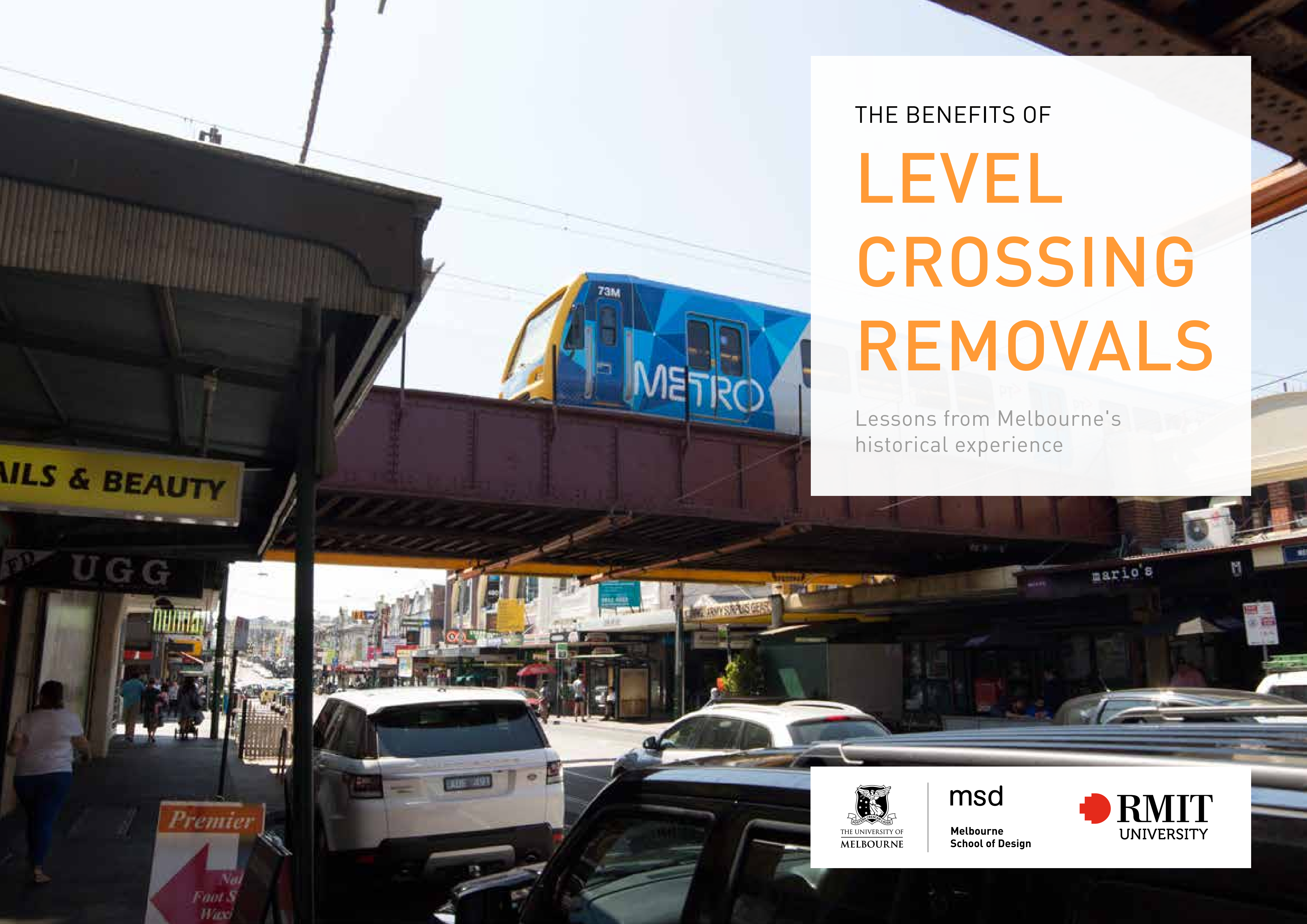

THE BENEFITS OF

LEVEL CROSSING REMOVALS

Lessons from Melbourne's historical experience

THE UNIVERSITY OF MELBOURNE

msd
Melbourne School of Design

RMIT UNIVERSITY

THE BENEFITS OF LEVEL CROSSING REMOVALS:
Lessons from Melbourne's historical experience

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PREFACE

This research is part of our on-going investigations of public transport futures for Melbourne.

Since 2005, we have worked with many colleagues and with our students at the University of Melbourne and at RMIT to incorporate understanding of the technical and operational requirements for effective public transport networks into contemporary architectural and urban design processes. Much of this work has been supported by a large cohort of industry partners in state and local government, and in the private sector. Its directions have been set though research made possible through Australian Research Council grants.

In 2012, we turned our attention to the experience of passengers in and around stations. We wanted to know how station design could best contribute to greater public transport use by encouraging pedestrians and cyclists, improving bus-train interchanges, and creating space for socially useful urban development.

Through the *Transit for All project*, funded by the University of Melbourne's Carlton Connect Initiative and our industry partners, student designs for new stations across the Melbourne suburban rail network were used to stimulate critical debate among the public and private sector networks of professionals responsible for much of Melbourne's recent work on new stations and level-crossing removals.

We began that project with an agnostic position on the relative merits of rail-under or rail-over options for level-crossing removals. However, after reviewing the work produced over three iterations of our design-research process, it became clear that elevated rail had some distinct advantages over the typical 'trenched-rail' designs being constructed around Melbourne.

