			Number of vehicles (per day)		
		Base case	Project	% change	Base case	Project	% change
Lilydale	2	27.3	+3.4	12%	140,031	+2,104	1.5%
Belgrave	2	30.1	+11.2	37%	221,934	+3,252	1.5%
Camberwell - Ringwood	2	21.2	+3.0	14%	267,859	+5,293	2.0%
Glen Waverley	2	31.0	+1.8	6%	248,609	+13,099	5.3%
Cranbourne	2	37.9	+7.9	21%	194,964	+5,589	2.9%
Pakenham	3	45.8	+1.1	2%	407,443	+16,960	4.2%
Caulfield - Dandenong	9	35.3	+7.1	20%	524,833	+38,586	7.4%
Mordialloc - Frankston	6	24.4	+9.7	40%	117,733	+4,079	3.5%
Caulfield - Mordialloc	5	28.6	+7.0	24%	351,794	+8,774	2.5%
Clifton Hill - Heidelberg	2	23.7	+0.1	0%	168,836	-354	-0.2%
Clifton Hill - South Morang	2	15.1	+6.1	41%	299,960	+7,915	2.6%
Upfield	3	28.1	+2.1	8%	555,188	+2,028	0.4%
North Melbourne - Glenroy	2	40.6	+2.3	6%	410,294	+7,962	1.9%
Sunbury	3	56.2	+4.1	7%	511,089	+6,841	1.3%
Werribee	3	49.6	+3.7	7%	355,471	+2,351	0.7%
Newport - Laverton via Altona	1	23.7	+12.9	54%	41,321	+308	0.7%
Williamstown - Footscray	1	47.6	+1.0	2%	259,526	+24	0.0%

Sources: VITM model outputs – difference between standard base case and standard project case.

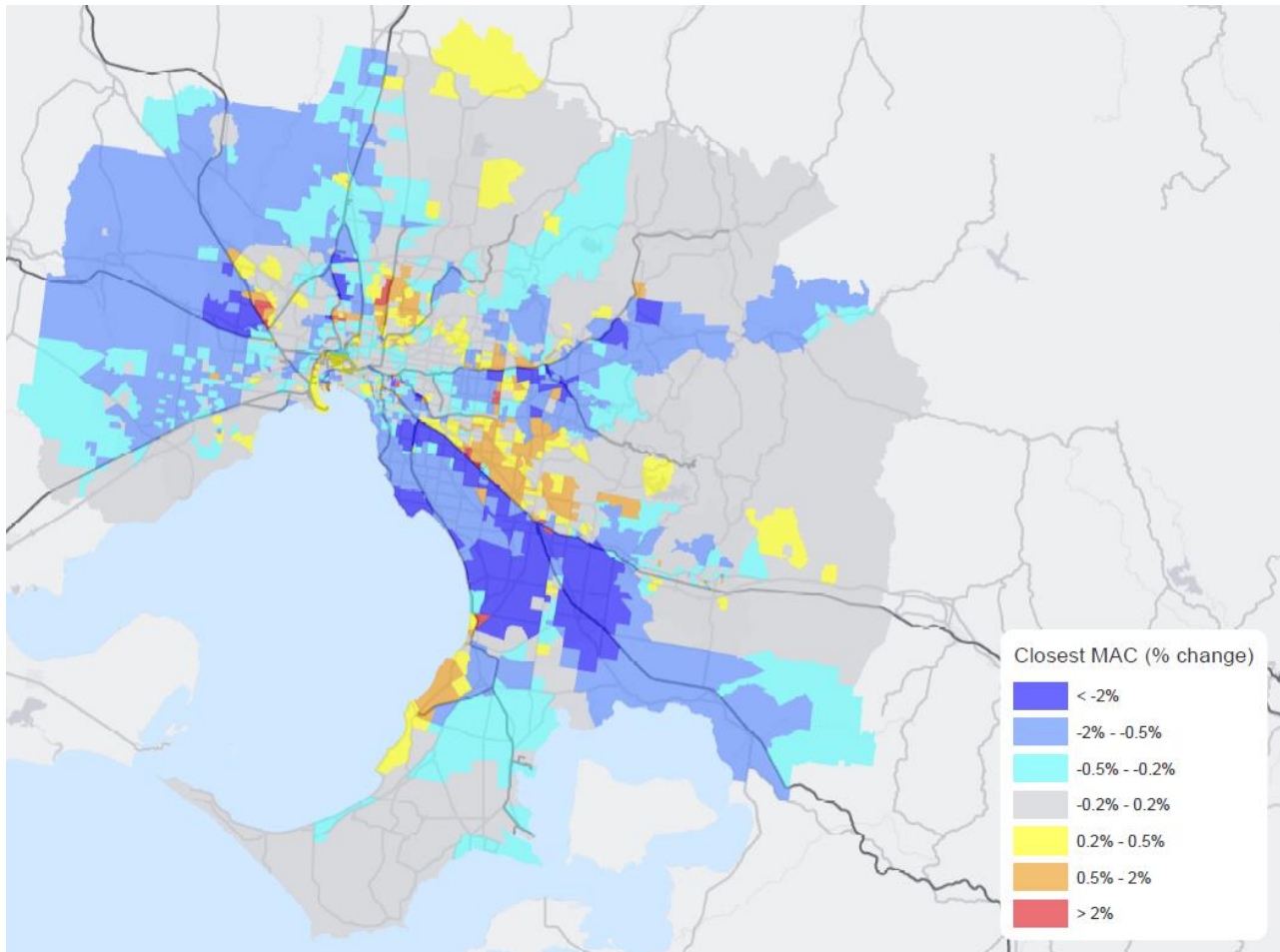
VITM modelling also allows some insight into how the LXR generates improvements in accessibility to key employment clusters, major education and health precincts, and activity centres across Melbourne.

The consistent trend emerging from spatially disaggregated accessibility analysis is of significant improvements around the ‘triangle’ made by the Frankston and Dandenong lines south of Caulfield, and deterioration in travel times and job accessibility for the areas immediately north-east of the Dandenong rail corridor around Princes Highway and the Monash Freeway. On certain accessibility measures, there are also noticeable gains in the Sunshine-St Albans-Deer Park triangle and for suburbs to the south of the Ringwood corridor and Lilydale line.

Figure 8-11 shows one map of accessibility impacts– the change in travel time to *Plan Melbourne* Metropolitan Activity Centres– to illustrate these trends.



Figure 8-11: Access to services – impact on travel time by car to closest Metropolitan Activity Centre, 2031



Source: VITM model outputs – change from base case to project case (standard). The Metropolitan Activity Centres are as laid out in Plan Melbourne (2014): Dandenong, Footscray, Fountain Gate/Narre Warren, Epping, Sunshine, Ringwood, Broadmeadows, Box Hill and Frankston.

### 8.5.3 Local amenity and project impacts

Level crossing removals have the potential to influence the liveability and prosperity of local precincts, particularly in the vicinity of railway stations and other major transport interchanges and community centres. They also have the potential to create a mix of positive and negative impacts, including land acquisition, land use impacts, environmental impacts and other temporary impacts during construction.

The program appraisal includes an overview of the multi-criteria assessment (MCA) of the local amenity and project impacts for the Reference Options selected for the 30 level crossing sites, noting that the other 20 sites have been subject to previous assessments and funding submissions. This assessment was undertaken by LXRA with the support of its technical advisors<sup>79</sup>.

An objective of the LXRP is to create better connected, liveable and thriving communities, and this analysis shows that more than half of the Reference Options have the potential to deliver clear improvements to their surrounding precincts. This is anticipated to occur on all sites on the Hurstbridge, South Morang, Glen Waverley and Lilydale lines, as well as six out of eight sites on the Frankston Line and around half the sites on the other lines.

<sup>79</sup> This assessment reflects the current status of the Reference Options. As reference options are developed further during the preparation of Project Proposals the Recommended Solution will be assessed against the MCA in accordance with the Options Assessment Framework described in section 6.1.2.

These sites have scored highly because of their potential to provide a clear improvement across a number of factors, such as the level of access within designated activity areas and/or by providing an increase in the number or quality of physical connection points across the rail corridor. They could also be contributing to improvements to public spaces or providing clear improvements to station access, including for pedestrians and cyclists. These sites align well with local land use policy and strategy, and in a number of cases provide clear opportunities for urban renewal, including across broader precincts.

A further seven sites are expected to experience at least a marginal improvement, with only a small number of sites showing limited opportunities to enhance local connectivity and amenity.

Table 8-26: MCA of the potential to create better connected, liveable and thriving communities

Line Groups	Clear Improvements	Marginal Improvements	No Improvements
Cranbourne and Pakenham	-	1	3
Frankston	6	2	-
Craigieburn and Upfield	2	1	2
Hurstbridge and South Morang	4	-	-
Sunbury and Werribee	2	-	-
Glen Waverley and Lilydale	3	-	-
Laverton and Williamstown	1	1	-
Total: all sites	18	7	5

A further objective of the LXR is to minimise, where possible, undesirable impacts of each project on local communities. Local project impacts include:

- *Land acquisition impacts* – Land acquisition is sometimes required to support the delivery of necessary transport infrastructure, during either the construction or operations phase. This may occur because of technical issues in accessing construction sites, to acquire land that is required to accommodate the physical shape and size of the infrastructure being delivered or to minimise any negative impacts on landowners with holdings in tight proximity to the infrastructure.
- *Land use impacts* – These impacts can affect residents, community services and local business operations and relate to adverse visual, noise, vibration or overshadowing impacts.
- *Environmental impacts* – These include possible impacts on flora and fauna, aboriginal cultural heritage, historical heritage and other environmental impacts such as contamination, noise, air quality and greenhouse gas emissions. These impacts can arise during construction or through the operational phases of removed level crossings.
- *Temporary impacts* – The construction of level crossing removals may result in disruption to road and public transport users (linked to temporary closures and/or operating restrictions), as well as local residents, businesses and users of nearby community facilities. There may also be disruption to major utility services.

The table below presents the assessment of the potential for the delivery of the Reference Option at the 30 sites to create these undesirable local impacts. These scores are based on the assessment of the impacts and will be subject to change as the Works Package/Project Proposals are developed. There may also be opportunities to mitigate some or all of the impacts at different sites.

This analysis shows that the Reference Options will have minimal impacts on *land acquisition* given the scale of the program, with 26 options demonstrating strong performance and only four options demonstrating average performance. For these four options, there could be minor or isolated pockets of land acquisition required (such as partial acquisition, isolated minor acquisition or temporary acquisition for construction purposes). There may also be limited acquisition of local government land (such as partial acquisition of road reserves).

None of the Reference Options demonstrate poor performance in respect of land acquisition.

The Reference Options demonstrate an average to strong performance in terms of impacts on *land use*, with seven sites performing strongly and 20 showing average performance. These sites are likely to have minor to moderate adverse amenity impacts upon residential areas (such as moderate visual, noise, vibration or overshadowing impacts caused by large changes in rail/road elevation near a continuous strip of properties and with a separation buffer such as side road or vegetated area) and local community infrastructure (such as schools, childcare centres, hospitals and parkland). There will be minor to adverse impacts on some local business infrastructure (for example, minor changes to shop access affecting road-dependent businesses). Three sites may have significant adverse impacts on some land uses.

The Reference Options are expected to demonstrate average *environmental* performance, with 26 sites having the potential to have moderate impacts on native vegetation (for example, where a permit/consent is required under state or federal legislation) and/or cultural heritage sites. Two sites should have no impact, whereas another two may have major impacts on environmental receptors.

*Temporary* impacts are expected to be significant at a large number of sites (18) across the Reference Options. These options may result in high disruption to road and public transport users (linked to temporary closures and/or operating restrictions), as well as local residents, businesses and users of nearby community facilities. There may also be disruption to major utility services.

Table 8-27: MCA of the potential to create project impacts – all sites assessed

Sites assessed: 30	Land Acquisition	Land use	Environmental	Temporary
Strong Performance	26	7	2	5
Average Performance	4	20	26	7
Poor Performance	0	3	2	18

### 8.5.4 Distributional analysis

A distributional impact analysis examines the allocation of project benefits across different groups in society, on the premise that certain infrastructure and service delivery projects have uneven effects on different groups of individuals, which should be highlighted for the information of stakeholders and decision-makers.

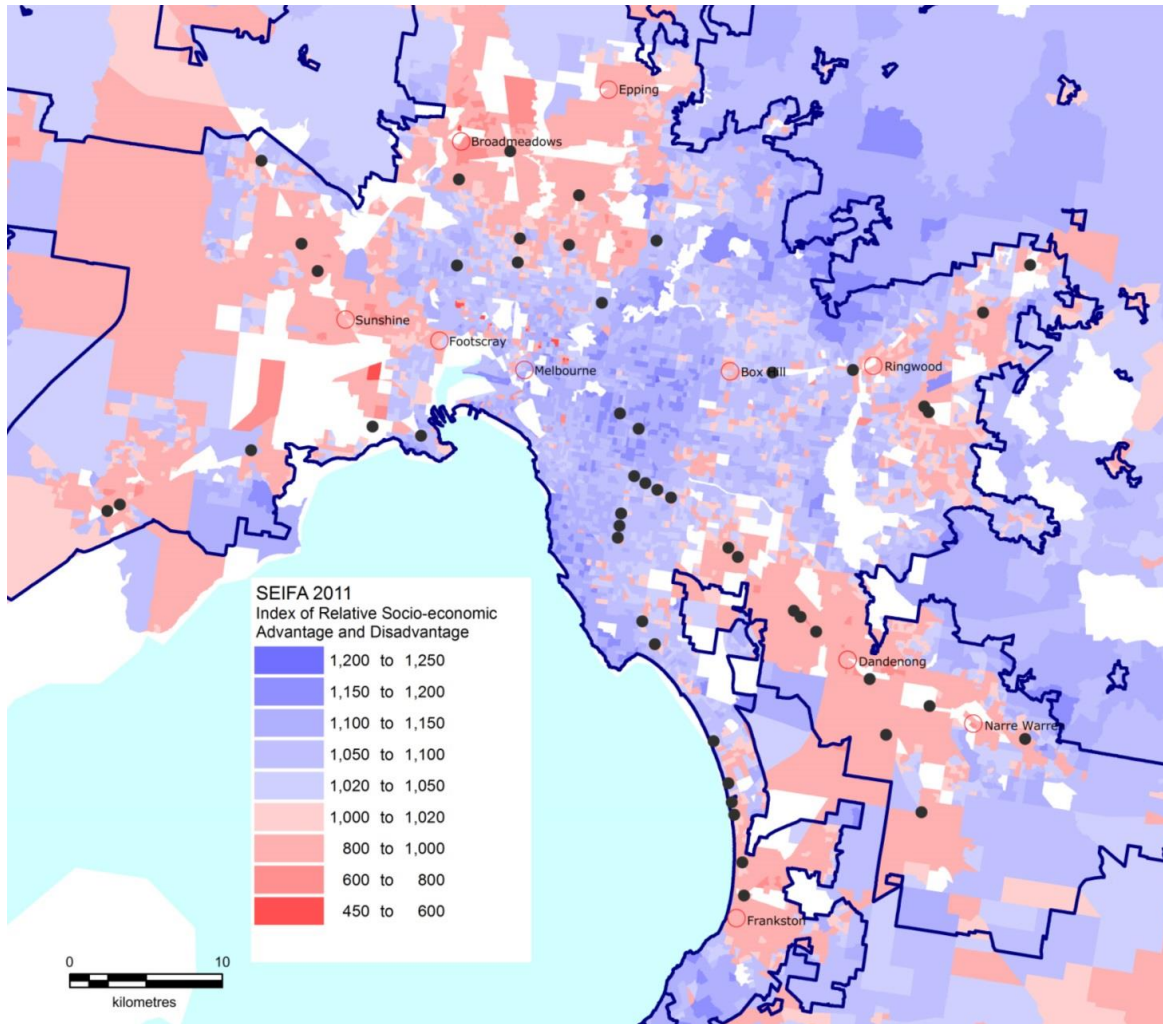
As a citywide transport initiative, the LXR can be expected to have a widely dispersed set of beneficiaries. A sizeable proportion of Melbournians are affected by these crossings: over a million vehicles traverse the 50 crossings each weekday. The LXR also generates benefits for both road and public transport users: drivers will be the major beneficiaries of the program, but public transport users will also gain from faster and more reliable bus journeys and more frequent rail services (which would likely not be feasible without the program).

A basic comparison of socioeconomic variables and other characteristics of the LGAs in which level crossings are being removed, illustrates the diversity of areas included in the LXR. While the investment has no explicit equity objectives, a number of level crossings will be removed from some of Melbourne’s most disadvantaged LGAs: 12 crossings will be removed from the four least-advantaged municipalities: Dandenong, Brimbank, Hume and Frankston. It is also notable that five crossings will be removed from LGAs on Melbourne’s urban fringe (including Wyndham, Casey, Hume and Yarra Ranges from Melbourne’s ‘interface’ council group), which will aid in improving problems of access to jobs and services for residents in these fast-growing areas.

Figure 8-12 overlays the locations of the 50 sites against small-area SEIFA scores,<sup>80</sup> illustrating the widespread coverage of the program across areas of both advantage and disadvantage around the city.

<sup>80</sup> SEIFA (Social-Economic Indexes for Areas) is a measure developed by the Australian Bureau of Statistics to rank areas according to their relative socio-economic advantage and disadvantage. The indexes are based on information obtained from the Australian Census.

Figure 8-12: SEIFA scores and location of 50 level crossings



Source: EY using ABS 2011 Census SEIFA score

## 8.6 LXP economic appraisal summary

### 8.6.1 Investment logic

The LXP has been conceived as a coherent program of level crossing removals, with associated works and local improvements, to address three identified problems:

- Conflicting demands of rail, road and pedestrian traffic cannot be accommodated at level crossings without overly constraining one or more modes, reducing transport efficiency and economic productivity.
- Rail corridors and excessive boom gate closures reinforce community severance and reduce local amenity.
- Frustration from level crossing delays invites risk-taking behaviour, causing serious incidents.