We are grateful to the Level Crossing Removal Authority for their support, which allowed us to continue this independent research in 2015. The results of some of that work are contained in this peer-reviewed report. It is offered as a contribution to the public debate on level-crossing removals and, more widely, on the re-vitalisation of Melbourne's public transport systems.

John Stone
Ian Woodcock

EXECUTIVE SUMMARY

The Victorian state government has committed to removing 50 level crossings in two terms of office: a faster rate of removal than in any other period in the history of railways in Melbourne. These level crossing removals have the potential to be more transformative of Melbourne public transport system than the tunnels for the Melbourne Metro project, and indeed, are a crucial pre-requisite for that project to deliver its benefits. Melbourne's historical experience of separating railways from roads shows that some types of level crossing removal have been more successful than others

To assess the likely impacts of any design for a level crossing removal, we employ a set of criteria that include connectivity, amenity, safety, economic development, future proofing potential, disruptiveness, and total value proposition. Significantly, our analysis focuses on assessments of the role that grade separations can play in improving intermodal transfer at railway stations. A major consideration in the performance of transfer nodes is their capacity to integrate, connect and serve the local community. Enhancing network effects is key to improving public transport access for all Melburnians and grade separations have a key role to play in this.

The study analyses the four main types of road-rail grade separations (elevated rail, trenched rail, road overpasses and underpasses) and assesses their effects using specific case studies (Glenferrie, Canterbury, Balaclava, Malvern, Mitcham, Springvale, Oakleigh, Huntingdale, Essendon, Middle Footscray and Anderson Rd., Sunshine). We found that road overpasses and underpasses have had serious detrimental effects on activity centres, however large or small, and should therefore only be considered in locations that are outside urban areas. Elevated and trenched rail grade separations were found to have been used where the focus was on improving railway performance, and provide the best opportunities for achieving efficient intermodal transfer. However, in terms of the overall range of criteria that need to be met, elevated rail provides the greatest potential for the full range of long-term benefits to be realised from the significant capital investments in grade separations.

The benefits of level crossing removal include:

- greater potential for multi-scale economic and social development related to increased activity around stations;
- the restoration rail's prominent position in the urban fabric;
- increased ground level connectivity;
- creation of linear parks and connected quiet streets for safer walking and cycling;
- opportunities for the fundamental re-organisation of Melbourne's bus system and its connection to the rail network. In fact, without such re-organisation, it is unlikely that the patronage growth expected from Melbourne Metro will ever occur.
- Improved passenger experience, views and wayfinding.

Realising these opportunities depends on the design quality of level crossing removals. The simple choice is between raising or sinking rail lines, and in many places, well-designed elevated rail will better deliver the benefits outlined above.

CONTENTS

INTRODUCTION

The state government's level-crossings removal project offers Melbourne as great an opportunity to transform its transport system as the CBD tunnels of the Melbourne Metro project.

Far from merely removing (or just relocating) annoying, disruptive, and unsafe suburban traffic bottlenecks, the project provides unique opportunities for changing the shape of Melbourne and the ways we move and connect.

LEVEL-CROSSING REMOVAL CAN:

- Maximise the potential for multi-scale economic and social development based on increased activity around stations
- Restore rail's prominent position in the urban fabric

In this report, we explore Melbourne's historical experience with removing level crossings.

Rather than a new beginning, the current program of level crossing removal projects represent an acceleration of a process that goes back more than a century.

Surprising to many, Melbourne already has a long history of living with elevated rail. Elsewhere in Melbourne, planners have chosen to put rail in a trench; and, for some time in the 1960s, they experimented with separating road and rail by building large road overpasses.

We have analysed the performance of a sample of Melbourne's past level-crossing removals and their surrounding precincts using parameters ranging from pedestrian connectivity to economic vitality. This analysis provides a basis for debate about the design of projects being developed in this new and accelerated phase of level-crossing removals across Melbourne.

Image: Nicola Inskip

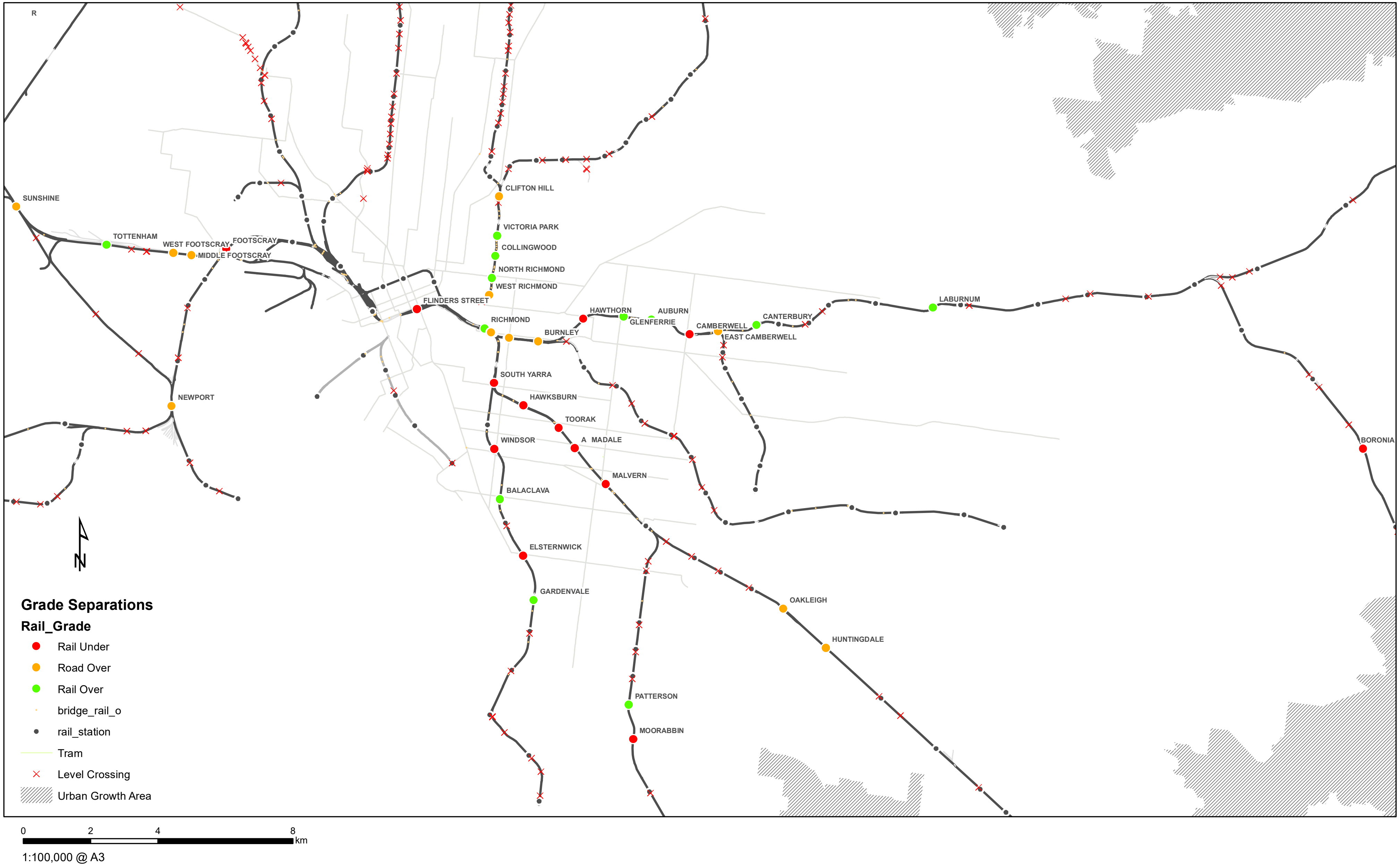
- Create linear parks and connected quiet streets for safer walking and cycling

- Be a catalyst for fundamental re-organisation of Melbourne's bus system and its connection to the rail network.

The extent to which these opportunities can be realised depends on the way level crossings are removed and their design quality. Simply put, we have a choice between raising and sinking the railway, and, in many locations, building well-designed elevated rail gives a better outcome.

Note: While this report explores the separation of road and rail, there are many examples across Melbourne of raised or sunken rail crossing for pedestrians. Most require users to tackle steep steps, long ramps or narrow underground passages, and few could be considered to be good urban design. Some recent examples, built as part of the Regional Rail Link, do perform better. However, a full exploration of design principles for grade separated pedestrian rail crossings is outside the scope of this project. In any case, direct, 'at grade' pedestrian access is the ideal, and this is in most circumstances best achieved through elevated rail.

ROAD-RAIL GRADE SEPARATIONS IN MELBOURNE 2015 (adjacent to stations only)



FUTURE TRANSPORT CHALLENGES

Melbourne faces major challenges in planning for future transport demand. As Australia's fastest growing capital city, Melbourne's population is projected to double over the next 30 or so years, passing 8 million by 2050.

In recent years, public transport patronage has risen at a faster rate than population growth, while growth in car use, for the journey to work at least, has stabilised (Mees and Groenhart 2012). This trend towards public transport will need to accelerate if we are to avoid a complete overloading of the road system as population rises. Growth targets for public transport use will have to be set much higher than the rate of population growth.

To understand the implications of such changes, comparisons with current experience are useful. For example, with a trebling of public transport use, suburban stations such as Murrumbeena, or Cheltenham would experience patronage volumes comparable to those currently experienced at a station like Richmond, while Frankston, Glen Waverley or Essendon's patronage would be comparable with current levels at Flagstaff in the CBD.

To enable the growth in passenger numbers required to allow the planned Melbourne Metro rail system expansion to reach its full potential, new ways of travelling between home and station will need to be found. There are simply not enough residents within the walkable catchments of rail, even with increasing densities (Lawrie and Stone 2015: 14).

For travel beyond walking distance, increasing the number of arrivals to the station by car is simply not feasible. Already, PTV (Public Transport Victoria) surveys show that unconstrained demand for parking at stations is typically five times or more what is currently provided, and, if most people were to drive to the station, it would be impossible to build enough car parking without burying the station precinct in concrete. Even with intensification within the walkable catchment of stations, most of the new rail passengers will have to come by bike or by bus.

Stations, adjacent streets and car parks will need to be retrofitted to make transfers from bike and bus efficient, convenient and safe. The removal of level crossings provides the perfect opportunity to get this right.

Cheltenham Station

Richmond Station

PUBLIC TRANSPORT NETWORK PLANNING PRINCIPLES

The context for level-crossing removals

The key to successful multi-modal public transport in a large, dispersed metropolis like Melbourne is what transport planners call the 'network effect'. The 'network effect' is the improvement to efficiency and effectiveness achieved by integrating multiple modes of mass transit into a single network. In short, network planning allows transport agencies to achieve a positive return on investment in new services by increasing patronage at a faster rate than the cost of increased service supply (Thompson et al 1976; Nielsen et al 2005; Nielsen and Lange 2008; Vuchic 2007; Mees 2000, 2010).

The requirements of this approach are two-fold.