By addressing these problems the program is expected to contribute towards:

- More reliable and efficient transport networks to improve productivity
- Better connected, liveable and thriving communities
- Safer communities.

The program appraisal assesses and quantifies these benefits – primarily through cost-benefit analysis but also with other descriptive tools – in order to provide Government and community stakeholders with a comprehensive picture of the costs, benefits and other impacts of the LXP.

### 8.6.2 Cost-benefit analysis summary

Typically, transport projects require a rate of return of 7 per cent, while social projects require a rate of return of 4 per cent. In recognition of the current levels of market rates, and practice in other jurisdictions around the choice of an appropriate discount rate for similar large projects, there are good reasons to consider that a real discount rate of approximately 4% is appropriate for the LXP.

However, to keep in step with the approach adopted by other major transport investments being undertaken by the Victorian Government, the appraisal results for the LXP are shown using the standard discount rate of 7% (real), and also present a sensitivity impact using a lower discount rate of 4% (real).

The core benefits anticipated as a result of the program, include travel time savings, reduced vehicle operating costs, road travel reliability benefits, public transport user benefits and avoided collisions.

As a standalone program, the LXP is expected to deliver a net benefit of -\$1.3 billion and Benefit Cost Ratio (BCR) of **0.78** using a 7 per cent discount rate. Using a discount rate of 4%, the net benefit of the project is \$2.2 billion and the BCR is 1.34.

The BCR has been calculated using a standard appraisal methodology. Additional and Wider Economic Benefits, which are excluded from the above core BCR figure, comprise of:

- Wider Economic Benefits: Primarily relating to productivity gains from agglomeration)
- Additional Benefits: such as improved network resilience to incidents, reduced perceived congestion benefits and the related benefits and costs of land use changes occurring as a result of the project).

Inclusive of Additional and Wider Economic Benefits, the LXP is expected to deliver a net benefit of -\$0.7 billion and Benefit Cost Ratio (BCR) of **0.9** using a 7 per cent discount rate. Using a discount rate of 4%, the net benefit of the project is \$3.1 billion and the BCR is 1.5.

This also excludes other significant benefits that the LXP can be expected to deliver, including Local amenity benefits, increased activity centre connectivity/ consolidation, and benefits for emergency services. It also excludes the avoidance of wider social impacts (ie. to families and communities) that are caused by accidents at level crossings.

The LXRП plays a critical role in enabling the full benefits of key rail projects, such as the Cranbourne Pakenham Line Upgrade (CPLU) and the Metro Tunnel to be achieved. This business case also includes a combined appraisal of these three major and critically interdependent transport projects.

These projects can in combination be expected to deliver large transport benefits and have a significant impact on Melbourne’s city structure, by encouraging households and businesses to locate in areas that will benefit from the significant accessibility improvements that these projects will provide. These induced land use changes can create benefits and costs in addition to traditional transport user and non-user benefits (including wider economic benefits or WEBs) that are usually included in transport cost-benefit analysis.

Analysis completed for this study highlights the potential for the combined program of LXRП, CPLU and Metro Tunnel to drive significant employment growth along rail corridors in the south-east, north and west, of Melbourne.

The combined program of LXRП, CPLU and Metro Tunnel is expected to deliver a net benefit of \$5.1 billion and BCR of 1.2 using a discount rate of 7%. When using a 4% discount rate, the net benefit is \$21 billion and BCR is 2.2

The Cost-Benefit Analysis Summary is provided in the Table below.

Table 8-28: Cost Benefit Analysis Summary

	4% Discount Rate (Real)	7% Discount Rate (Real)
<b>LXRП (Reference Case)</b>		
Core transport system benefits	\$8.7 Billion	\$4.7 Billion
Benefit Cost Ratio	<b>1.34</b>	<b>0.78</b>
<b>LXRП (Reference Case, including Additional &amp; Wider Economic Benefits)</b>		
Additional & Wider Economic Benefits	\$1.3 Billion	\$0.7 Billion
Benefit Cost Ratio	<b>1.5</b>	<b>0.9</b>
<b>Combined Appraisal (LXRП, Metro Tunnel &amp; CPLU)</b>		
Core transport system benefits	\$31 Billion	\$14 Billion
City-shaping benefits	\$5 Billion	\$3 Billion
Productivity benefits	\$4 Billion	\$4 Billion
Benefit Cost Ratio	<b>2.2</b>	<b>1.2</b>

Source: EY using VITM model outputs

### 8.6.3 More reliable and efficient transport networks to improve productivity

Level crossings sit at the interface of road, rail, cycling and pedestrian networks, with railway stations located adjacent to or near many of the 50 crossings in the LXRП.

The LXRП is expected to generate a wide array of transport benefits: travel time savings for business and individual road users (on both crossing links and the wider network), reductions in vehicle operating costs, improvements in journey time reliability, improvements in bus travel times and the reliability of rail interchange, and – significantly – the ability to run more rail services without further exacerbating already severe road disruptions at key junctions.

The key monetised benefit and largest contributor to overall project benefits is the aggregate travel time saving, expected to amount to over \$2.5 billion over the model period, which arises from an overall 0.2 per cent improvement in average network speeds generated by the LXRP. Improvements in road journey reliability contribute a further \$1 billion in benefits.

Productivity impacts are expected to arise from a deepening of labour pools and reductions in business-to-business travel times that improve the effective 'density' of economic activity across the city. Section 8.5.2 showed how job accessibility and travel time to key economic clusters are expected to change, with a trend of broad improvement due to the LXRP and some regional variation. In particular, areas southwest of the Caulfield-Dandenong rail corridor and around the Frankston corridor show the strongest and most consistent accessibility improvements, while areas northeast of the Dandenong corridor around the Princes Highway and Monash Freeway may see deteriorating travel times as cross-corridor traffic flows increase.

A Wider Economic Benefits (WEBs) figure was calculated in order to quantify the aggregate effect of these accessibility improvements on productivity (agglomeration benefits). Total WEBs are expected to be \$0.7 billion, with agglomeration benefits contributing \$0.5 billion of this.

#### 8.6.4 Better connected, liveable and thriving communities

The second ILM benefit reflects the recognition that the LXRP is not purely a transport project, but has a critical 'place-making' dimension as well. Many of the 50 sites sit at the heart of activity centres and local communities, and many contribute negatively to the amenity of their immediate environment at present, with road congestion and visually unattractive structures detracting from local amenity and worsening the severance of local communities bisected by rail corridors.

Severance can occur at different scales. On a larger scale, level crossing delays impact residents' access to key services and the removal of level crossings can improve travel times to these services. On a local scale, rail corridors can function as a barrier between residents and the destinations they access – such as schools, shops and local services – via short trips or as pedestrians.

At the city-wide scale, modelling travel time improvements to key destinations – the *Plan Melbourne* education precincts, health precincts, Metropolitan Activity Centres and local activity centres – shows clear accessibility improvements for many areas across the city. The social value of these travel time improvements, and of additional trips generated to capitalise on this easier access, is included in the CBA within the aggregate travel time savings benefit calculation. A breakdown of travel time savings by trip purpose shows benefits valued at \$1.9 billion accruing to non-commuting trips.

A multi-criteria assessment of the potential for the level crossing removals at each of the 30 sites to create improvements to their surrounding precincts found evidence that 'clear improvements' – defined according to set criteria – are possible at many sites (18 of the 30). This is expected at all sites on the Hurstbridge, South Morang, Glen Waverley and Lilydale lines, at six of eight sites on the Frankston Line and at around half the sites on other lines. Seven of the 30 sites are expected to show marginal improvements and only five have limited opportunity to enhance local connectivity and amenity.

#### 8.6.5 Safer communities

As noted in Chapter 2, over the last decade there have been over 60 collisions between trains and vehicles or pedestrians on Melbourne's rail network that resulted in a serious injury (22) or fatality (38), as well as around 700 near-misses. Twenty of these 38 fatalities occurred at sites included in the LXRP. The opportunity to contribute towards safer communities arises not only from reducing the risk of car/train accidents at these crossings, but also from the potential for better designed station precincts to improve safety for pedestrians in the wider vicinity of the crossing.

Adopting an approach that combines avoidance of accidents directly attributable to level crossings with a further reduction proportionate to the reduction in kilometres travelled on the broader network, the CBA has estimated a value of \$134 million associated with the avoidance of the human and physical costs of accidents.

### 8.6.6 Summary table (Reference case)

The key program benefits (monetisable and non-monetisable), CBA summary statistics and findings from the non-CBA impact analysis as they relate to the key categories of benefit identified in the Investment Logic Map are summarised in the following table. The full program appraisal is provided in Appendix H (*redacted*).



Table 8-29: Summary of program appraisal (Reference Case)

	Benefit category	CBA benefit item	Description	Ref.	KPI / measure	Value (discount rate=4%)
COST – BENEFIT ANALYSIS	More reliable and efficient transport networks to improve productivity	Business travel time savings (road)	Travel time savings to business due to faster travel times across level crossings and consequent flow-on speed increases across the broader road network.	s8.4.2	Journey travel times / junction (LX) delays Network KPIs	\$256 m (freight) \$571 m (other business)
		Vehicle operating costs	Value to road users of lower vehicle operating costs.	s8.4.2	\$ cost savings / % decrease	\$636 m (all road users)
		Reliability benefits (road)	Reduced variability in road travel times (business and non-business users)	s8.4.2	Variability (s.d.) of LX travel time	\$956 m (VITM model)
		Reduced incident disruption benefits	Delays to rail passengers and road users following incidents at level crossings are avoided (road user impacts are not included in general travel time savings figures).	s8.4.3	Incidents avoided / rail user incident time savings	\$6 m (rail)
		Wider Economic Benefits	Agglomeration, output changes in imperfect markets, incremental tax revenues	s8.4.2	Effective Job Density / other measures	\$737 m (agglomeration) \$151 m (labour supply change) \$95 m (imperfect competition)
		Enabling rail capacity upgrades	Rail service upgrades improving rail journey times, patronage, and road congestion can be implemented without unacceptable boom gate closures.	s8.3.5	Net benefit (NPV) of CPLU Net benefit (NPV) of MM	Implicitly included in travel time savings; not an additional benefit
		Land-use change benefits	Benefits from higher population density across Melbourne (lower public infrastructure and service costs, health benefits, energy savings, additional WEBS, land value changes)	s8.4.3 s8.5.4	Population density change Rail corridor development statistics	Small additional +ve
	Better connected, liveable and thriving communities	Non-business travel time savings (road)	Travel time savings to individual road users due to faster travel times across level crossings and consequent flow-on speed increases across the broader road network.	s8.4.2	Journey travel times / junction (LX) delays Network KPIs	\$2,628 m (non-business)
		Public transport user benefits	Rail de-crowding, bus travel time savings, value to rail users of improved station amenity and easier access and interchange	s8.4.3	Patronage at redeveloped stations	\$786 m (station) \$494 m (interchange) \$245m (other PT benefits)
		Externalities (pollution)	Reduced road emissions (CO2 and noxious gases)	s8.4.2	Volume/concentration of emissions	\$0.06 m (noxious gases) -\$0.00 m (CO2 emissions)
Construction disruption disbenefit		Disruption to local businesses, rail and road users, pedestrians, and residents during construction phase (delays, inconvenience, noise, vibration).	s8.4.3	Metrics of disruption	-\$61m (road and rail)	

Commercial-in-Confidence information has been redacted prior to publication

	Reduced perceived congestion at level crossings	Drivers value relief from congested road conditions (e.g. stop-start traffic or queuing) at a higher rate than their value of time. The project will reduce travel times on some heavily congested links at level crossings.	s8.4.3	Hours travelling on congested road links Number of drivers queuing at boom gates	\$274 m (reduced perceived congestion)		
	Public transport timetabling benefits	More reliable travel across LXs and around stations improve public transport integration (via more reliable interchange) and permit improvements in bus routing and timetabling.	s8.4.3	Bus on-time performance	Small additional +ve		
	Local amenity benefits and precinct activation opportunities	Opportunities for state/local governments to improve amenity (e.g. reduce noise/visual impacts of trains), reduce pedestrian and cyclist travel and waiting times, and improve land use at station precincts by undertaking complementary works or actions.	s8.5.3	Assessment of potential for clear/marginal/no improvements to station precincts (from site assessments)	Moderate addnl +ve		
	Safer communities	Reduction in accident costs	Removal of car/train conflict and reduced exposure of pedestrians to risk will reduce accidents, injuries and fatalities at level crossing sites. Increase in traffic on the wider network will have a partially offsetting disbenefit.	s8.4.2	Level crossings: Frequency/severity of incidents (ALCAM modelling) Wider network: VKT	\$266 m (crossings) -\$21 m (wider network)	
	Other: Resource cost corrections Other: Residual asset value		Difference between actual VOC/toll/PT fare savings & user-perceived. Value of infrastructure assets at end of evaluation period	s8.4.2	- Depreciated cost	\$1,373 m (RCCs) \$531 m (asset value)	
<u>Project Costs (4%):</u>		<u>Net Benefits (4%):</u>	<u>Sensitivity tests:</u>	<u>Benefit-Cost Ratios</u>	<u>Benefits (4%):</u>		
Capex	\$6,396 m	Core benefits	NPV=\$2,208	7% discount rate	NPV -\$1,303m	Core benefits	\$8,695m
Opex	\$229 m	Core + WEBS	NPV=\$3,191	P90 costs	NPV \$2,095m	WEBS	\$983m
Real options (savings)	-\$139 m	Core + WEBS + addnl	NPV=\$3,471		BCR 1.32	Additional benefits	\$280m
TOTAL	\$6,487 m					TOTAL	\$9,958m
	<b>Benefit category</b>	<b>Analytical tool</b>	<b>Impact description</b>	<b>Ref.</b>	<b>Impact</b>		
IMPACTS ANALYSIS	More reliable and efficient transport networks to improve productivity	CGE modelling	Construction stimulus and ongoing lower transport costs improve productivity and macroeconomic outcomes (employment, GSP)	s8.5.1	Construction stimulus and ongoing lower transport costs improve productivity and macroeconomic outcomes. Additional GSP of around \$200-300m and additional employment (up to 1,750 jobs) during construction period		
		Spatial impact analysis	Widespread improvements in business-to-business access (seen in travel time to National Employment Clusters), in depth of labour markets and in access to jobs (seen in Effective Job Density or jobs accessible within a 45 min commute)	s8.5.2	Moderate improvements in access to employment clusters/jobs south-west of Caulfield-Dandenong (CD) corridor and along Nepean Hwy/Frankston line. Some deterioration in travel times between CD corridor and Monash Freeway.		

*Commercial-in-Confidence information has been redacted prior to publication*

Better connected, liveable and thriving communities	Spatial impact analysis	Widespread improvements in travel time to Metropolitan Activity Centres, education and health precincts, and local activity centres.	s8.5.2	Strong gains on all accessibility measures south-west of CD corridor. Improvements on some measures south of Ringwood corridor and around Sunshine/St Albans. Deterioration on some measures northeast of CD corridor.
	Distributional analysis	Potential for improvements in travel times, amenity and safety across areas of different socio-economic status. Distribution of time savings by household/business travellers.	s8.5.3	12 level crossings are being removed across Melbourne’s four least advantaged LGAs (by SEIFA score) – Dandenong, Brimbank, Hume and Frankston. Travel time benefits accrue mostly (90%) to non-business travellers.
	Land-use modelling	Changes in population and employment distribution	s8.5.4	Changes in population/employment distribution: minimal change expected due to LXP, but model results show CPLU driving growth in SE-Melbourne.

# Chapter 9

## Program deliverability



## **CHAPTER 9: PROGRAM DELIVERABILITY - SUMMARY**

The Major Transport Infrastructure Governance Framework has been developed to provide a framework for the stewardship of the LXP. The LXP will be managed in accordance with the LXRA Project Management Framework.

An initial procurement options analysis has been undertaken to inform the packaging assumptions in this business case, and overarching Communications and Stakeholder Engagement Strategy has been developed and a Risk Management Plan has been developed to guide the assessment of risk.

All of these strategies and plans will be reviewed and refined throughout the Program's development and delivery. A Program Procurement and Packaging Strategy has been prepared to further develop the program level packaging strategy and consider program level delivery issues across the North Eastern, North Western and Western rail corridors.

Project Proposals or Works Package Proposals will outline the detailed communications and engagement activities undertaken and the detailed risk assessment for the Recommended Solution.

The LXRA has developed an Urban Design Framework, which sets benchmarks and measures for high quality design outcomes and place making approaches, and a consistent consideration of urban design principles and objectives across the program. The UDF establishes the expectations of the Victorian Government and local governments for high quality, context sensitive urban design outcomes from the LXP. It aims to achieve a high quality urban design response that enhances urban amenity and minimises any adverse impacts resulting from the proposed project and its associated structures and development. The UDF will inform the development of the design and the Recommended Solution for each site or package.

The Victorian Government has committed to deliver the program of 50 level crossing removals in two terms of government, or by 2022. This commitment also includes the delivery of 20 level crossing removal projects within its first term in office, or by 2018. These will be delivered in packages or bundles as appropriate. A value capture strategy will guide the delivery of integrated development opportunities alongside the core level crossing removal works.

The Works Package/Project Proposals will support funding requirements for each delivery package and be developed to align with this Program Business Case. Works Package/Project Proposals will be submitted progressively to suit the funding requirements of the Program.

## 9 Program deliverability

### 9.1 Change management

The Level Crossing Removal Authority is responsible for all aspects of the LXRP, including planning and development, stakeholder engagement and procurement – through to construction and delivery.