1. Create a simple and stable inter-connected network of public transport lines throughout the day with a structure and timetable that is easy for users to learn and understand.
2. Accept and support the proposition that many, potentially even a majority of travellers will need to transfer between services to access their selected destination (Mees and Dodson 2011, p. 25

In their review of the literature, Mees and Dodson (2011, pp. 3-4) identify five key practices that support network planning:

a. simple and direct network structures
b. hierarchically planned lines
c. high service quality (fast, reliable and frequent)
d. co-ordinated and convenient transfers
e. clear, consistent and inclusive information and marketing.

While all of these five practices are essential to the effective operation of an intermodal mass transit network, it is the nature of the transfer nodes or 'interchanges' that is the focus of this report.

One of the key aspects of the network approach is that it can provide high levels of mass transit service to the dispersed and low-density forms of urbanisation that predominate in Australian cities. Successful examples of network planning are found in low-density urban environments, such as Toronto, Vancouver and the rural and suburban hinterland of Zurich and Vienna.

Mees and Dodson also concluded that there were significant shortfalls in service provision and mode shares in Australian cities compared to what could be achieved if network planning was properly implemented. This is particularly the case for Melbourne, the only one with extensive train, tram and bus systems. Despite their spatial extent, these systems have mainly been conceived, planned and managed separately rather than as complementary modes within an integrated network. The establishment of PTV in late 2011 is part of an attempt to facilitate such integration. However, the benefits of network integration must compete for attention against politically attractive expenditure on new infrastructure, and this is one of the tensions in the public discourse around improvements to public transport in Melbourne.

Grade separations can play a major role in enhancing network performance within the broader issues of station design, station access, and better integration of stations into the surrounding urban form (Coxon, Burns and DeBono 2008; Maher and Skinner 2011; Semmler and Hale 2010; Hale 2011, 2013; Hale and Miller 2012; Hale and Eagleson 2014; Curtis and Scheurer 2012; Charles and Galiza 2013; Woodcock and Wollan 2013).

Grade separations have traditionally been approached from two perspectives. First, and primarily, level crossings are conceived as a safety issue (Hughes 2003; McPherson and Daff 2005). Second, they are seen as a problem for motorists and pedestrians in terms of congestion and access (Taylor and Crawford 2009; Lill and Kane 2012). These two issues feature prominently in the political rhetoric about level crossings and the need for their removal.

A third perspective that has only recently begun to gain prominence is the constraint level crossings can have on timetabling and on improving service frequencies for trains. On busy rail lines, peak-hour rail services can result in severe road congestion because of the length of time boom gates are down. Running more trains would exacerbate this situation. We also understand that rail timetable planners attempt to minimise boom-gate delays by having trains from opposite directions pass each other at the level-crossing. This constraint means that opportunities to reduce waiting times for transfers between services can be lost.

A fourth, and rarely observed corollary of long boom-gate closures is that buses and trams also get caught up in congestion. The invisibility of this problem reflects the still marginal status of mass transit in mainstream Australian urban planning culture. At the same time, many transport planners advocate the single most cost-effective way to significantly improve access to public transport in Melbourne is to re-arrange bus routes and run more frequent services over longer periods of the day and weekend. This is because buses cover the largest geographical area and run on existing roads. Other transport planners have suggested expansion of the road-based light rail network. Both options to substantially improve access to public transport are severely constrained by the large number of level crossings across Melbourne.

About two-thirds of Melbourne's level crossings restrict the flow of road-based public transport, and level crossings make intermodal transfers difficult at about half of the interchange stations in the metropolitan area.

The level-crossings removal program offers opportunities to resolve issues of road-space priority and efficient bus-rail interchanges in ways that significantly improve the performance of our transit system as an efficient network. Although the 50 currently proposed by the Victorian Government are a good start, almost twice as many will ultimately need to be removed to allow the full potential of network planning allow for a quantum leap in access to and use of public transport.

	Population in region (millions)	Transit agency region (km^2)	**Tripmaking** (unlinked, per capita)	**Service-km** (bus + tram + train-km, per capita)	**Trips/ service-km**
Melbourne	4.05	2,200	**116**	**35.4**	**3.3**
Sydney	4.3	2,600	**119**	**37.4**	**3.2**
Munich (MVV)	2.5	5,470	**241**	**34.8**	**6.9**
Zurich (ZVV)	1.45	1,840	**399**	**53.8**	**7.4**

Benefits of the 'network effect': efficiency of public transport in Australian and European cities: 2009/10

STONE 2011, *Can successful European models of public transport governance help to save Australian cities?*, Proceedings of 5th State of Australian Cities Conference, November 2011, Melbourne

URBAN DESIGN & PLANNING PRINCIPLES

LAND USE AND TRANSPORT INTEGRATION

For several decades, Melbourne's metropolitan strategic plans have been based on a set of fundamental premises: in aspirations if not in implementation. Despite their apparent superficial differences, these plans are all built around ambitions for economic efficiency and growth, liveability and sense of place, equity and accessibility.

The plans acknowledge that achieving these ambitions requires better integration between public transport and land use coupled with good urban design. The consistent intention has been to limit horizontal expansion of the metropolitan area and focus development around high-quality, effective public transport in order to reduce our reliance on fossil fuels, lessen carbon pollution (and other noxious emissions) and at the same time, create more lively public places, increase social capital and improve public health by increasing levels of physical activity.

Much of the policy and public discourse around achieving these ambitions rests on a belief that improved public transport requires a dramatic increase in residential densities across the whole metropolitan area. If this were true, it will be a very long time before improvements to public transport could ever be justified. International research shows, however, that this focus on the supply of denser dwellings to provide the demand for improved public transport is misguided. Rather, research and international experience shows that efficient and effective public transport networks can operate in Melbourne's current suburban environments and that rapid retro-fitting of such networks can lead development and land-use changes in positive ways that support the improved public transport.

GOOD URBAN DESIGN

Good urban design is about creating lively, safe and pleasurable public places. There are well-established principles for achieving these outcomes. Such places have a mix of uses to draw a diversity of people to them throughout the day. They are easily accessible on foot, bicycle and public transport and relatively free of vehicular traffic. To achieve a good mix of uses, these places need to have many small and fewer large buildings and commercial spaces to ensure that independent businesses can thrive alongside larger franchises and accommodate diverse uses such as libraries, community and civic spaces, educational and recreational facilities.

Ground-level connectivity is at the heart of good urban design and this is sometimes referred to as 'permeability'. This essential quality of a lively public place is about maximising pedestrians' choices about how they move through public space, and minimising distances between points of major interest. Intrinsically linked to connectivity is the economic and social activity that produces the 'buzz' of a lively, safe public space. The more permeable or connected a place is for pedestrians, the more likely that shops and cafes and other services will thrive because of the number of passers-by.

These principles can be seen at work historically in the fine-grained street patterns found in the older parts of cities world-wide, and most clearly in the laneways and small streets in the centre of Melbourne. The interior planning of shopping malls is based on these principles, too, which is why they are such successful commercial environments.

The same need for good ground-level connectivity applies to the design of residential areas so that inhabitants have

Public transport is fundamentally about pedestrians

the choice to walk or ride and to take the shortest routes for access to school, recreation and social activities, not just for shopping and for work. Railway lines built 'at grade' severely limit ground level connectivity, an effect known as 'severance'. In many suburbs with railway lines, the only places to cross the tracks safely are at level crossings on roadways that can be between one and two kilometres apart, sometimes more.

Disconnection between communities can remain even after road-rail grade separation, sometimes becoming worse, sometimes improving, depending on how it is carried out. This can have negative impacts for residential areas as well as retail and commercial areas that rely on accessibility for pedestrians. It can also constrain accessibility to recreational facilities and public open spaces close to railway lines. As a rule, ground-level connectivity should never be reduced, and the aim should always be to improve it as much as possible to 'future proof' the area to maximise the potential for future change, economic growth and social participation.

ACCESSIBILITY TO AND BY PUBLIC TRANSPORT

The aim of metropolitan strategic plans for Melbourne (and similarly, for all other Australian state capitals and major cities) has long been to create places with good access to public transport. It is a fundamental aspect of public transport that all passengers at some point in their journey will be pedestrians. This is where planning principles for good urban and public transport design come together. Enhanced accessibility involves designing stations, interchanges and individual stops with the needs of pedestrians uppermost. This includes safety and amenity considerations that require the proximity of public transport modes to each other, as well as to places that offer activities such as retailing, refreshments and a wide range of recreational, health and community services.

While access to good public transport from home is an aim, once someone has made the choice to travel on public transport, when they leave the train, tram or bus, they are pedestrians. This means that to make public transport viable, as many different activities as possible should be available within an easy, safe and attractive walk of railway stations, or via a transfer to another journey on public transport.

The implications for integrating land use and public transport are clear. Rather than being merely facilities for efficiently moving passengers on and off trains, stations in particular need to be conceived as key nodes in the network of public places where economic, cultural and social exchange occurs (Mayor of London 2002; Coxon et al 2008; Maher and Skinner 2011; Hale 2013; Woodcock and Wollan 2013). There is a long history of such an approach in many parts of the world such as Canada, the UK, Europe and Japan, where policy and

Advertising business opportunities surrounding Glenferrie Station, 1918.

practice has been more focused on actual integration of land use with public transport. It is also not a new idea for Melbourne, it has simply been overshadowed by many decades of car-focused planning. Many of Melbourne's early railway stations and town centres show evidence of this kind of planning, with Glenferrie Station being one of the best examples of integrating space for retailing and refreshments into the station design when the Hawthorn to Camberwell corridor was grade separated and upgraded in 1918.

In short, it is clear that the issues that need to be considered when establishing relative priorities for level-crossing removals go well beyond simple measures of local congestion and road safety. The multi-criteria Australian Level Crossing Assessment Model (www.alcam.com.au) can help with this task, but optimisation of public transport performance needs to be included, as do important urban design criteria, as we will discuss below.

MELBOURNE'S HISTORY OF GRADE SEPARATIONS

Melbourne has long had one of the most extensive passenger railway systems in the world. This was one of the reasons for its early expansion and its relatively low density compared to its nineteenth-century contemporaries. Most of the important engineering work in building such a large rail system was done in the first fifty-odd years after the railways began in 1863, with many expansions and upgrades along the way involving grade separations and additional tracks to improve railway operations. However, in the last hundred years, maintenance, upgrade and grade separation work slowed down, with only around 40 level crossings being removed.

Today, Melbourne has over 170 level crossings, of which the current state government plans to remove fifty within eight years. This is a faster rate than at any time in the history of Melbourne's railways. Currently, across Melbourne's passenger rail system, there are 228 places where railways have been separated from roads. Over two-thirds of these grade separations were done between 1863 and 1918, an average rate of three grade separations per year. In the subsequent period up to 2015, the average rate of level crossing removal slowed dramatically to much less than one per year. By comparison, the current state government plan to remove level crossings is equivalent to a rate of over six per year, every year, for eight years.