The governance arrangements for the LXRA are described in Section 9.2. No other change management procedures are required to deliver the Program.

On completion of the LXRP, rail assets will be owned and maintained by VicTrack and/or rail operators; road assets will be owned and maintained by VicRoads or local councils.

The transition to operational stages will involve training train drivers and staff on new station and rail layouts, plus incorporation of new assets into rail systems. Training and completion costs have been allowed for in the cost estimates for the Program.

### 9.2 Governance

#### 9.2.1 Principles

The governance arrangements for the LXRP have been established within the context of foundation principles for public sector governance<sup>81</sup> and project governance. In particular, these arrangements aim to:

- Develop and deliver the project through implementation of best practices across relevant disciplines;
- Provide a clear separation between infrastructure planning and project approval on the one hand and project delivery on the other;
- Make project delivery clearly accountable to government; and
- Provide robust oversight and stewardship of the Program.

#### 9.2.2 Governance framework

The Major Transport Infrastructure Program Governance Framework has been developed to provide a framework for the stewardship of the Level Crossing Removal Program and the Metro Tunnel project. The framework sets out the terms of reference and guiding principles for the governance structure for all phases of project implementation.

DEDJTR<sup>82</sup>, Public Transport Victoria and VicRoads (responsible for delivery of Thompsons Rd) are accountable for the finalisation of the project development stage and the resulting documentation including the Business Case and Project Proposals.

The project development stage has its own governance structure, depicted in Figure 9-1. The Lead Deputy Secretary – Transport is the Chair of the Major Projects Steering Committee (MPSC), which is the key forum for project decisions during project development. The purpose of MPSC is to ensure that projects are developed in accordance with strategic directions set by the Transport and Infrastructure Policy, Planning and Delivery Committee (TIPPDC).

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<sup>81</sup> Australian Public Service Commission (2007), Building Better Governance, Canberra

<sup>82</sup> The LXRA is an Administrative Office within DEDJTR that has been established to deliver the LXRP

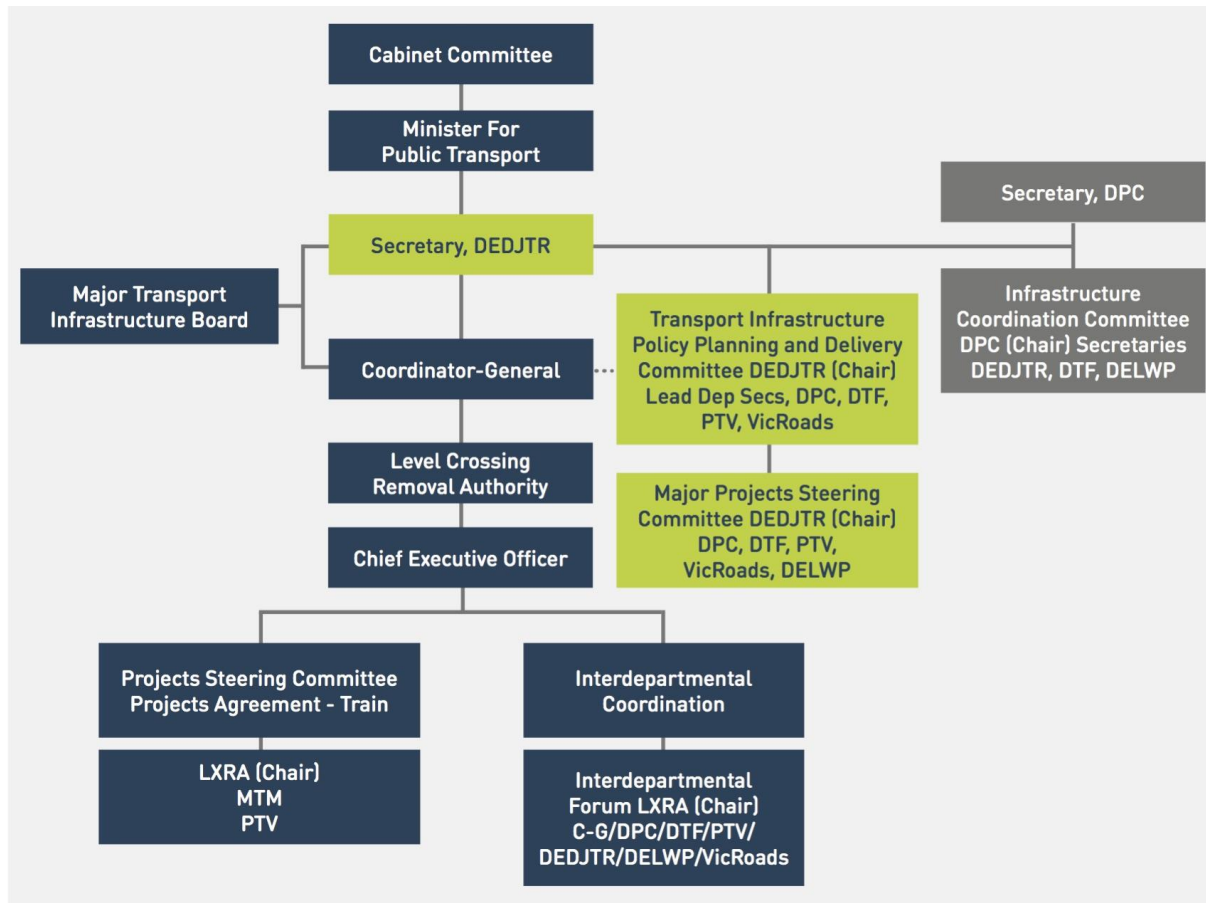
Importantly, the MPSC includes representation from DEDJTR portfolio agencies (including Public Transport Victoria and VicRoads) as well as from DPC and DTF. The MPSC provides a forum for all relevant government agencies to provide oversight of the program’s development work and documentation (including the procurement strategy) prior to the LXRП being recommended to the Government for funding and delivery. Additional forums have been established to ensure that DTF, DPC, PTV, DELWP and VicRoads are well informed of progress of the business case and have an input to solving problems as they arise.

Pursuant to the Franchisee Agreement for metropolitan rail (Projects Agreement-Train), a Projects Steering Committee has been established that includes representatives from LXRA, PTV and MTM. This committee (which will continue to operate throughout the development and delivery phases of the LXRП) provides a forum to discuss and resolve matters relating to the project.

The Infrastructure Coordination Committee, chaired by the Secretary, DPC, provides an opportunity to discuss and inform Heads of Departments of project-related matters to be considered by the Government for decision.

Ultimately, the Government is required to approve the LXRП Business Case, Project Proposals or Works Packages, and funding in order for the project to be delivered.

Figure 9-1: Governance structure – project development



With the Government having approved key decisions (including the scope, budget and procurement approach for the LXRП), the governance focus shifts during the Project Delivery phase to driving performance against key delivery metrics including safety, program and cost to deliver the scope approved in the business case.

Consequently, the key governance group during delivery is the Major Transport Infrastructure Board (MTIB), which has been established by the Government to oversee Victoria’s transport infrastructure program.

If issues arise during delivery in relation to budget and/or major scope items or the benefits to be achieved by the Program, these matters will be brought back to the MPSC. Both the MPSC and the TIPDC will continue to receive high level progress briefings and reports throughout delivery of the LXR.

In addition, DEDJTR has established a Transport Network Delivery Group to share information across agencies including LXRA, Melbourne Metro Rail Authority, PTV and VicRoads. The role of this group is to coordinate disruption and access to the transport network in order to maximise efficiencies across the suite of transport infrastructure projects being delivered.

The following table provides further details about the roles and responsibilities within the LXR governance framework.

Table 9-1: Governance framework roles and responsibilities

Role	Responsibilities
Level Crossing Removal Authority (LXRA)	An Administrative Office within DEDJTR has been established to deliver the LXR. The Chief Executive Officer (CEO) of LXRA reports to the Coordinator General.
Coordinator General	The Premier has appointed the Coordinator-General as Head of the Melbourne Metro Rail Authority pursuant to the <i>Public Administration Act 2004</i> . The Coordinator-General, Major Transport Infrastructure Program, oversees the delivery of the Level Crossing Removal Program as part of a suite of significant transport infrastructure projects. The Coordinator-General works collaboratively with members of the Department's Executive Board and other senior staff and undertakes the role of Coordinator-General in accordance with the Victorian Public Sector values and code of conduct.
Major Transport Infrastructure Board	The Victorian Government has established the Major Transport Infrastructure Board (MTIB) to ensure effective governance in the delivery of its major transport infrastructure program. The purpose of the MTIB is to ensure that project delivery accords with approved business cases and scope and technical requirements, is cost effective, promotes sustainability, enhances community amenity and is consistent with broader transport policy objectives.
Transport and Infrastructure Policy, Planning and Delivery Committee	The Secretary, DEDJTR, has established the TIPDC which is responsible for overseeing the effective governance of the transport portfolio and key infrastructure investment, through clearly defining the strategic directions that will enable economic development and jobs creation, ensuring integrated network planning and close coordination across the transport system areas serviced by DEDJTR, and overseeing the delivery of major transport and infrastructure policies and projects.
Major Projects Steering Committee (During Development)	The Lead Deputy Secretary – Transport is the Chair of the Major Projects Steering Committee (MPSC). The MPSC ensures that projects are developed in accordance with strategic directions defined by the Transport and Infrastructure Policy, Planning and Delivery Committee.
Transport Network Development Group (During Delivery)	The Lead Deputy-Secretary – Transport has established the Transport Network Delivery Group (TNDG) to provide a forum to consider and respond to whole of network risks, issues and interdependencies during project delivery.
Infrastructure Coordination Committee	The Secretary, DPC, has established the Infrastructure Coordination Committee (ICC) to provide whole-of-government oversight of major project development and delivery.



Governance arrangements will be developed for delivery of each package of work as part of the development of Works Package/Project Proposals, all of which will report through to the LXRA Chief Executive Officer.

Contracts that have already been awarded (all of which are Alliances) have Alliance Leadership Teams that will also report through to the LXRA Chief Executive Officer.

### 9.3 Project management strategy

The LXRP will be managed in accordance with the Level Crossing Removal Authority’s Project Management Framework (PMF).

The PMF outlines the principles, plans, procedures and tools to efficiently manage the Program and ensure effective governance. It is based on the mission statement: ‘The Level Crossing Removal Authority exists for the purpose of expertly delivering transport infrastructure projects for the Victorian Government.’ LXRA’s vision is to deliver Great Change by transforming the way Victorians live, work and travel.

The PMF is a dynamic framework intended to always reflect best practice public sector project management.

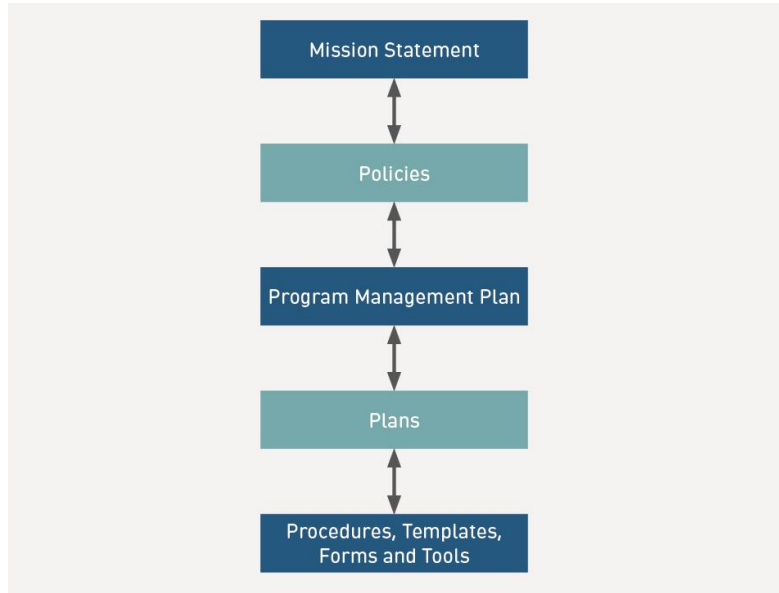
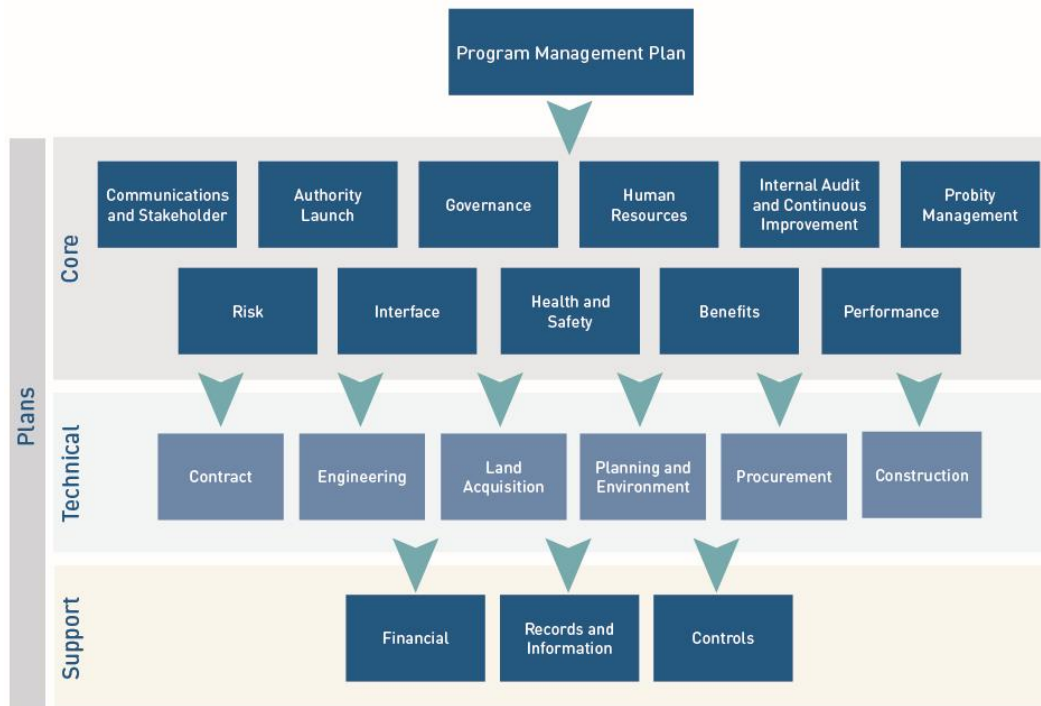


Figure 9-2: Program Management Framework

A Program Management Plan (PMP) has been developed and is an integral parent document to the core technical and support management plans and procedures. These include Communications and Stakeholder, Governance and Risk Management Plans. The plans and procedures specify the minimum requirements that are mandatory across all the individual projects.

Figure 9-3: Program Management Plan



The PMP and the supporting plans and procedures are aligned to LXRA policies, strategies and mission statement.

Core plans ensure that appropriate governance, control and interface management is implemented.

The technical plans are the specialist plans that contribute to the Program throughout the development and delivery lifecycle to ensure that the work packages are designed, constructed and handed over in alignment with the strategic objectives – while considering all necessary regulatory, safety, environmental and quality requirements.

The support plans include financial, records and control management plans and are critical within the project delivery architecture.

A number of procedures, templates, forms and tools have been developed to support the PMP.

## 9.4 Works Package/Project Proposals

This Program Business Case will enable the Government to make budget provisions over the forward program and beyond and to release funding into Central Contingency for all 50 level crossing removals.

Works Package/Project Proposals are now required to secure the release of funding from Central Contingency for future work packages<sup>83</sup>.

<sup>83</sup> Funding has been released for the first five packages of level crossing removals following the preparation of full business cases and/or Works Package/Project Proposals and work is well underway to deliver these level crossing removals.

Work Package Proposals are specific to Program Alliances, whereas Project Proposals must be completed for all other work packages. Each must be approved and be assessed under the DTF High Value, High Risk Project Assurance Framework. Works Package/Project Proposals will only be assessed under the HVHR framework if they are deemed high value (>\$100 million) or high risk under DTF's Project Profile Model (PPM).

The Works Package/Project Proposals will support funding requirements for each delivery package and be developed to align with this Business Case. Works Package/Project Proposals will be submitted progressively to suit the funding requirements of the Program.

***Details Included in Project Proposals & Works Package Proposals:***

- Design development of remaining options informed by further investigations (including but not limited to geotechnical, traffic, environmental investigations)
- A detailed options analysis, which will explain in detail the options considered for each level crossing removal or package of level crossing removals, including stakeholder and community views.
- Development of design options informed and guided by the Urban Design Principles
- The outcomes of the Final Assessment in accordance with the Options Assessment Framework and rationale for the selection of the recommended solution
- A detailed scope description of the recommended solution
- An outline of how the recommended solution contributes to the overall program objectives
- Consideration of interdependencies
- Information on integrated development opportunities
- An outline of constructability issues, staging and timing
- Consideration of Real Options
- A detailed risk and opportunity assessment
- Details of how the benefits identified in the business case are to be measured for the package.
- Information on planning requirements and other approvals
- Gateway reviews will be carried out as required on Project/ Works Package Proposals in accordance with the Gateway Process agreed with DTF.

***Details Included in Project Proposals Only:***

- Proposed delivery model and governance arrangements
- Flexibility will be maintained when describing the recommended solution to allow for the market to respond with enhanced or alternative solutions as appropriate during the procurement process. (Any responses that differ from the recommended solution will be assessed as part of the Market Based Assessment in the Options Assessment Framework.)
- A P50 and P90 cost estimate for the recommended solution and an independent review of the cost estimate.

***Details Included in Works Package Proposals Only:***

- Details of the Target Outturn Cost (TOC)
- Value for Money evaluation and Owner Developed Costs verified by Independent Review.