There are some important distinctions between the types of road-rail grade separation that have been used in Melbourne. These reflect major shifts in how people move and in policy priorities. Prior to 1950, public transport in all its forms, but especially rail (along with cycling and walking) was the primary mode of transport. After 1950, with the post-war shift to automobility, public transport, cycling and walking dramatically declined, reaching their lowest point in the 1980s. Since then, they have become increasingly popular again, though they still have a long way to go to achieve the prevalence they once had.

Transport mode shares not just a matter of personal preferences, though the way they are discussed may make it seem so. The legacy of the post-war shift in planning, urban design and infrastructure priorities has created a city where many Melburnians, like Australians everywhere, have no choice but to drive. To become a more equitable city in terms of access to employment, education, healthcare and recreation, substantial improvements in public transport and facilities for cycling and walking must be implemented so that everyone enjoys the range of choices about transport currently enjoyed by a privileged few in Melbourne, but are taken for granted in cities such as Berlin, London, Zurich and Tokyo.

Flinders Street viaduct, circa 1910. Source: Museum of Victoria

New Railway Bridge, Auburn Road, 1916, after re-grading

Armadale Station, 1910 after re-grading

Improving rail operating efficiency: Elevated or trenched rail

In most cases, in particular those grade separations carried out prior to World War II, the motive for separating rail lines from roads was to improve the capacity and efficiency of rail operations. Mostly, this involved elevating or lowering the railway line to remove steeper gradients that limited train performance. Improvements involving track duplications and other additions were made to whole corridors not just one-off level crossing removal projects. Once the vertical alignment of one section of railway is changed, the requirement for shallow track gradients influence conditions over long distances.

Also, in situations such as the corridor between Hawthorn and Camberwell, or South Yarra to Caulfield, where roads were closely spaced, re-grading the tracks entailed removing a series of level crossings all at once. Similarly, when the Hurstbridge and South Morang lines were extended from Victoria Park to Flinders St., the entire corridor was constructed as grade separated, mostly as elevated tracks on embankments. When the Glen Waverley Line was constructed by extending the railway from East Malvern, the entire corridor was grade separated with a combination of elevated and trenched sections as necessary for the optimal grading of the line.

Thus, the history of level-crossing removal and station redevelopment in Melbourne is marked by an early preference for elevating lines and stations on embankments or lowering them in wide, landscaped trenches or 'cuttings' to allow roads and tramways to cross them unimpeded. These types of grade separation occurred mainly in affluent suburbs in Melbourne's east and southeast. They have mostly left attractive urban design legacies.

Good examples of elevated rail grade separations can be found at the following stations: Glenferrie, Auburn, Canterbury, North Richmond, Newmarket, Balaclava, Gardenvale and Patterson. Likewise, good examples of early trenched grade separations can be seen at: Hawthorn, Camberwell, South Yarra, Hawksburn, Toorak, Armadale, Malvern and Windsor.

Pedestrian ramps, Oakleigh Station, due to discontuance of ground level connectivity after level crossing removal (2015)

Pedestrian underpass, Oakleigh Station (2015)

Improving road traffic flows: road overpasses

In the 1950s and 1960s, with the rise of the road engineer and the shift of planning priorities towards the car in general, grade separations that changed the road levels relative to the railway become more common, in particular, road-over-rail grade separations or 'overpasses'. Notably, these grade separations that changed the level of the road were engineered for the benefits they provided to traffic flows and were not usually part of projects to improve rail operations, since they generally left the tracks untouched.

These overpasses have had largely disastrous results for local suburban centres, exacerbating disconnections already caused by the surface rail tracks.

Examples of this type of grade separation can be seen at: Oakleigh, Huntingdale, Clifton Hill, Sunshine, Broadmeadows and Newport. At all of these sites, pedestrian access was grade separated above or below the line, with no level access retained, making it more difficult to cross the railway for walkers and cyclists.

Springvale Station, after re-grading beneath Springvale Road 2015

Nunawading Station, after re-grading beneath Springvale Road (2015)

Recent trenched rail

More recently, grade separations have typically involved lowering the tracks into narrow trenches lined with rough concrete walls and anti-suicide fences. Compared to historical designs, these trenches have little landscaping potential and add to the ground-level disconnection of communities due to the high costs of building over them, and, in some cases, involve the loss of existing at-grade pedestrian crossings.