## 9.5 Risks and opportunities

### 9.5.1 Risk assessment and management

LXRA will manage risk by providing a systemic methodology that supports managers and project team members in making informed decisions and improving outcomes. LXRA’s approach to risk management is based on the guiding principles of AS/NZS ISO 31000:2009 – Risk Management Principles and Guidelines, the Victorian Government Risk Management Framework and the DEDJTR Project Management Framework.

A Risk Management Plan has been developed to provide an overview of the key concepts of risk and issue management and guidance on how the risk and issue management process can be applied practically by the LXRA throughout development, construction, delivery and closure activities (including commissioning and handover) of the LXRP on behalf of the Secretary, DEDJTR.

The plan provides a framework to ensure risk and issues management activities occur in a consistent manner across all stages of the Program. It will be reviewed and updated throughout the Program lifecycle, as outlined within the Program Management Plan (PMP), to reflect the current status of the Program and to ensure it remains a relevant and valuable tool for future management of the LXRP.

Detailed construction risks (including, but not limited to, traffic management and road /rail operation, utility service relocation, noise impacts and environmental issues) will be captured in Project Proposals unless identified to be of higher impact by exception.

The following risk criteria have been used to identify Program risks:

- Risks that may impact the overall duration of the Program preventing the ability to deliver all 50 removals in eight years.
- Risks that may result in the Program budget being exceeded
- Risks that may impact the overall value for money outcome of the program, including integration with other asset programs, quality and sustainability of the assets and overall community support for the program. Risks that need to be highlighted given they may prevent some of the short listed Project Proposal options being feasible. This needs to be highlighted early so that no commitment is made to adopting options for some sites prior to a detailed investigation
- Risks that may result in the need to reallocate other government funding by bringing funding forward or delaying funding.

Table 9-2 provides a list of program level risks that have the potential to negatively impact the delivery program and budget for the 50 sites. Appropriate controls are being implemented to mitigate these risks. As part of the project options development, site specific risks have been identified. The mitigation of site specific risks has been included in the cost estimates.

Table 9-2: Program risks

Risk category	Risk description	Mitigation/Action
<b>Governance</b>	Lack of project governance	Clearly defined and documented LXRA processes and procedures, as described in Section 9.2  Forums have been established for sharing of information across Government projects
<b>Performance Management and reporting</b>	Network and schedule risks pertaining to extensive shutdown along various rail corridors due to simultaneous works	Network operation/ occupation strategy required to inform shutdown requirements, disruptions and options assessments. Coordination with Metro Tunnel, PTV etc.

Risk category	Risk description	Mitigation/Action
<b>Market capacity</b>	Contractors (road & rail) unable to service multiple major construction projects during the current LXRA program resulting in delays and or increased cost	Program to consider market when planning works Procurement packaging strategy to encourage market participation at different levels of industry to maximise participation
<b>Safety</b>	Poor safety behaviours increase the risk of fatality or significant injury during project(s)	Proactive safety management from LXRA and contractors Zero harm approach to safety management and culture development. Procurement models to mandate safety requirements
<b>Community and stakeholders</b>	Proposed level crossing removal solution does not align with Council and local community expectations. Solutions may not align with local structure plan and Council's preferences.	Early consultation with stakeholders and community will be undertaken in accordance with the Stakeholder Management Plans for each delivery phase
	Disruption to local and state transport networks, both public and freight transportation.	Early planning, staging construction and communications strategy
	Disruption to business within local neighbourhood centres.	Early communication with local residents and businesses
	Negative attitudes towards land acquisition.	Early consultation with affected landowners and local communities
	Requested changes in scope as a result of consultation.	Early consultation to understand and manage expectations
	Change in program resulting in not delivering the 50 level crossing removals	Early advice on complementary projects relying on level crossing removals Identification of an exit strategy that will reduce impact to proposed projects
<b>Industrial relations</b>	Lengthy Enterprise Bargaining Agreement (EBA) negotiations resulting in possible delays and/or increased costs	Procurement Strategy to include consideration of workforce sources and strategies to mitigate risk through engagement across multiple parties and any EBA negotiations.
<b>Compliance</b>	State or Federal legislation requirements change during the life of the project resulting in increased scope and cost	Early engagement of statutory authorities to establish a line of communication to enable monitoring of requirements and notification of potential changes
<b>Resources (specialists)</b>	Industry capacity unable to undertake such extensive rail and construction works simultaneously	Early identification of required skillsets and possible shortages Procurement models identify and engage additional resources (if required)
	Competing projects from other states attract resources away from Victoria resulting in delays to program	Early market engagement and industry information sessions to keep them engaged with LXRA Program works. Encourage project teams to develop and implement staff retention plans
<b>Scope</b>	Projects do not cater for future road and rail planning, which may preclude future transport upgrades or provide obstacles that add significant cost	Undertake real options analysis involving early communication with PTV, MTM and VicRoads

Risk category	Risk description	Mitigation/Action
	Need to upgrade existing ageing infrastructure such as power and signalling, beyond what is required for removal of the level crossing, which may result in increased scope/cost.	Early identification of existing assets with PTV and MTM. Determine extent of scope & cost required
	Works at rail crossings do not take into consideration proposed maintenance or project works by PTV and or VicRoads within close proximity to the sites, therefore prolonging impact to residents and commuters	Early investigation with MTM, PTV and VicRoads to identify opportunities to align works
<b>Integrated development</b>	Integrated development opportunities are not implemented, resulting in no revenue to the state	Plan the work as one project with equal focus on core works together with integrated development. Commence early investigations to identify integrated development opportunities. These investigations have already identified opportunities to use adjoining land and capitalise on land use planning proposals.
<b>Approvals (planning)</b>	Planning, heritage, cultural heritage and environmental approval process may delay commencement and in turn delay the overall program	Early identification of planning overlays and their key issues Develop Environmental Management Plan
<b>Utilities</b>	Impact on key utility services that require extensive approvals to relocate or disrupt, resulting in delays and cost increases	Establish LXRA Utilities Group to develop relationships with utility service authorities Early identification of major utilities that require relocation Undertake early works where possible.

Risks are being managed actively for the projects currently underway and under construction. Delivery teams are managing site specific risks and regularly reporting to LXRA project managers.

As the new projects move to the Works Package/Project Proposal phase, the LXRA project teams will identify any site specific risks, mitigation measures and opportunities. These will be described in detail for the recommended solution.

During delivery, each individual project (such as Alliance, Design & Construct and so on) will develop a Risk Management Plan that will determine how it will assess and manage risk for delivery of the works within its scope. These plans will be reviewed and agreed with LXRA.

## 9.5.2 Opportunities

The following high level opportunities have been identified to date:

- Interdependencies with scheduled maintenance works and other road and rail projects are being identified. The identification of these interdependencies will allow for a reduction in costs by coordinating activities such as rail occupations and traffic management, as well as reducing disruption to commuters and local residents. Disruption can be reduced by undertaking project works in 'one hit', eliminating the need to come back and disrupt the network at a later date;
- Workshops have been held with authorities including VicRoads, PTV and MTM to identify other opportunities that could be considered in the scope of the level crossing removals, including making provision for future projects;

- Work has been undertaken to identify opportunities that add value to existing land uses and capitalise on land use planning projects. This opportunity could include collaboration with local government to realise synergies between the LXRA Program and local area strategic plans; and
- Real Options, as described in Section 7.4.

During the development of Works Package/Project Proposals, opportunities will be considered in more detail.

## 9.6 Procurement strategy approach

The Level Crossing Removal Project falls under the Department of Treasury and Finance’s High Value High Risk process. As noted in Section 7.1.2, there are a number of synergies in delivering a program of 50 level crossing removals that can be optimised to achieve efficiencies in quality, time and cost. The procurement strategy approach recognises that these potential synergies will become more defined as further development work on the Level Crossing Removal Project and its individual sites is progressed, and builds in flexibility to capture these synergies through progressive development of detailed procurement strategies that are targeted at packages of work.

### 9.6.1 Methodology

Given the nature of the LXRP, the five step approach adopted is tailored from the DTF Procurement Strategy Guidelines (refer Figure 9-4). For example, as the scope of the LXRP includes removal of 50 level crossings, packaging analysis will comprise a larger component of the approach in comparison to other projects. This is a critical step in achieving value for money outcomes for the state. Works Package Proposals/Project Proposals will be developed for each delivery package, as outlined in Section 9.4.

The five step approach is summarised in Figure 9-4, followed by a description of each step.

This Business Case addresses the first three steps of the process for all remaining level crossing removals. The outcomes of this procurement options analysis is supplemented by Package Procurement Plans which further develop the packaging strategy independently for each package and will cover steps 4 and 5, by validating the assessment undertaken in this Program Business Case and recommending a final delivery model.

Figure 9-4: Procurement options analysis – five step approach



The key requirements for each step are:

**Step 1: Data gathering** – Identify project characteristics and risks and define procurement objectives. The procurement objectives defined in this step will form the basis of evaluation in recommending a delivery model.

**Step 2: Packaging analysis** – Develop packaging value drivers to identify a reference packaging solution.

**Step 3: Delivery model shortlisting** – Assess delivery models and an initial shortlist to take forward for detailed analysis against procurement objectives.

**Step 4: Validation** – Review any new information within the context of the procurement framework and assess other precedent projects under a range of delivery models.

**Step 5: Recommended delivery model** – Recommend a delivery model, based on the preceding steps.

## **Step 1: Data gathering**

### Characteristics and risks

The following provides a high level description of the key characteristics and risks of the LXP relevant to the procurement strategy approach. A more detailed analysis is included in Appendix I.

- The scale of the Program means that a variety of sites with individual design, construction and environmental challenges will need to be managed.
- There are similarities in the scope and construction techniques across the sites, providing the opportunity for work packaging and continuous improvement opportunities.
- A large range of stakeholders with a corresponding large range of issues and potentially competing interests.
- The occupation and access regimes are complex, particularly given the likelihood that multiple level crossing removals will occur concurrently across the entire network.
- Obtaining planning approvals for a large number of level crossing removals will be complex given the number of stakeholders involved and the varying conditions and requirements at each site.
- Australia's strong infrastructure pipeline could create pressure on the supply of skilled resources and materials that could challenge both the Program's budget and timing for completion. This is particularly the case for rail specific skill sets, given the amount of rail work being undertaken in Victoria, NSW and Western Australia.
- The potential disruption to road and rail networks will need to be considered and managed during delivery, particularly when delivery of this project overlaps with the delivery of other major infrastructure projects.
- Optimisation of value capture opportunities.
- Franchise agreements play a significant role in the delivery of the Program.
- Continuous improvement as more level crossing removals are delivered.

### Procurement objectives

Procurement objectives articulate the key outcomes that the selected packaging and delivery method approach should achieve. Determining appropriate procurement objectives will ensure that delivery models are effectively assessed and a tailored approach developed to achieve the LXP's objectives.

Given the scale and complexity of the LXP, procurement objectives have been defined at a high level so that they can be applied across all packages. This facilitates a systematic application across each Package Procurement Strategy, providing a consistent framework throughout the life of the LXP. The high level nature of this framework also allows for consideration of specific issues and differences in characteristics or priorities at the package level.

The procurement objectives were agreed in a procurement workshop in September 2015. The rating of procurement objectives (High, Medium, Low) will occur in each Package Procurement Strategy, as each package has different characteristics and drivers that will place a different level of importance on the procurement objectives. For example, some packages may place a higher level of importance on managing disruption to the rail network whereas others may place a higher level of importance on value capture opportunities. This enables flexibility at the package level to ensure that the ultimate delivery model selected is well tailored to the specific characteristics of that package.

The Program procurement objectives are defined in the table below.



Table 9-3: Procurement objectives for the LXRP

Procurement Objective	Description
Price	The extent to which the procurement approach supports low cost delivery of capital works (whilst meeting specification), efficient risk pricing and maximises economies of scale.
Time	The extent to which the delivery model is able to deliver the Program within the Government's time constraints and provide time certainty.
Continuous Improvement	The extent to which the procurement approach is able to leverage knowledge gained during the Program (continuous improvement and productivity improvement) and potentially apply the learnings to (and from) each package in the Program.
Management of disruption	The extent to which the procurement approach minimises disruption to the transport network and community, including efficient management of the occupations and access schedules.
Value capture	The extent to which the procurement approach delivery model maximises net revenue opportunities from identified value creation or capture opportunities or keeps available value creation or capture opportunities.
Industry capacity and capability	The extent to which the procurement approach optimises LXRA and industry's capacity and capability, including providing clarity for industry to plan and prepare for resource needs.
Risk management	The extent to which the procurement approach supports effective risk management with risk allocated to the party(ies) best placed to manage the risk.

## Step 2 – Packaging analysis

Step 2 considers whether there are Program components that should be delivered separately or together in bundles or packages. Given the scale of this Program, packaging is an important element of the procurement strategy to support effective delivery and to achieve better value for money outcomes.

Constructor market capacity and appetite for risk can place constraints on the size of any individual package, making it important to develop packages that are of a size commensurate with market value, risk management and capability.

This section sets out the reference packaging solution, which has been based on the packaging value drivers.

### Packaging value drivers

The following value drivers have been identified to support the assessment of the packaging options. These value drivers are features of potential packaging options and are expected to drive strong performance of each package option against the procurement objectives.

Table 9-4: Value drivers

Packaging Value Driver	Description
Geographic location	Packaging level crossing removals which are located close together and/or on the same metropolitan rail lines may drive cost efficiencies, economies of scale, minimise disruption and effectively manage occupation schedules.
Construction technique	Packaging level crossing removals based on the expected construction technique (e.g. rail under road, etc.) may drive delivery and cost efficiencies by facilitating economies of scale in design development and technical expertise (including opportunities to apply continuous improvement learnings) and materials supply. This value driver aims to maximise industry capability and capacity.
Development potential	Packaging level crossing removals which are assessed as having high development potential may provide opportunities to leverage delivery approaches tailored for value capture, and may increase the attractiveness of the package, driving innovation.
Interface with broader transport network	There may be synergies in disruption management in packaging works/sites with a high impact on the road or rail network together, streamlining stakeholder consultation processes. Packaging sites with low impacts on the broader transport network may optimise industry capability and capacity (for example, by providing effective opportunities for different tiers of qualified contractors).
Readiness	Packaging level crossing removals based on readiness can drive timely sequencing and completion of the LXR.
Size & scale	Consideration of the size and scale of packages is important to develop options that are attractive to bidders and provide opportunities for economies of scale, which reduces industry bid costs and optimises industry capacity and capability. This includes consideration of a range of package sizes and types that can be put out to tender.

### Strategic Packaging Approach

As outlined within the value drivers, there are various approaches to packaging works. For the LXR at a strategic level, the primary drivers of value to inform the initial approach to structuring delivery are geographic approach and construction technique, as prior experience with level crossing removals indicates that these two drivers have the greatest potential to influence cost and time outcomes and contribute to continuous improvement from package to package.

Accordingly, two strategic level packaging approaches have been considered within the procurement strategy approach, as follows:

- Corridor-based approach that seeks to package works along rail corridors to achieve construction and occupation efficiencies and minimise disruption.

A discipline-based approach that seeks to package like work types across the network to achieve economies of scale and continuous improvement outcomes (e.g. Stations, Power and Signalling works or rail track works).

The following table outlines the key benefits and considerations in each approach:

Table 9-5 Key benefits and considerations

Corridor-based approach:
<p>The potential benefits for corridor-based packages include:</p> <ul style="list-style-type: none"><li>• Creating opportunities for better rail and amenity solutions and efficiency in operations.</li><li>• Achieving economies of scale in design and delivery (e.g. leveraging common occupations, community consultation).</li><li>• The ability to apply innovation to the design and construction across the broader corridor.</li><li>• In some cases, eliminates the potential cost of re-work where level crossing removals on the same corridor are delivered in separate packages at different times.</li><li>• Can reduce interface risk where different packages may be delivered with overlapping occupation requirements or works limits.</li><li>• Given the extent of investment in the rail network programmed over the next five to eight years, a corridor approach better enables the interface with, or addition of, other network upgrades that may be implemented by other agencies.</li></ul>
<p>Considerations in development of this approach include:</p> <ul style="list-style-type: none"><li>• Not all sites may be developed to a level that enables pricing at the same time.</li><li>• Supporting market capacity and inclusion within the size and scale of packages.</li></ul>
Discipline-based approach:
<p>The potential benefits for work type-based packages include:</p> <ul style="list-style-type: none"><li>• Creating opportunities for economies of scale across specific disciplines.</li><li>• Enabling continuous improvement and efficiencies.</li><li>• Efficient use of critical skill sets.</li></ul>
<p>Considerations in development of this approach include:</p> <ul style="list-style-type: none"><li>• Introduction of significant interface risks and stakeholder management complexities.</li><li>• Management of required occupations across the network.</li></ul> <p>Time and physical interdependencies between work elements (e.g. stations as part of bridging works)</p>

### Strategic Packaging Solution

As a foundation for further development of Package Procurement Strategies, the **corridor-based approach** is considered the most effective basis for delivery.

The strategic packaging solution has been developed based on the packaging value drivers listed above and reflects the nature of work undertaken to date. Each Package Procurement Strategy will commence with this as a basis for package and assess further as new information comes to light, such as more detailed scope and risk analysis, changes to industry conditions and continuous improvement lessons learnt.

Further information on the assessment of the strategic packaging solution and supporting rationale is provided in Appendix I.

### Step 3: Delivery model shortlisting

Level crossing removals can be delivered under various models. Delivery models that are widely recognised and/or recently used in the transport sector and which are consistent with the Department of Treasury and Finance's procurement guidelines are listed below. The advantages and disadvantages of each are included in Appendix I.

- **Construct only**

The State is responsible for the full design of the project and will either develop the design internally or engage an external design team to develop the design documentation to Issue for Construction stage. A tender process is then run for the construction phase. The design documentation forms part of the tender specification for this procurement process and the contractor delivers the works according to the specified design for a fixed price (subject to variations).
- **Design and Construct (D&C) – Traditional**

The State prepares a design brief outlining the functional specifications and key user requirements for the works. This is less fully developed than the design documentation required for a construct-only contract. Bidders then nominate a fixed price for undertaking detailed design and construction works that is based on this functional specification.
- **D&C – Risk Allocated**

Same as above, except that during the tendering phase bidders nominate certain risks as being either shared risks between the State and Contractor, or risks retained by the State.
- **D&C – Collaborative**

Variant on the traditional or risk allocated D&C model with an increased focus on interaction and collaboration, with bidders during the procurement phase building on some of the interactive tendering processes used in other delivery models such as dual TOC (target outturn cost) alliancing. This greater emphasis on collaborative planning and scope determination prior to contract award is intended to provide a mechanism for contractor input earlier in the design process and also to increase the level of certainty around the State's specification at contract award to reduce the likelihood of claims or contract variations.
- **Design, Construct and Maintain (DCM)**

A DCM includes an ongoing maintenance obligation from the contractor in addition to the initial D&C delivery.
- **Managing Contractor**

A managing contractor is selected via a tender process and engaged by the State to manage delivery of the full package of works including project management, design, tendering documentation and construction delivery. The managing contractor is paid actual sub-contractor costs and a tendered management fee, which can either be a lump sum or a percentage of actual costs. They may also receive incentive payments for achieving costs and schedule targets.

The managing contractor is engaged early in the process to provide constructability input. The State collaborates with the managing contractor on the design and delivery aspects of the project. The State has the ability to provide input to the design development and the opportunity to influence the design and construction process.

There are many variants of the managing contractor form of delivery. The common variable elements are degree of design, the type of tender process and how the fee and the estimate of the works (that is, the guaranteed maximum price) are finalised.

▪ **Early Contractor Involvement (ECI)**

ECI comprises two phases: ECI phase and Construction phase.

The ECI phase involves the early engagement of a contractor(s) to provide input to the solution development and design process. Selection for the ECI phase is based primarily on non-price criteria, although limited price criteria such as preliminaries and margin may also be considered. The ECI phase may be undertaken with a single contractor or two contractors in parallel.

The construction phase involves the selected contractor delivering the project under a more traditional D&C style contract or an approach to market to price the resulting project solution.

▪ **Alliance**

An alliance approach involves both the State and key stakeholders sharing the risks and rewards of the project. It creates a 'no blame' situation and attempts to create a collaborative approach through strong group culture.

The alliance model can take various commercial forms, being either a competitive (dual TOC) process or a partial price arrangement. A competitive alliance includes two parties undertaking a collaborative interactive tender process with the successful bidder being selected based on price and non-price criteria. A partial price process involves an interactive EOI process, with some elements of the TOC being competitively priced. The reference design and final TOC will be developed with a single selected party, based on their initial response to the EOI phase.

The alliance model can be used to deliver works as a single package ('Project Alliance') or a number of packages/ sites ('Program Alliance'). A Program Alliance enables a longer-term relationship with the ability to progressively develop sites and/or add scope to the program; enabling alliance participants to work collaboratively over time to develop preferred options for the level crossing removals, realise cost savings and implement continuous improvement initiatives.

▪ **Public Private Partnership (PPP)**

A PPP involves a consortium of parties, who are engaged to design, build, finance and operate/maintain the project over a set period of time.

The private sector finances construction and is then paid a service payment by the State over the operating phase.

Preliminary shortlist of delivery models

Infrastructure Australia's five step approach requires the delivery models described above to be shortlisted and to then be assessed against the Program's procurement objectives. The following delivery models have been shortlisted:

- D&C (traditional)
- D&C (risk allocated)
- D&C (collaborative)
- ECI
- Alliance (Project Alliance and Program Alliance)

The rationale and possible project options to be delivered under these models, in light of the procurement objectives for the LXP is included in Appendix I. Final assessment of the delivery models for each package will occur in the relevant Package Procurement Strategy

### **Steps 4 and 5: Validation and Recommended Delivery Model**

Steps 4 and 5 will occur separately in the relevant Package Procurement Strategy.

Step 4 will include the identification of any new information within the context of the procurement framework to review the packaging approach. This may include a reassessment of the strategic packaging solution if new information deems other packaging options more suitable. In addition, step 4 will include an assessment of other precedent projects to help inform the Package Procurement Strategy. This will include an assessment of other level crossing projects that have undergone procurement and delivery phases.

Step 5 will present a detailed procurement options analysis to recommend the most appropriate delivery model for that package. The procurement objectives defined in Section 9.6 will form the criteria for the delivery model options analysis, ensuring systematic and consistent application across each Package Procurement Strategy. As mentioned earlier in this chapter, the weightings of the procurement objectives will differ from package to package, depending on the unique characteristics and priorities in those packages.

## **9.7 Stakeholder Engagement and Communication**

### **9.7.1 Stakeholder identification and early consultation**

Level crossing removals are often high value, high risk projects that involve substantial rail, road, tram and bus disruptions, as well as impacts on busy commercial centres. Each site will require significant management of a number of stakeholders and affected persons, as well as access to different transport networks managed by different parties.

An overarching Communications and Stakeholder Engagement Strategy has been developed for the LXR, which sets out the approach that will be taken to ensure consistent, accurate and timely communications in response to both proactive and reactive issues across the LXR. Further details of the strategy, its objectives and key challenges are provided in Section 9.7.2. Individual Communications and Stakeholder Engagement Plans will be developed for each level crossing site or project package to identify specific issues, risks and communication approaches.

A wide range of stakeholders are associated with the Program, often with competing interests that must be understood and balanced as far as possible. In depth analysis and stakeholder mapping has been undertaken to identify the most appropriate means to engage with relevant stakeholders.

Stakeholder consultation has occurred for the overarching LXR and for the development and assessment of the project options. Stakeholders have provided input, ranging from operational, technical and/or governance perspectives. Consultation to date with key stakeholders are summarised below. Full details of key stakeholders consulted and their current views are included in Appendix J (*redacted*). These stakeholders will have an ongoing role in the LXR and will be engaged further during the development of Works Package/Project Proposals.

#### **Commonwealth Government**

The Commonwealth Government will be consulted as required during development of Works Package/Project Proposals.

#### **Infrastructure Australia**

The approach to developing the LXR has been presented to Infrastructure Australia.

Infrastructure Australia has been informed of the LXR, the approach to assessing value for money across the LXR, rather than for individual sites, and the use of the Options Assessment Framework, which allows flexibility to revisit decisions around shortlisting of options should further information become available.

### **State Government authorities**

Meetings have been held with State Government authorities to introduce the LXR and understand the main interests of these authorities in relation to the Program.

The meetings included representatives from Department of Premier and Cabinet (DPC), Department of Treasury and Finance (DTF), Department of Environment Land Water and Planning (DELWP), Department of Economic Development, Jobs, Transport and Resources (DEDJTR), VicRoads, Public Transport Victoria (PTV), VicTrack, Heritage Victoria (HV), Aboriginal Affairs Victoria (AAV), V/Line, the Environmental Protection Authority (EPA) and Metropolitan Planning Authority (MPA).

These sessions enabled the LXR business case to be developed with input from all key government stakeholders and to ensure their views were considered and, where appropriate, strongly aligned with the development of the scope of the Program. All State Government stakeholders are supportive of the Program.

A number of State Government Authorities (DPC, DTF, DELWP, DEDJTR, VicRoads and PTV) are represented in fortnightly Level Crossing Inter-agency Project Development Coordination Meetings.

The Office of the Victorian Government Architect (OVGA) has provided assistance in developing an Urban Design Framework for the Program, including urban design principles. The OVGA has also provided formal advice on the urban design of projects currently in procurement or delivery.

All State Government Authorities will continue to be consulted during development and delivery of Works Package/Project Proposals.

### **Local Councils**

Local Councils will play a major role in the development and delivery of the level crossing removals.

Initial meetings with Council CEOs were undertaken to outline the LXR, gather feedback and establish an ongoing consultative relationship for developing each level crossing removal. All Councils consulted are generally supportive of the Program.

Further consultation at Council Officer level was undertaken during the planning and assessment of project options. Most Councils advised that further detail on project options would be required in order for Council to provide a formal position on their preferred solution for removing the level crossing. The main issues raised for consideration during further development of project options were:

- Maintaining accessibility to surrounding land uses;
- Minimising land acquisition;
- Privacy issues with overlooking from raised level crossing removal solutions;
- Consultation with local interest groups;
- Provision of pedestrian and cycling links across rail corridors; and
- Opportunities to increase or improve open space.

Councils also identified how the project options might align with existing, draft and future Structure Plans.

Brimbank, Glen Eira, Greater Dandenong, Monash, Maroondah, Manningham and Stonnington Councils have projects that have progressed into procurement and delivery stages. Councils have been involved in the alliance tender process that has informed the proposed design solutions.

### ***Road and rail operators***

Road and rail operators – VicRoads, Metro Trains Melbourne (MTM), Yarra Trams, freight operators, bus operators, Transurban and Australian Rail Track Corporation (ARTC) – have been consulted as part of the assessment of project options. Further consultation on construction and operational issues will be undertaken during detailed development of Works Package/Project Proposals.

### ***Representative organisations and industry associations***

Representative organisations and industry associations – Royal Automotive Club of Victoria (RACV), Bicycle Network Victoria (BNV), Victoria Walks, Bus Association of Victoria (BAV), Public Transport Users Association (PTUA) and Victorian Transport Authority (VTA) – have been consulted to understand their interests and how they want to be consulted as the project progresses.

Victoria Walks provided advice regarding how pedestrians should be considered at and around stations. Bicycle Network Victoria will consider producing overarching principles to be adopted across the Program.

### ***Utility providers***

Utility providers have been consulted during the development and assessment of project options. Further consultation will be undertaken during detailed development of Works Package/Project Proposals.

### ***Community research***

Market research was undertaken to understand community perceptions and expectations of the Program and their information needs with respect to planning and delivery, including preferences for communication channels and involvement in consultation. The research involved 22 stakeholder focus groups and over 1,300 telephone and online surveys. Key results were:

- There is a high level of awareness and extremely strong support for the delivery of level crossing removals. However, awareness of the scope of the Program and the 50 level crossings to be removed could be raised.
- Given there is low awareness of the scope of the Program, the benefits of widespread removal of level crossings are not fully appreciated. Key to this is raising awareness of the scale of the Program and the benefits it will provide to Melbourne.
- There is a desire to understand the sequencing of the level crossing removals. The timing of level crossing removals is complex and needs to be managed across the network, and it is important to communicate how this timing is determined.
- There is a strong desire for information about the level crossing removals, particularly during construction where information about detours and disruptions is essential.

### ***Community surveys***

In early 2015, over 1,600 community members were surveyed to gain a better understanding of community needs, issues and opportunities. These surveys were undertaken across the following eight locations:

- McKinnon Road, McKinnon
- Centre Road, Bentleigh
- Furlong Road, St Albans



- Heatherdale Road, Mitcham
- Mountain Highway and Scoresby Road Bayswater
- Heatherton Road, Noble Park
- Corrigan Road, Noble Park
- Chandler Road, Noble Park.

The main themes of survey responses were:

- Traffic and disruption – Across all level crossings (excluding Centre Road in Bentleigh and Furlong Road in St Albans), the most significant concern was the existing level of traffic congestion and travel disruption. This was often seen to lead to dangerous behaviour, with vehicles and pedestrians illegally crossing the railway line.
- Safety and security – Safety was the most important consideration for survey respondents from Centre Road, Bentleigh and Furlong Road, St Albans. Safety related to passenger safety, in which a small number of respondents cited the deaths of friends and family at the level crossing, or to seeing deaths occur while frequenting the station.
- ‘Hurry up and build it’ – A large number of respondents across the eight level crossing sites expressed frustration at the lack of action to date on level crossings.

Effective consultation with the community will be a fundamental requirement throughout the remaining stages of the Project, including during development of the Works Package/Project Proposals.

### 9.7.2 Communications and stakeholder engagement strategy

An overarching Communications and Stakeholder Engagement Strategy has been developed for the Level Crossing Removal Program and will be further refined throughout the Program’s development and delivery. The strategy is based on identification of key objectives; acknowledgement of challenges in achieving these objectives; and a range of communications tools and activities that will be implemented throughout the different project phases to deliver successful outcomes.

A copy of the Communications and Stakeholder Engagement Strategy and the Strategic Communications Approach, which outlines the proposed approach to communications throughout the various phases of the LXR, is included in Appendix J (*redacted*). Examples of materials and tools used to date are provided in the following sections.

#### **Key Objectives**

The key objectives of communications and stakeholder engagement for the LXR are:

- To deliver consistent and effective messages throughout planning and delivery of level crossing removals regarding the benefits, timing and scope of the project across all sites, throughout metropolitan Melbourne and across Victoria
- To minimise impacts on communities and transport network users through effective communications and community relations
- To productively engage with community and stakeholders on key issues such as prioritisation of level crossing removal sites, viability of design and construction options and additional project features such as value capture and development opportunities
- To challenge preconceptions in the community regarding conventional solutions for level crossing removals (eg. rail under road) by raising awareness of the suitability, desirability and benefits of alternative solutions in appropriate circumstances
- To set a new benchmark for stakeholder engagement through identifying and implementing innovative engagement and communications techniques

## **Key Challenges**

A number of stakeholder management risks and challenges have been identified that will require effective and flexible mitigation strategies. These are considered additional to the traditional construction risks associated with impacts from rail and road closures and construction activities:

- The scale and geographical spread of the project will present challenges in achieving a consistent approach to community engagement for what is essentially a global project with local solutions.
- The expectations of communities and stakeholders in regards to level crossing removal solutions must be clearly understood and managed, particularly if a general perception or preference exists for a particular delivery solution (eg. rail under road). This is likely to be a significant challenge.
- Planning requirements, in particular the added complexity of property development rights opportunities, will require a consultation approach that covers a broader scope than traditional consultation and engagement programs for transport projects.
- Coordination with agencies and other key stakeholders such as local government is fundamental to positive stakeholder management outcomes, and significant efforts are being invested in these relationships to ensure successful delivery.

## **Key Communications and Engagement Techniques**

Achieving these objectives and overcoming the challenges noted above requires a highly sophisticated approach to stakeholder engagement and communications. A range of strategies, tools and communications channels will be utilised as part of this approach

### Interactive tools



3D animation and interactive simulations are being used as a key tool to aid community consultation and provide a visual representation of project solutions. Interactive models will be used at a wide range of community and stakeholder activities to deliver an in-depth understanding of key project features across the program. These interactive models provide real-time opportunities for community members to view proposed design solutions from a range of perspectives. They will be particularly effective when providing visual evidence of how alternative solutions (eg. rail over road) can be delivered in a way that complements existing urban environments and architectural forms. Interactive models will also prove effective in community consultation around representing value capture solutions.

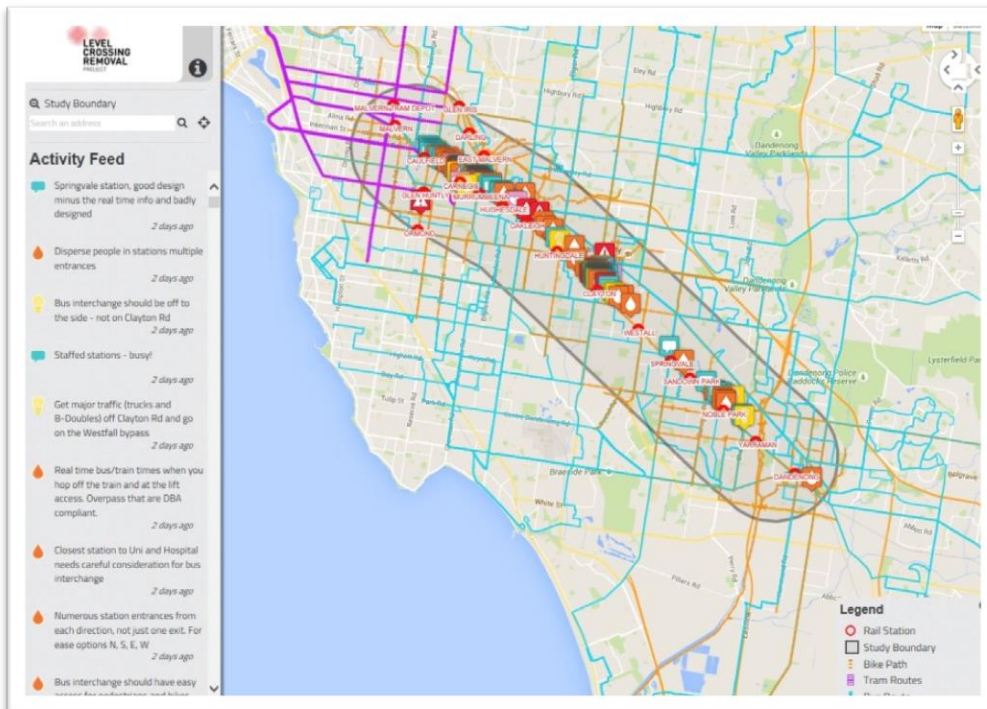
### Online and social media platforms

Online, digital and Social Media platforms will be a significant component of our suite of communications tools. A Social Media Strategy has been developed that outlines how online tools will be used to engage with those interested and impacted by the project. This includes engagement via a project website, but more specifically the use of Social Media channels in the context of the overarching Communications and Stakeholder Relations Strategy. These channels will be used to disseminate information and facilitate public participation in the planning, development and delivery of its 50 level crossing removals. These tools allow us to maintain a responsive and interactive presence with the broader Melbourne public, as well as providing insight into public commentary, perceptions and reactions to the project.