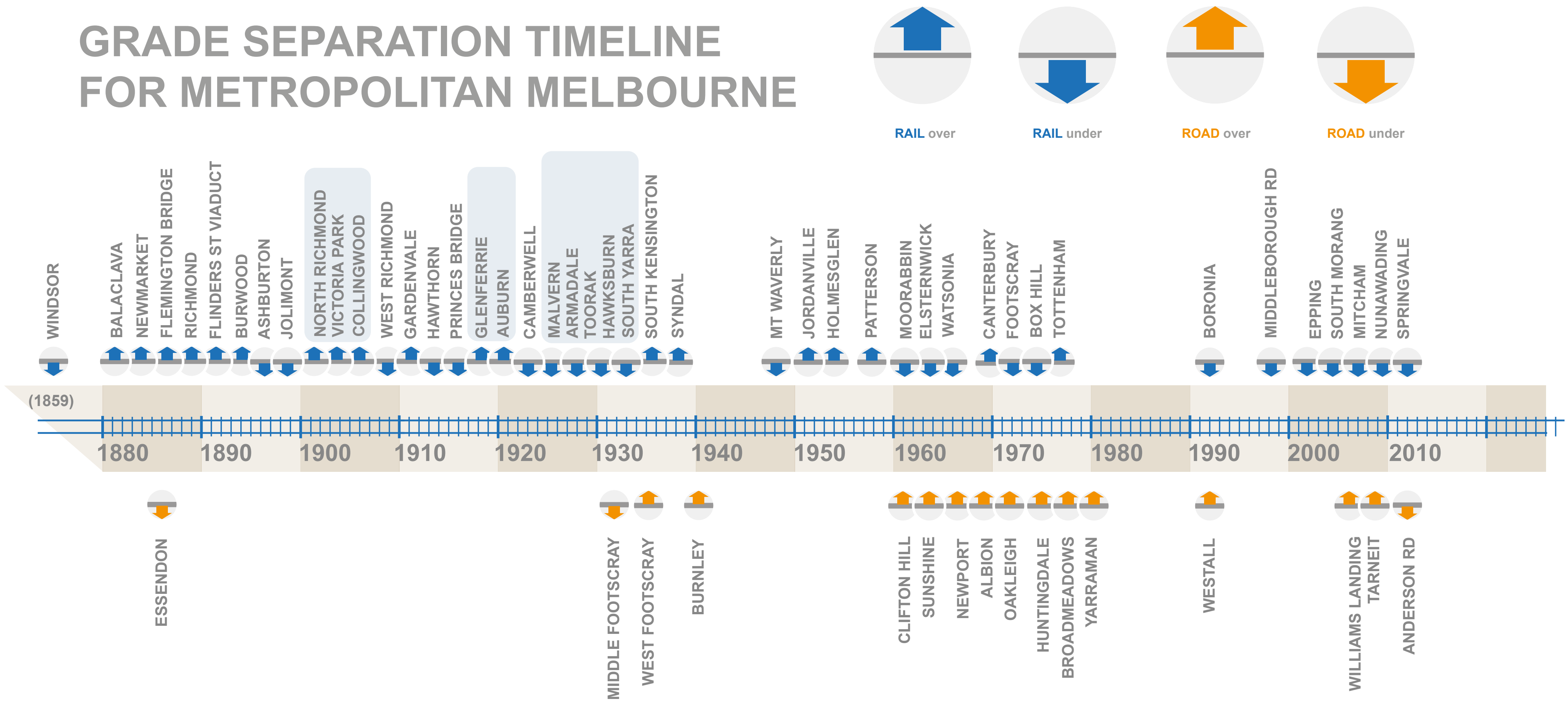
Once the railway is trenched in this modern way, opportunities for better integration of stations with local neighbourhoods are extremely limited. Examples of these more recent trenched grade separations can be seen at: Nunawading, Epping, Mitcham and Springvale.

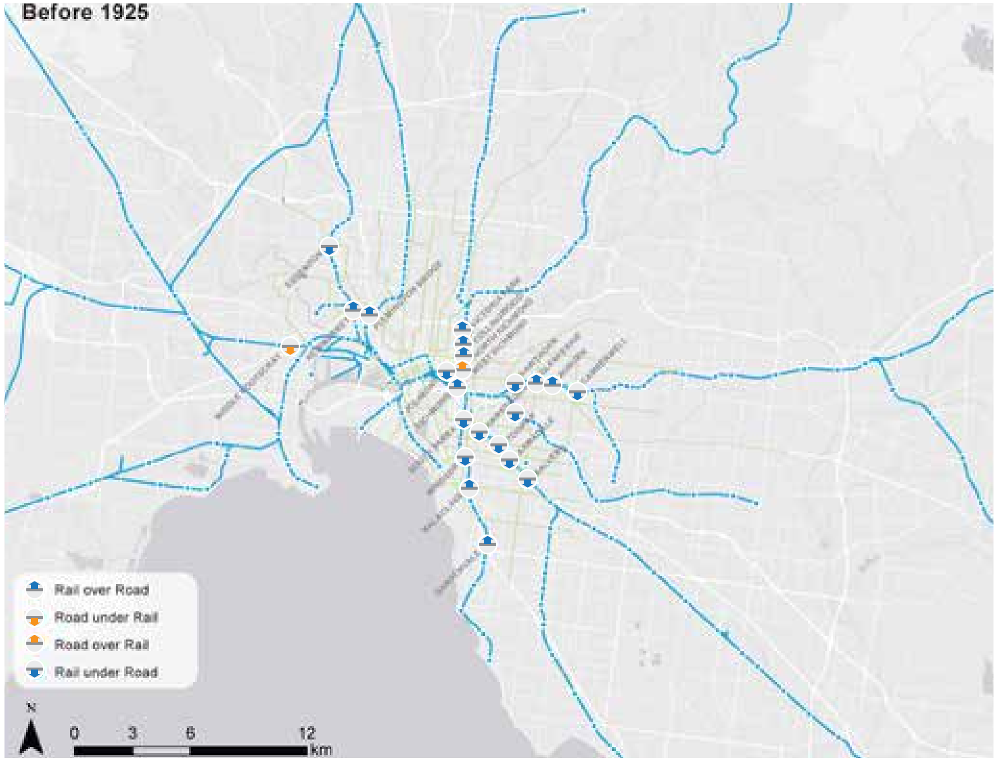
In some cases, trenching has been necessary due to constraints imposed by nearby railyards or hilly topography.