Other key digital tools to be developed will include a smartphone app that provides project-specific updates on milestones, achievements and disruptions and an interactive online map that allows the public to access information, statistics and updates on individual level crossing removal sites. Online engagement has already proven successful as a means of communicating with a wide audience in an interactive manner. The LXRA Facebook page has over 3,400 'Likes' since its inception, with the highest recorded activity reaching nearly 80,000 individuals through a single post in November 2015.

The Communications and Stakeholder Engagement Team has also utilised the 'Social Pinpoint' platform that allows users to comment on specific issues or features within a defined area. This tool has been particularly effective during the consultation phase for the Caulfield-Dandenong project, with over 1,500 comments received through the interactive engagement process.



### Media strategy

An opportunity exists to build on the significant goodwill that resides within the community towards level crossing removals by developing a proactive media strategy that identifies opportunities to engage with key media outlets, commentators and influencers and to promote key project messages that influence positively stakeholder and public attitudes. These opportunities may include briefings to local newspapers on site-specific project details, guided site visits during rail shutdowns or major milestones and key promotional opportunities such as public forums or panel appearances by LXRA personnel. This approach will allow us to raise the profile of the project and to maintain a degree of positive influence over media relations and emerging stories and issues. In addition to traditional media outlets, this strategy will include targeting prominent commentators whose views are already acknowledged and respected.



### Innovative techniques

Innovative community engagement techniques are being investigated and adopted to drive effective consultation outcomes. A research study is being undertaken that will assess world's best practice for delivering complex projects. This will look to identify best practice examples in urban design principles, in gaining consistency across a large number of project sites, in managing stakeholder expectations and in identifying innovative ways of communicating and delivering complex projects. This study will then help to inform our approach to establishing new benchmarks in community engagement.

An example of how this approach has been implemented already is through the Community Tender Advisory Panel that was established during the Caulfield-Dandenong procurement process. This concept has been developed to overcome challenges associated with probity, commercial negotiations and confidentiality which often limit effective public consultation during a competitive tender process. The panel consisted of representatives from the community and key stakeholder groups; the participants were presented with progressively developed design solutions at key points during the tender process to gain an insight into the design options and to provide feedback that bidders will incorporate into their solutions. Concepts around impacts from construction methodologies were also tested with the CTAP group. By having the panel act as a proxy for the wider community, more effective and more widely accepted design solutions can be developed at the critical tender phase. Feedback from the panel members themselves was extremely positive and the bidders responded clearly to the inputs that were provided to help them shape their tender responses.

As part of the key messaging being delivered through community engagement activities, the LXRA teams have been highlighting the need to consider all potential design solutions (rail/road over/under) in order to achieve the best outcomes across all of the 50 level crossing removal sites. This has included a number of activities and visual representations designed to provide clear understanding of how these solutions might be applied in different locations. Community information sessions have contained a series of visual images from projects around the world that demonstrate positive outcomes in terms of functionality, aesthetic appeal, safety, urban design and other features. A significant element of these activities has been to repeatedly and consistently deliver the message that rail over solutions will need to be considered at a number of sites, and that there are significant benefits associated with this option. The LXRA has entered into a partnership with University of Melbourne (see below) which will also assist in providing support for rail over solutions by demonstrating a considered view of the benefits of this option in urban settings.



### ***Key engagement phases***

The stakeholder engagement approach for each phase of the Level Crossing Removal Program will require a tailored solution congruent with the level of detail that LXRA is able to provide at each stage and the degree to which inputs from consultation can be incorporated into project solutions.

LXRA has identified key stakeholder engagement activities during each phase of the Program: planning and development, procurement and delivery. These activities are intended to generate the most effective consultation outcomes within a coherent and consistent communications structure. Specific engagement activities, including the timing of activities and content of messaging and presentations, will be further developed as the Program progresses. (see below example process chart for Caulfield-Dandenong consultation activities).

#### **Planning and development**

Initial activities consisted of CEO-level briefings with local government, followed by further meetings between project teams and Council officers across the 19 municipalities covered by the project. Other stakeholder groups such as Bicycle Network Victoria and RACV have also been engaged at this stage to understand high-level issues and aspirations. There is also a research partnership with University of Melbourne to identify examples of high-quality architectural and functional integration of transport infrastructure into existing urban environments.

A market research study has been undertaken that contained a blend of quantitative and qualitative research in order to understand key community attitudes and perceptions of the Program. This early engagement and

conceptual mapping will help inform the overarching LXP Communications and Stakeholder Engagement Strategy that will guide all activities over the course of the project.

Subsequent community engagement will involve broader public forums that build on the information gathered in early stages and the lessons learned from project delivery in order to deliver the most effective communications around the Program's benefits.

### Procurement

A structured stakeholder and community engagement approach has been developed for packages in the procurement phase, with the Caulfield-Dandenong package (CD9) being the first example of this process. Prior to and during the release of the Expression of Interest (EoI) phase, community 'pop-up' sessions were held at stations along the rail corridor, in conjunction with doorknocks of local traders, to raise awareness of the project. Local MPs were invited to participate.

Briefings to local government were also initiated at this stage. As the process moves into the Request for Proposal (RfP) phase, the stakeholder management approach focuses on three 'streams' of engagement designed to provide maximum value in terms of feedback for shortlisted proponents to develop their designs. These streams broadly consist of:

- Key stakeholder briefings and workshops – structured sessions for proponents to interact with tenderers and communicate key issues
- Community interactive feedback sessions – public drop-in sessions for community members to view design concepts, provide feedback on their key concerns and understand the key benefits and constraints of the Program
- Community Tender Advisory Panel – an initiative designed specifically for the LXP that gives community members and stakeholders a greater level of detail and insight into bidders' design solutions than traditional consultation allows.

Figure 9-5: Project Development and Engagement Phases

## LEVEL CROSSING REMOVAL PROJECT – CAULFIELD TO DANDENONG

### Project development and engagement phases

Phase 1 PROJECT ESTABLISHMENT JUNE-JULY 2015				
What we'll be doing	Engagement objectives	Key stakeholders	General public	Community Tender Advisory Panel
<ul style="list-style-type: none"> <li>Releasing an Expression of Interest for companies to design and build the project under an alliance contract</li> <li>Obtaining background information and technical detail to assist with project development</li> </ul>	<ul style="list-style-type: none"> <li>Explaining the project and contract process</li> <li>Understanding community expectations and concerns</li> </ul>	<ul style="list-style-type: none"> <li>Urban Design Workshops (Council/OVGA/PTV/VicRoads/MPA)</li> <li>Introductory Meetings and Establish Key Contacts (Inc. Monash Health, Monash University, Sandown Racecourse)</li> <li>MP Briefings</li> <li>Council Briefings (Procurement and consultation process)</li> </ul>	<ul style="list-style-type: none"> <li>Pop Ups at key community locations - Handing out 'Register your details' cards</li> <li>Trader Visits - Handing out 'Register your business with LXRA' Cards</li> <li>Community Group 1:1 meetings</li> <li>Newsletter (Full Corridor)</li> </ul>	<ul style="list-style-type: none"> <li>Advertise for Volunteers</li> <li>Terms of Reference Developed</li> <li>Confidentiality Agreements Developed</li> <li>Volunteer screening and interviews</li> <li>Briefing CTAP facilitator (separate to Alliance facilitator)</li> <li>CTAP Group convened</li> </ul>
Phase 2 DESIGN DEVELOPMENT JULY - AUGUST 2015				
What we'll be doing	Engagement objectives	Key stakeholders	General public	Community Tender Advisory Panel
<ul style="list-style-type: none"> <li>Shortlisting two companies to continue through the alliance tender process</li> <li>Obtaining input on issues, impacts and values to assist shortlisted companies with project development</li> <li>Finalising principles to guide the project development</li> </ul>	<ul style="list-style-type: none"> <li>Obtaining input into urban design principles</li> <li>Obtaining input on project issues and impacts along the corridor</li> </ul>	<ul style="list-style-type: none"> <li>Council RFP Workshops</li> <li>Key Stakeholder Meetings (At discretion of bidders)</li> </ul>	<ul style="list-style-type: none"> <li>Interactive Community Feedback Sessions</li> <li>Book prominent community locations</li> <li>Advertisements in local newspapers</li> <li>Promotion via Local MPs</li> <li>Email to contact list</li> <li>Session #1 (Late July-Aug): "Tell us what is important to you in your community"</li> <li>Newsletter Edition 2</li> </ul>	<ul style="list-style-type: none"> <li>CTAP meetings commenced and chaired by Local MP.</li> <li>Location-by-Location: "What's important in my community" (Urban Design Presentation)</li> </ul>
Phase 3 DESIGN REFINEMENT AUGUST-NOVEMBER 2015				
What we'll be doing	Engagement objectives	Key stakeholders	General public	Community Tender Advisory Panel
<ul style="list-style-type: none"> <li>Working with shortlisted companies on their proposed project design</li> <li>Providing an update on key project design considerations and construction impacts for community feedback</li> </ul>	<ul style="list-style-type: none"> <li>Providing an update on project development</li> <li>Obtaining community feedback on key design considerations and expected construction impacts being raised by shortlisted companies</li> </ul>	<ul style="list-style-type: none"> <li>Council RFP Workshops (Evaluation Session)</li> <li>Key Stakeholder follow-up meetings (At discretion of bidders)</li> </ul>	<ul style="list-style-type: none"> <li>Produce public materials in consultation with both consortiums for Session# 2</li> <li>Material reviewed by Internal Review Panel (Legal/Commercial/Probity)</li> <li>Interactive Community Feedback Session#2 (Late August)</li> <li>'Procurement Update' Seeking input on clearly defined design and construction elements currently in development.</li> <li>Newsletter Edition 3</li> </ul>	<ul style="list-style-type: none"> <li>Workshops continued</li> <li>Presentation to group on Procurement Process</li> </ul>
Phase 4 PROJECT DELIVERY NOVEMBER 2015 ONWARDS				
What we'll be doing	Engagement objectives	Key stakeholders	General public	Community Tender Advisory Panel
<ul style="list-style-type: none"> <li>Notifying the preferred bidder</li> <li>Working with preferred to identify specific design elements that will be determined via community and stakeholder input</li> </ul>	<ul style="list-style-type: none"> <li>Explaining the project design and how community input has been incorporated to date.</li> <li>Consulting on specific design elements to be finalised</li> <li>Explaining the impacts expected during construction</li> </ul>	<ul style="list-style-type: none"> <li>Council briefings</li> <li>Key stakeholder briefings</li> <li>Seeking formal input on final design elements</li> </ul>	<ul style="list-style-type: none"> <li>Session#3: Interactive Community Feedback Sessions</li> <li>Trader meetings</li> </ul>	<ul style="list-style-type: none"> <li>Presentation from preferred proponent</li> <li>Facilitated CTAP input into final design elements</li> <li>Opportunity for CTAP participants to continue into MP Stakeholder Liaison Groups</li> </ul>

## Delivery

Stakeholder management for projects currently in the delivery phase is subject to overall governance from the LXRA Communications and Stakeholder Relations Team, with day-to-day community and stakeholder liaison activities the responsibility of the project delivery teams.

Key features of stakeholder engagement in this phase include establishment of Stakeholder Liaison Groups chaired by local MPs as well as ongoing provision of public information around project construction activities, impacts and design features. Particular emphasis is being placed on the prominence and consistency of LXRA branding across all public communications materials including rail passenger communications in order to highlight the volume of work being undertaken as part of the Program. Recent works activities and public announcements have identified a need to raise the level of communications activities to ensure clear, consistent and effective messaging is delivered, particularly as the volume of works (and consequent disruption) is anticipated to increase significantly as projects move deeper into delivery. The LXRA Communications and Stakeholder Relations Team is collaborating closely with PTV and MTM to develop new standards for communications around stations and for rail disruptions generally.

A detailed stakeholder consultation plan will be established for each phase, tailored to address key concerns raised from stakeholders. The detailed stakeholder consultation plans will be unique to each package of works for development, procurement and delivery.

## 9.8 Environmental Considerations

### ***Sustainability***

One of the key objectives of the *Transport Integration Act 2010* is environmental sustainability in developing and managing the Victorian transport system. As part of its Sustainability Policy (Appendix K), the LXRA has adopted four guiding principles:

- Deliver urban design solutions which connect and enhance local communities;
- Manage resources efficiently through embedding energy, water and material saving initiatives into the design and construction of the assets;
- Protect and enhance natural assets by minimising the LXRP's environmental footprints; and
- Future-proof the infrastructure so it is resilient to projected effects from changes in climate.

LXRA has become a member of the Infrastructure Sustainability Council of Australia (ISCA) and the Green Building Council of Australia (GBCA) and is requiring the LXRA projects to obtain independent certification using their respective sustainability rating tools. To ensure the projects deliver infrastructure that is recognised as best practise the projects are required to achieve, as a minimum, an ISCA IS rating of 'Excellent' and a GBCA Green Star for Above Ground Rail rating of '4 Star Green Star'.

### ***Flora and Fauna***

To inform the options assessment described in Chapter 6, desktop flora and fauna studies have been undertaken for all 50 sites. Detailed assessments, including field surveys, will then inform the design of each level crossing removal, and the approvals that are required under Federal (*Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act), or State *Flora and Fauna Guarantee Act 1988* (FFG Act) and *Planning & Environment Act 1987* (P&E Act).

### ***Aboriginal Cultural Heritage***

Based on preliminary investigations, some of the level crossing sites have been identified as having areas of potential aboriginal cultural sensitivity, which will be investigated further as detailed design is undertaken.



The requirements of the Aboriginal Heritage Act 2006 will apply to all packages of work and where required, a Cultural Heritage Management Plan (CHMP) will be developed for each study area.

### ***Post-Settlement Heritage and Archaeology***

Desktop investigations have informed the options assessments for all sites and field investigations will be carried out where required. A limited number of places either on the Victorian Heritage Register or Victorian Heritage Inventory have been identified. All will be subject to the requirements of the Heritage Act 1995, and discussions have commenced with Heritage Victoria in relation to the engineering options being considered.

A strategic approach to heritage approvals and permit conditions is being considered and will be discussed with Heritage Victoria.

There will be heritage places of local significance that will be impacted by the Project. Each of these will be discussed with the relevant municipal council and other stakeholders on a case-by-case basis. Approvals are managed via the relevant planning scheme under the Planning and Environment Act 1987.

### ***Noise and Vibration***

The management of non-construction noise impacts from rail and road infrastructure is governed by two policies:

- The Department of Economic Development, Jobs, Transport and Resources (DEDJTR) “Passenger Rail Infrastructure Noise Policy (PRINP)”, April 2013; and
- VicRoads “Noise Policy” (VNP)

The PRINP will be applied to all projects (even where no planning scheme amendment is required) in order to maintain a consistent approach to noise mitigation across the program of works. LXRA will develop a Guide on noise attenuation requirements to provide a consistent approach to noise attenuation across the LXRA program of works, and apply the VicRoads noise policy where relevant. The application of these policies will result in a project cost, which at this stage is inestimable.

### ***Environment Effects Statement (EES)***

To determine whether to refer the project to the Minister for Planning for consideration as to whether an Environmental Effects Statement under the *Environment Effects Act 1978* is required, self-assessments against the Ministerial Guidelines have been undertaken for the packages in delivery, and will be undertaken for all future packages.

## **9.9 Urban amenity and physical integration of activity precincts**

### **9.9.1 The LXRA Urban Design Framework (UDF)**

Urban design is concerned with making great places. This includes the arrangement, appearance and function of suburbs, towns and cities to ensure a successful urban environment. It is both a process and an outcome of creating localities in which people live, and engage with each other and with the physical place around them.

The LXRA has developed an Urban Design Framework, which sets benchmarks and measures for high quality design outcomes and place making approaches, and a consistent consideration of urban design principles and objectives across the program.

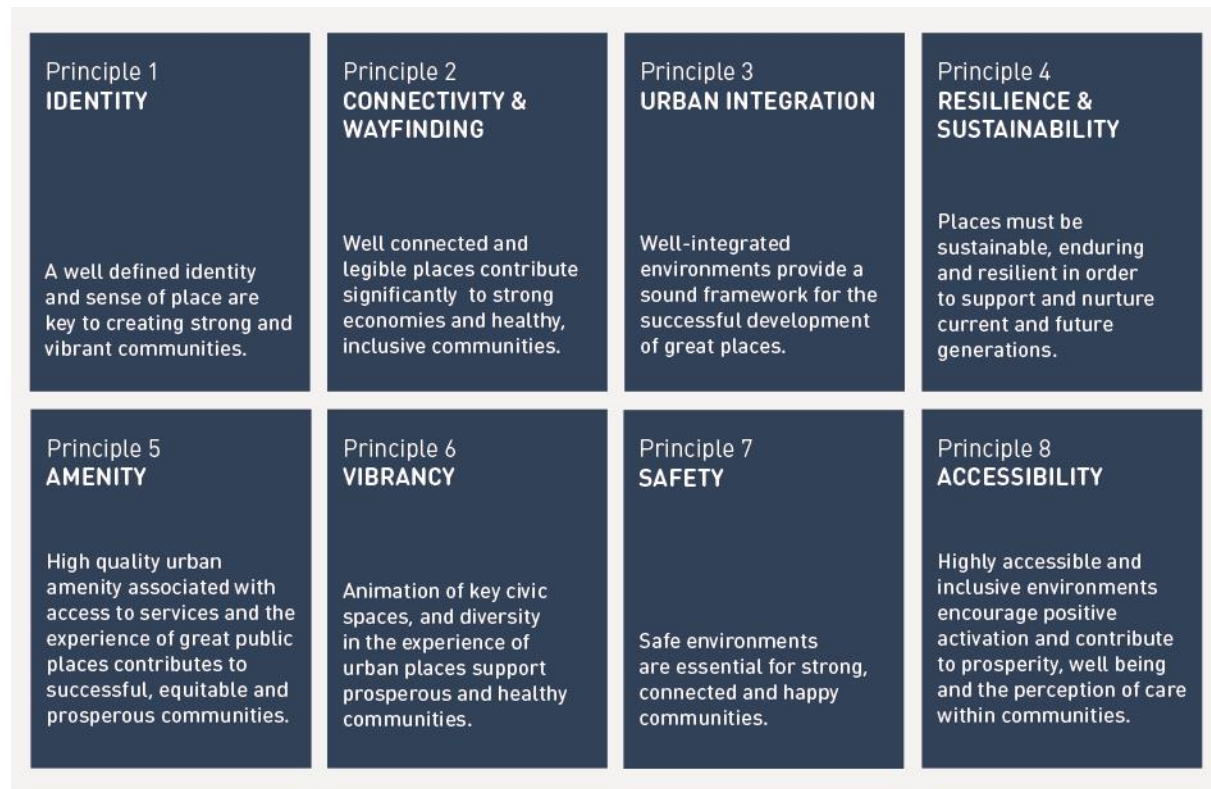
The UDF establishes the expectations of the Victorian Government and local governments for high quality, context sensitive urban design outcomes from the LXRP. It aims to achieve a high quality urban design response that enhances urban amenity and minimises any adverse impacts resulting from the proposed project and its associated structures and development.

The role of the framework is to guide the planning and design and delivery of the proposed project infrastructure, and to evaluate urban design outcomes and value capture opportunities. The principles, objectives, local considerations, measures and qualitative benchmarks articulated in the UDF are provided to:

1. Ensure proposals are developed with good urban design considerations treated as integral to project solutions
2. Articulate the basis for the urban design review team to provide feedback during the interactive bid process
3. Support the RFP evaluation criteria for urban design, including value capture
4. Establish the minimum quality expected by the state in terms of performance outcomes and benchmarks for quality.

Rather than providing prescriptive urban design solutions, the UDF articulates what is to be achieved in terms of urban design quality and performance. It lays out eight broad principles, as shown below, each of which is associated with a set of more specific objectives. The framework is provided as Appendix L

Figure 9-6: Urban Design Framework principles



## 9.9.2 Capturing urban design opportunities through grade separations

The level crossing removal options described in Section 5.2 have different impacts on the functionality and amenity of surrounding areas.

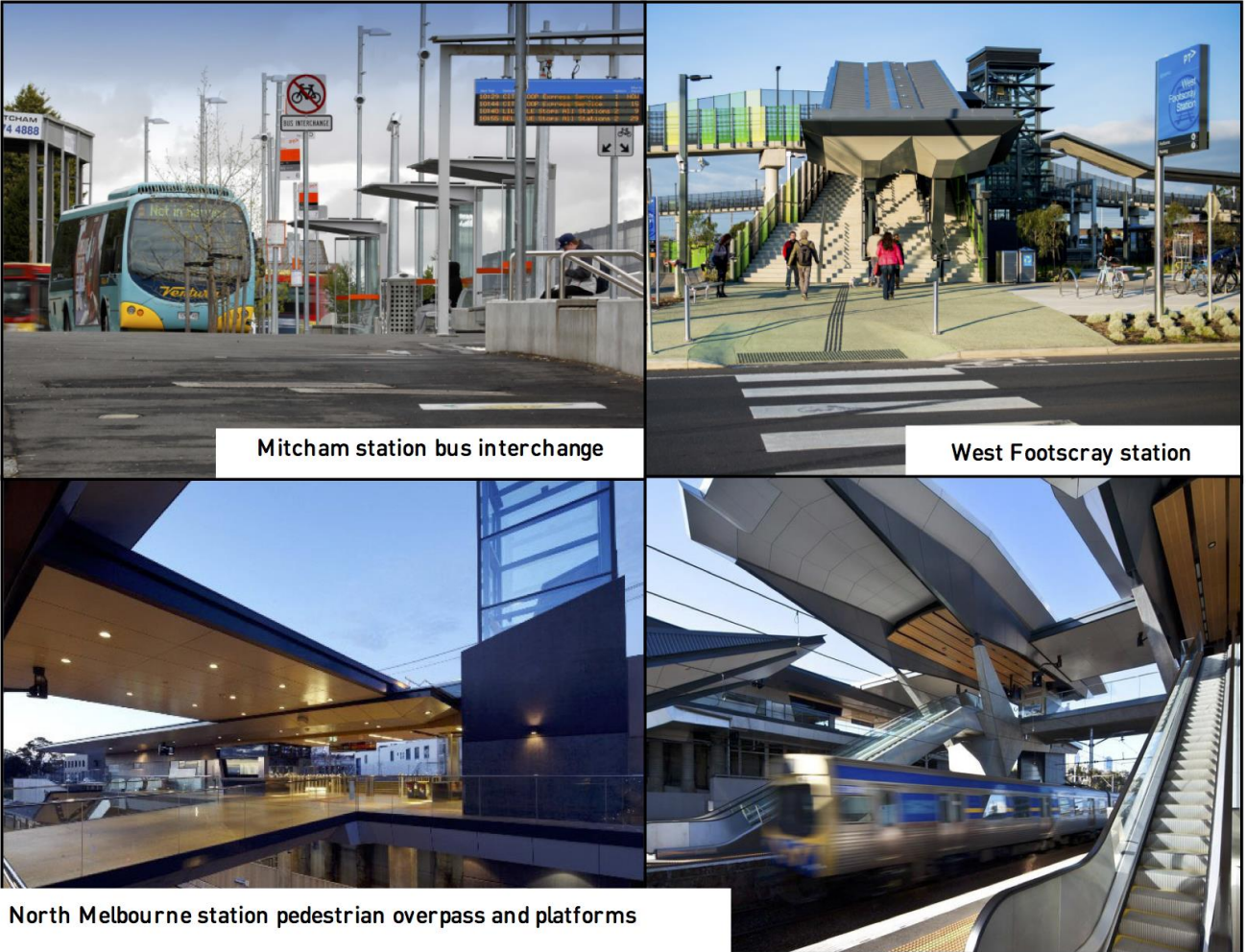
Road-over-rail bridges or road-under-rail cuttings, for instance, can in some instances isolate minor roads from the major crossing and make traversing the tracks for pedestrians more difficult than crossing at-grade. Rail-over-road bridges can have positive and negative outcomes: they may create more crossing points under the rail line (improving permeability), but may be deemed visually unattractive or may overshadow nearby houses.

Many of these potentially negative impacts can be mitigated by good design – by incorporating additional elements into the project to avoid noise issues or visually unattractive structures or spaces and consideration of pedestrian movements and permeability at the outset. These might include noise attenuation treatments, architectural ‘sleeving’ of rail overpasses (to minimise noise and visual impacts) and making use of space under bridges or over tracks wherever possible.

Design elements aimed at improving amenity in recent grade separation proposals have included:

- Larger/open concourses with station functions facing the street
- Elevated ceilings to obtain high levels of natural light and clear views
- Incorporation of local streetscape materiality into concourses through the introduction of paving materials currently employed by councils
- A landscape strategy that considers how to retain and enhance, where possible, the trees, landscape and recreational uses that lie beyond the immediate station precinct affected by the location of the railway
- Better integration of train stations with the surrounding area, and better linkages and pedestrian permeability, particularly in activity centres.
- Design and treatment of the barriers, balustrades and elements that are an essential part of the construction and safety of the precinct to ensure that these are in keeping with the local character

Figure 9-7 Examples of urban design treatments



### 9.9.3 Urban realm improvements

The process of redesigning stations allows the identification and implementation of opportunities to better integrate stations with their surrounding areas and to improve safety, land use and local amenity along with transport outcomes.

The UDF includes principles and objectives that will further the goal of improving the urban realm in conjunction with the level crossing removal, with a focus on creating better connected, more liveable and thriving communities.

For example, the objectives associated with the principle of Connectivity and Wayfinding – improving connectivity, seamlessness (ease of movement between spaces), legibility and public transport (inter-modal connections) – provide the opportunity to greatly improve the attractiveness of public transport and the conditions for pedestrians.

These are both integral components of connected and thriving communities. The principles and their associated objectives will be considered in the development of reference designs, and further reinforced in the preparation of Works Package/Project Proposals. Site-specific solutions that improve the urban amenity and physical integration of activity precincts and communities along rail corridors will be developed in consultation with local councils and the community, and will be further analysed by an urban design review panel.

While the particular design elements that best furthers these principles and objectives will depend on the site context, design features from recent level crossing removal projects that act to improve the urban realm include:

- Shifting bus stops and taxi waiting areas to reduce interchange walking distance
- Pedestrian and activity centre integration across railway lines which historically have been separated
- Provision of additional short-term kiss & ride facilities and taxi zones
- Providing integrated bicycle storage
- Provision of new pedestrian operated signals, to improve safety and access to the stations as well as connectivity for the community
- Provision of retail tenancies to maximise use of station space and fill gaps in retail provision and active frontages in commercial settings.
- Laneway retail on lanes adjacent to the station
- Building office space above the station on the street front, with office lobbies located to activate the surrounding street.

#### Improving Safety Outcomes

Safety Outcomes in the vicinity of stations are not solely a function of the existence of a level crossing. Station precincts are often in complex traffic environments and the design of roads and cycle and pedestrian routes affects safety.

Removal of a level crossing removes one major risk, but the redesign of stations, public transport interchanges, pedestrian crossings, parking and local streets as part of the project creates an opportunity to further improve safety outcomes. Embedding a process in the design of works that ensures the right perspectives and expertise are considered is critical.

## 9.10 Delivery

### 9.10.1 Timelines and milestones

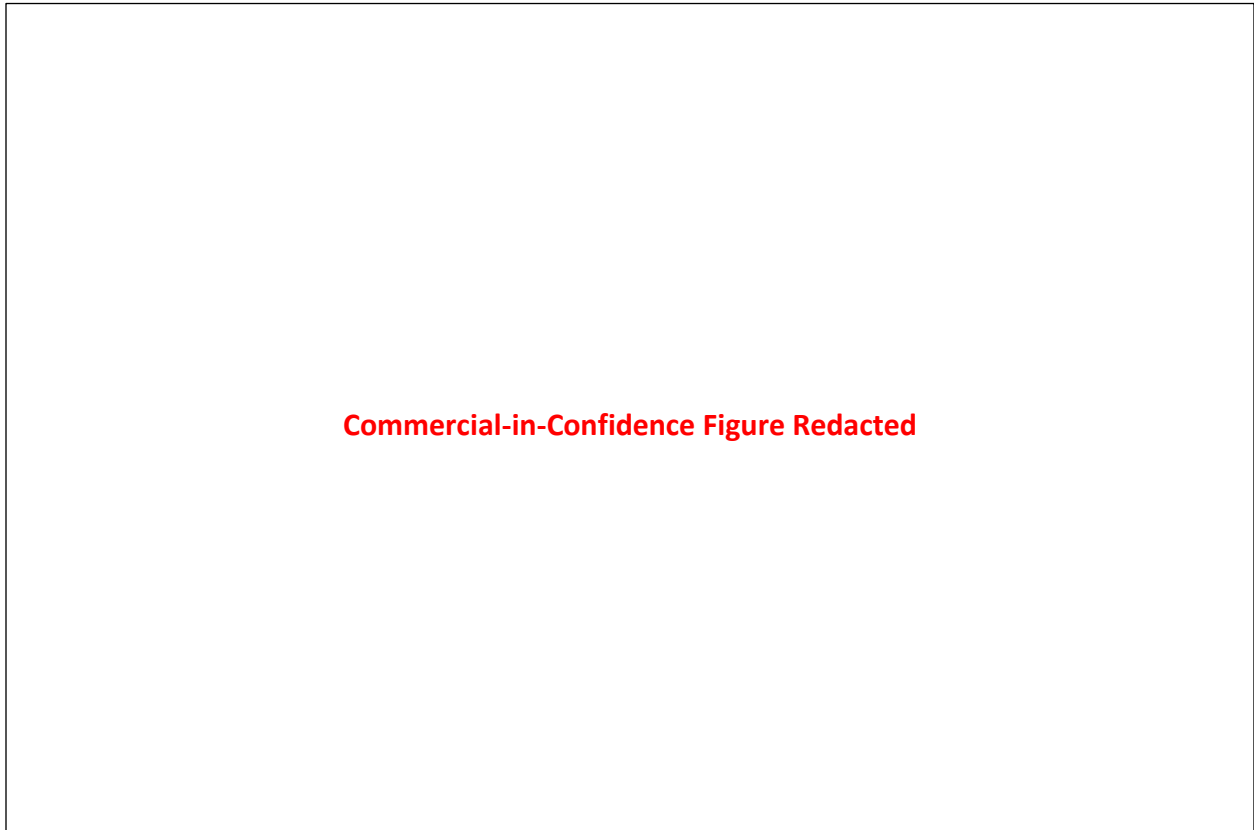
The Victorian Government has committed to deliver the program of 50 level crossing removals in two terms of government, or by 2022. This commitment also includes the delivery of 20 level crossing removal projects within its first term in office, or by 2018.

The typical time from planning to completion of construction for the removal of a level crossing is up to three years. This includes business case development, planning and environmental approvals (both State and Federal), community consultation, land acquisition and procurement. This time will be condensed by adopting a program approach and preparing an overall planning strategy for the Program. As noted throughout this business case, significant time and cost reductions can be achieved by packaging grade separations, and multiple packaging options are available for the Program.

This business case is based on the packages and programs developed for the first 20 sites, with a 'reference' timing and 'reference' packaging for the remaining 30 sites. LXRA will continue to develop the packaging and timing during the development of the Works Package/Project Proposals.

Detailed programs have been developed for the delivery of all level crossing removal projects currently being delivered or in procurement. A high level program for removal of the first 20 sites is shown below.

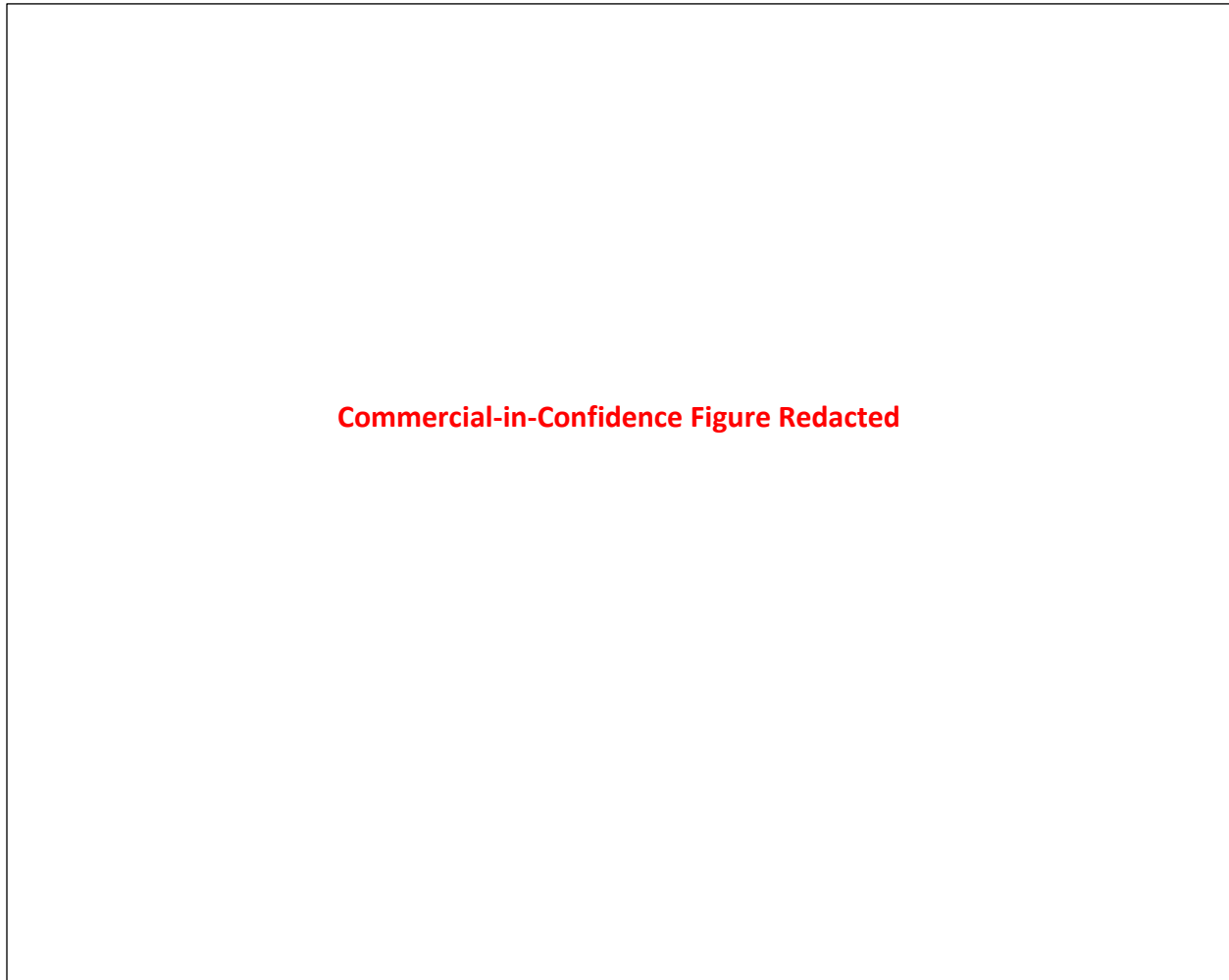
Figure 9-8: Program for 20 level crossing removals



The indicative timing for the remaining 30 sites is shown below (which forms a Reference Case used to establish Project Costings). Ways to reduce time will be considered during the development of Works Package/Project Proposals for these 30 sites, including packaging of preconstruction activities, consideration of legislative options to increase certainty of times and alternative procurement models and approval mechanisms to reduce procurement time frames.

Detailed programs will be developed for each delivery package as part of the development of Works Package/Project Proposals.

**Figure 9-9: Program for 30 level crossing removals (Reference Option/ Packaging Only: Used as a basis for Program Appraisal and Costings)**

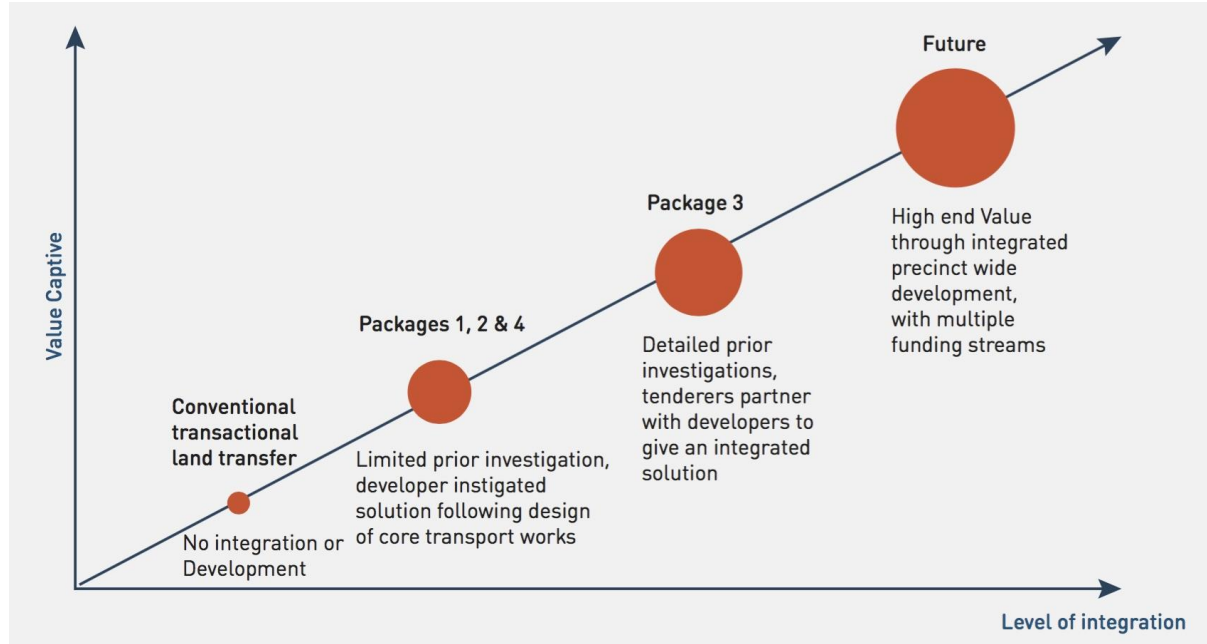


## 9.10.2 Value Capture Delivery

LXRA has prepared an Integrated Development Opportunities and Urban Renewal strategy to guide its approach to delivery of integrated development opportunities (IDO) within its core grade separation works.

The strategy has been prepared in response to strategic insights from the value capture experience on the first level crossing removals and lessons learnt from national and international value capture project insights. LXRA have to date experienced a broad spectrum of value capture approaches, driven to a large extent by the necessary timing and acceleration of project planning. The LXRA Value Capture spectrum and the phase consideration of value capture is illustrated below.

Figure 9-10: LXRA Value Capture Spectrum



The LXRA experience to date and the future approach to Value Capture procurement will be informed and guided by appropriate risk management on a case by case basis. The strategy will continue to evolve as the principles are tested through feedback from the market.

Effective use of the value capture requires new thinking and approaches to level crossing removal project planning including:

1. understanding how to identify which priority projects present significant value capture opportunities;
2. understanding how project planning, design, procurement and delivery may be optimised to both create additional benefits and capture a proportion of their value;
3. the use of high quality commercial leadership and appropriate capability to ensure that value capture planning, design, procurement and delivery, as well as stakeholder engagement, are effective - development of expert multi-disciplinary teams to integrate infrastructure options that generate value through innovative strategic planning, commercial and development opportunities; and
4. developing governance strategies and agreements to lock in value capture revenue streams for the delivery of the infrastructure.



### ***Developing Project Proposals / Value Capture Governance - Investment Lifecycle and High Value/High Risk Guidelines (HV/HR)***

The Government has in place well established processes for identifying and delivering projects to meet the service needs of the Victorian community. These processes are detailed in the Investment Lifecycle and High Value, High Risk Guidelines (HVHR) (Investment Lifecycle Guidelines). LXRA has developed a Value Capture Framework designed to supplement rather than replace existing departmental processes and the Investment Lifecycle Guidelines.

The various stages at which the Minister for Public Transport, Premier and Treasurer's approval are required, including value capture activities is outlined in Figure 9-11.

Each core infrastructure project requires a tailored value capture approach, comprising flexible, iterative design and an interactive planning and decision making process.

The approach to value capture to date and in the future includes:

- a) Site Identification Analysis for future level crossing removal locations undertaken by LXRA's Property Development Consultants. This analysis will consider core infrastructure design and corridor constraints plus local and adjacent land use context, master planning, community needs and scope to contribute to improved urban amenity.
- b) Design options analysis for those sites identified to have medium to high opportunity for integrated development and value outcomes. This will consider the constraints of the core infrastructure delivery and operations requirements.
- c) Engagement with local government Stakeholders of medium to high value IDOs to further inform design and market appetite for retail, civic, residential and commercial development at each site.
- d) Works Package/Project Proposal and detailed feasibility analysis of reference options and any other options revisited during the Works Package/Project Proposal stage.
- e) Maximising IDOs and urban renewal across the program has the potential to alter the design of core infrastructure on the basis that more benefits are achieved resulting in an overall net gain.

### ***Implementation risks***

The LXRP will typically introduce some added complexities that may create additional project execution risks if not properly managed. In terms of planning, this value capture strategy provides a robust and consistent approach to:

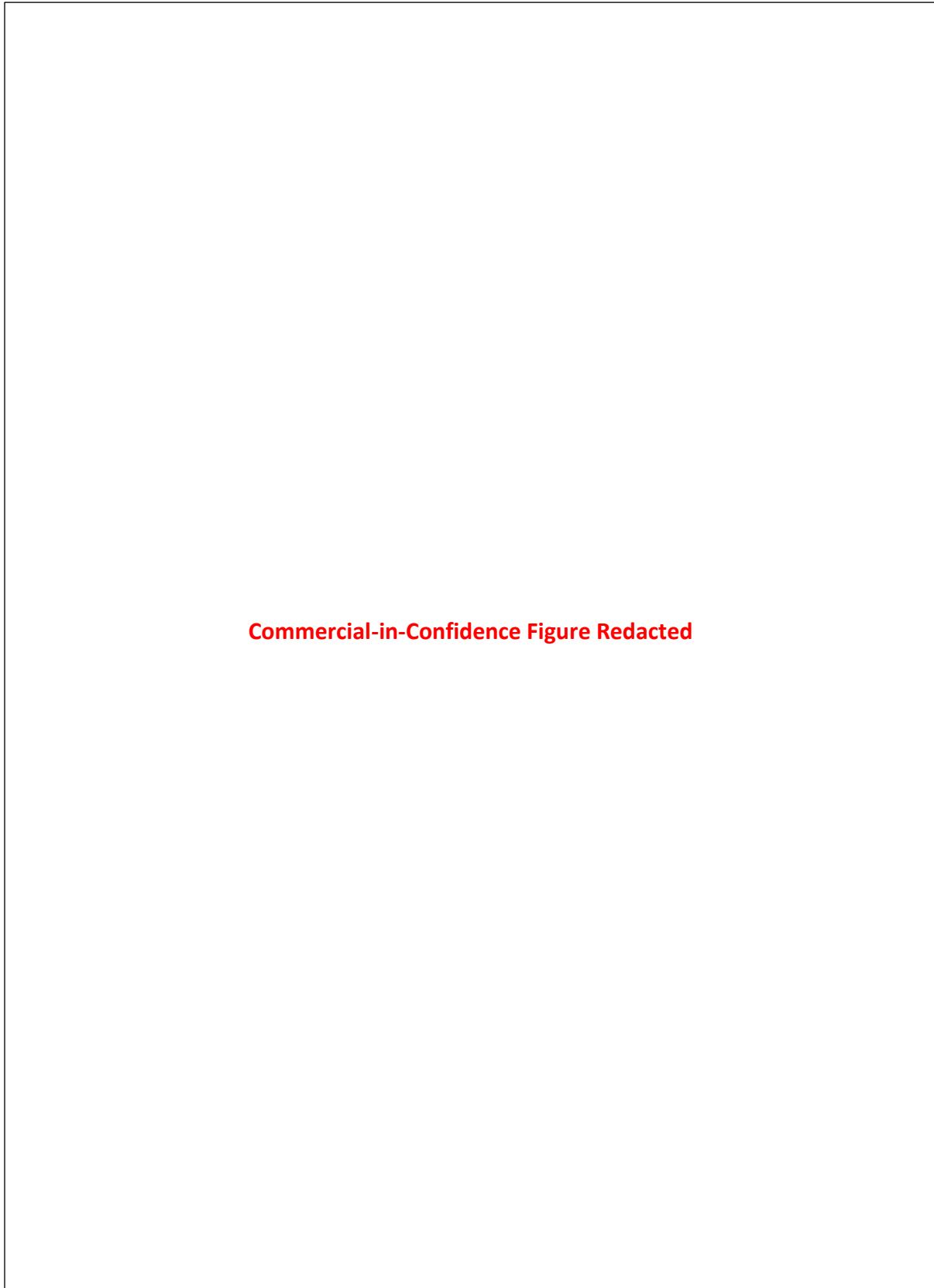
- Potential for a lack of coordination – because value capture relies on the integration of land use, transport and urban planning, there is scope for sub-optimal outcomes driven by a lack of integration of these disciplines.
- Jurisdiction mismatch – value capture necessitates close cooperation between different levels of government (mainly State and local). Conflicting priorities and project objectives can make agreement on a project challenging, and may increase project risks.
- The focus of the value capture approach is on how to optimise benefits or value from the level crossing removals projects. While much of this value will flow from the planning, scope, design and delivery of the project, there may also be a need for behaviour change interventions in certain circumstances.

### ***Experienced multi-disciplined team***

The success of the value capture initiative will require enhanced capabilities within departments and agencies in order to optimise project designs to create additional benefits and associated revenue opportunities alongside the traditional transport infrastructure benefits.

As a result LXRA has established a multi-disciplined team of lateral, cross-sectoral practitioners to consider options that generate value that can be captured through innovative strategic planning, commercial and development opportunities.

**Figure 9-11: LXRA Value Capture Framework (Project Proposals Only)**



## 9.11 Performance measures

An Investment Logic Map (Section 2.2) and a Benefit Management Plan (Appendix B) have been developed for the LXRP. The following key performance indicators will be used to demonstrate benefits of level crossing removals:

- Network efficiency
- Reliability of Travel Times on the road and rail network
- Public transport network improvements
- Economic productivity
- Local area amenity
- Infill land developments around rail corridors
- Access to jobs, education and services
- Public Transport Intermodal connectivity
- Frequency and severity of incidents
- Exposure to risk

Baseline data will be collected prior to each level crossing removal project entering the construction phase. A detailed Benefit Management Plan will be prepared as part of the Works Package/Project Proposal, which will outline the baseline data and targets for each delivery package of level crossing removals.

## 9.12 Exit strategy

The LXRP is one of the Victorian Government's key transport commitments and therefore a detailed exit strategy has not been developed. Should this initiative not be endorsed by the Expenditure Review Sub-Committee for full funding, the Government's ability to fulfil its commitment to remove 50 level crossings in eight years is unlikely to be met.

Because the 50 level crossing removals will be procured progressively in packages over eight years, procurement and early works activities can be terminated for any one of these packages prior to entering into binding contract agreements for delivery.

In the event the Project is not delivered, the implications on other interrelated projects will need to be considered. These implications include:

- The full realisation of benefits of other projects will be compromised if these level crossings are not removed.
- The proposed CPLU project includes additional rail services and therefore a significant increase in boom gate down times is expected. If level crossings are not removed, the reliability of road connections across this rail line will deteriorate, leading to increased congestion on these road corridors and increased community severance.
- The untangling of the central rail network being proposed by the Metro Tunnel allows for the unlocking of capacity on the existing rail network. If level crossings are not removed across the network, utilising this unlocked capacity by running extra services will increase severance for the road network that will impact in turn on road transport services, including on-road public transport and freight.

A reprioritisation of the 50 level crossings could be undertaken if a limited or staged program was considered. This would reduce the impact on other transport projects currently underway, but would allow some of the public transport and road benefits to be delivered.

## 9.13 Signoff

The detailed signoff for this business case, including the Independent Cost Reviews, is included in Appendix O (*redacted*).

## 10 Acronyms & Terms

Acronym	Description
ABS	Australian Bureau of Statistics
BCR	Benefit Cost Ratio
BITRE	Bureau of Infrastructure, Transport and Regional Economics
Burnley Cordon Group	Lilydale Line, Glen Waverley Line, Belgrave Line, Alamein Line
Burnley Group	Glen Waverley Line, Alamein Line, Lilydale Line, Belgrave Line
Caulfield Cordon Group	Frankston Line, Pakenham Line, Sandringham Line, Cranbourne Line
CBA	Cost Benefit Analysis
CBD	Central Business District
CD9	9 level crossings being removed from the Caulfield to Dandenong rail corridor
Clifton Hill Cordon Group	South Morang Line, Hurstbridge Line
Clifton Hill Group	South Morang Line, Hurstbridge Line
CPLU	Cranbourne Pakenham Line Upgrade
Cross City Group	Stoney Point Line, Sandringham Line, Williamstown Line, Frankston Line, Werribee Line
Dandenong Group	Pakenham Line, Cranbourne Line
DDA	Disability Discrimination Act 1992
DEDJTR	Department of Economic Development, Jobs, Transport & Resources
DELWP	Department of Environment, Land, Water and Planning
DTF	Department of Treasury and Finance
EPA	Environment Protection Authority (Victoria)
Evening Peak	The period between 4pm – 6pm on a weekday

Acronym	Description
FY	Financial Year
Gateway	<p>DTF's Gateway review process examines projects at key points (Gates) in their development to provide an independent assessment of the project's current progress and assurance that it can proceed successfully to the next stage. The process aims to ensure that the best available skills and expertise are deployed on the project; that stakeholders fully understand the issues involved; that time and cost targets are realistic; and that government investments achieve value for money. The process is delivered by the Department of Treasury and Finance.</p> <p>Gate 1 – concept and feasibility                      Gate 2 – Business Case                      Gate 3 – readiness for market                      Gate 4 – tender decision                      Gate 5 – readiness for service                      Gate 6 – benefits evaluation</p>
HCV	Heavy Commercial Vehicle
HVHR	<p>High Value/High Risk. An investment is HVHR if:</p> <ul style="list-style-type: none"> <li>· total estimated investment is greater than \$100 million, regardless of funding source; and/or</li> <li>· the investment is identified as 'high risk' using a risk assessment tool; or</li> <li>· Government identifies the investment as warranting extra rigour.</li> </ul> <p>HV/HR projects are also subject to Gateway reviews.</p>
IDO	Integrated Development Opportunity
ISCA	Infrastructure Sustainability Council Australia
LAC	Local activity centre
LCV	Light Commercial Vehicle
LX	Level crossing
LXRA	Level Crossing Removal Authority
LXRP	Level Crossing Removal Project
MAC	Metropolitan activity centres
MCA	Multi-Criteria Analysis
Metro Tunnel	The Metro Tunnel Project (also known as Melbourne Metro)
Morning Peak	The period between 7AM – 9AM on a weekday

Acronym	Description
MTM	Metro Trains Melbourne
NEC	National Employment Cluster (as identified in Plan Melbourne)
Northern Cordon Group	Upfield Line, Werribee Line, Craigieburn Line, Sunbury Line, Williamstown Line, Flemington Racecourse Line
Northern Group	Upfield Line, Craigieburn Line, Sunbury Line
PT	Public Transport
PTV	Public Transport Victoria
RCIS	Road Crash Information System
Reference Option	One of the options, as presented in this Business Case, to be taken forward to the Final Assessment phase. The Reference Option has been selected to inform the funding envelope to deliver the LXR. It is a feasible option to remove the level crossing but not necessarily the only option.
Recommended Solution	The outcome of the Final Assessment phase, undertaken during the development of Works Package/Project Proposals.
SCATS	Sydney Coordinated Adaptive Traffic System
TMF	Train Maintenance Facility
UDF	Urban Design Framework
VITM	Victorian Integrated Transport Model

# 11 Appendices

The following is a list of Appendices to this business case. Appendices are contained in a separate volume.

- A Evidence of the Problem
- B Benefits Management Plan
- C Assessment of Delays at Level Crossings
- D Transport Modelling – *redacted in full due to commercial sensitivity*
- E Options Assessment Framework
- F (Not Used)
- G Cost Estimates – *redacted in full due to commercial sensitivity*
- H Program Appraisal – *redacted in full due to commercial sensitivity*
- I Procurement Strategy
- J Strategic Communications Approach and Council Consultation Summary – *redacted in full due to commercial sensitivity*
- K LXRA Environmental Investigations and Sustainability Policy
- L Urban Design Framework
- M Combined Appraisal of the Level Crossing Removal Project, Cranbourne-Pakenham Line Upgrade and the Metro Tunnel – *redacted in full due to commercial sensitivity*
- N Gateway Review Report – *redacted in full due to commercial sensitivity*
- O Sign Off Sheets – *redacted in full due to commercial sensitivity*