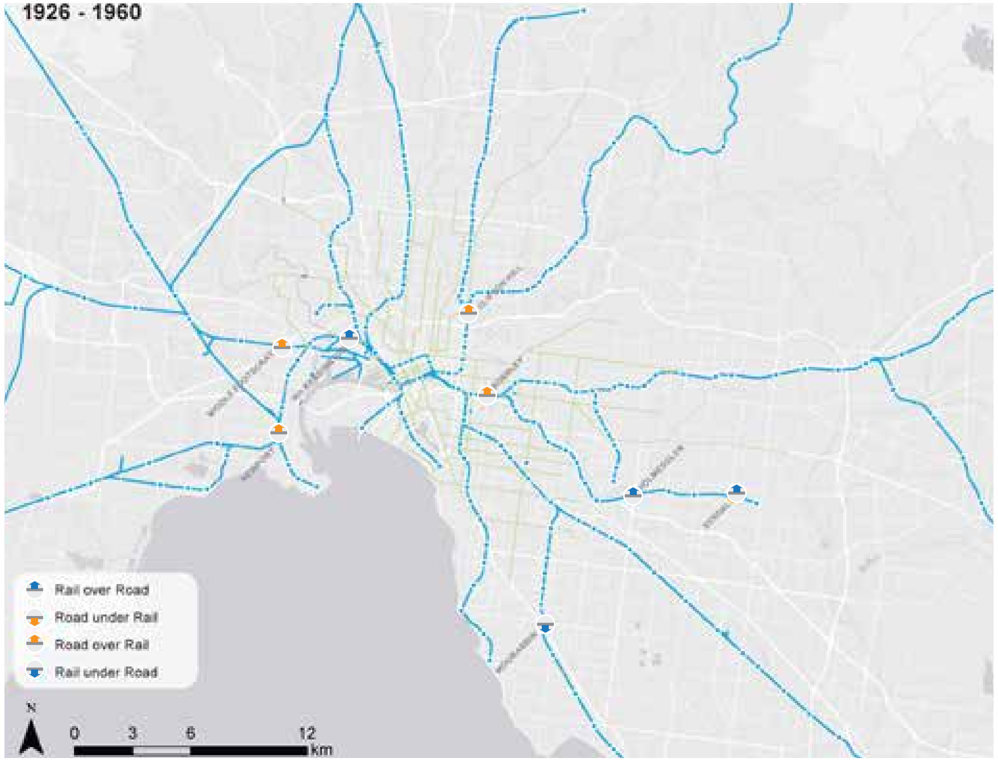
Unfortunately, some decisions to use trenched rail were taken under the previous government where none of these engineering reasons were applicable.

At Blackburn, the existing at-grade station is to remain in situ but the rail gradient on the city-bound approach is being steepened from 1 in 40 to 1 in 30 so that the railway can be in a partial trench to pass under Blackburn Road before rising again steeply to the present station. And, in the western suburbs, we believe that the decision to trench the line at St Albans was made due to a lack of understanding of the differences and potentials of the options, and there is no evidence publicly available that the full range of options for some other grade separations now underway were properly considered or canvassed when they were originally planned.

GRADE SEPARATION TIMELINE FOR METROPOLITAN MELBOURNE

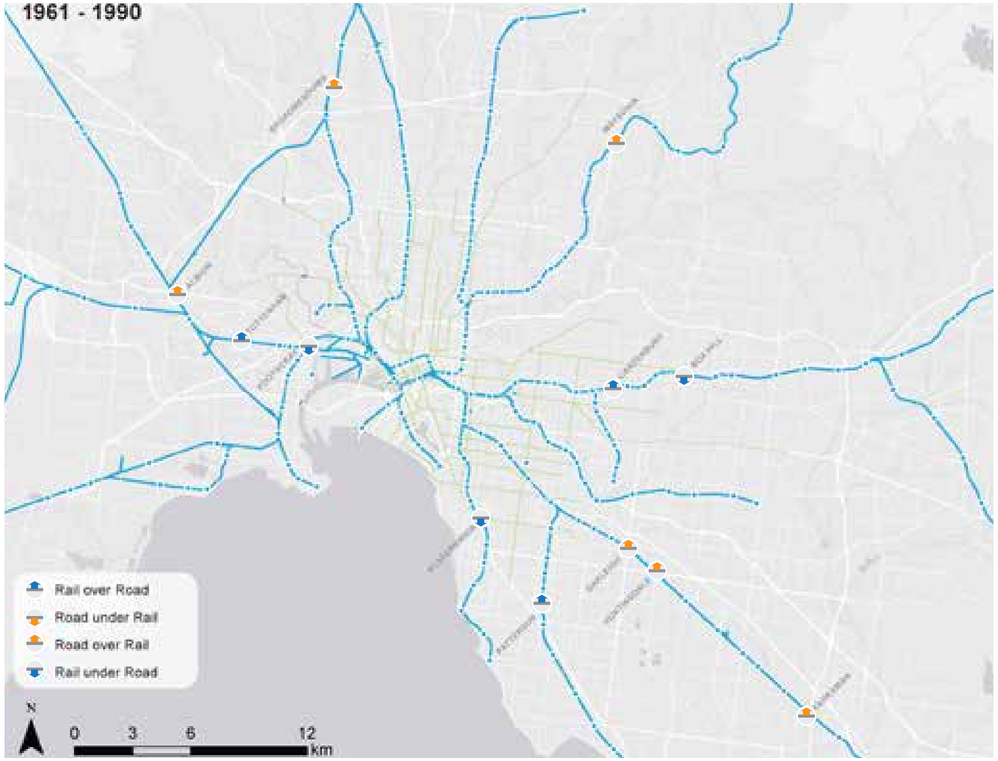


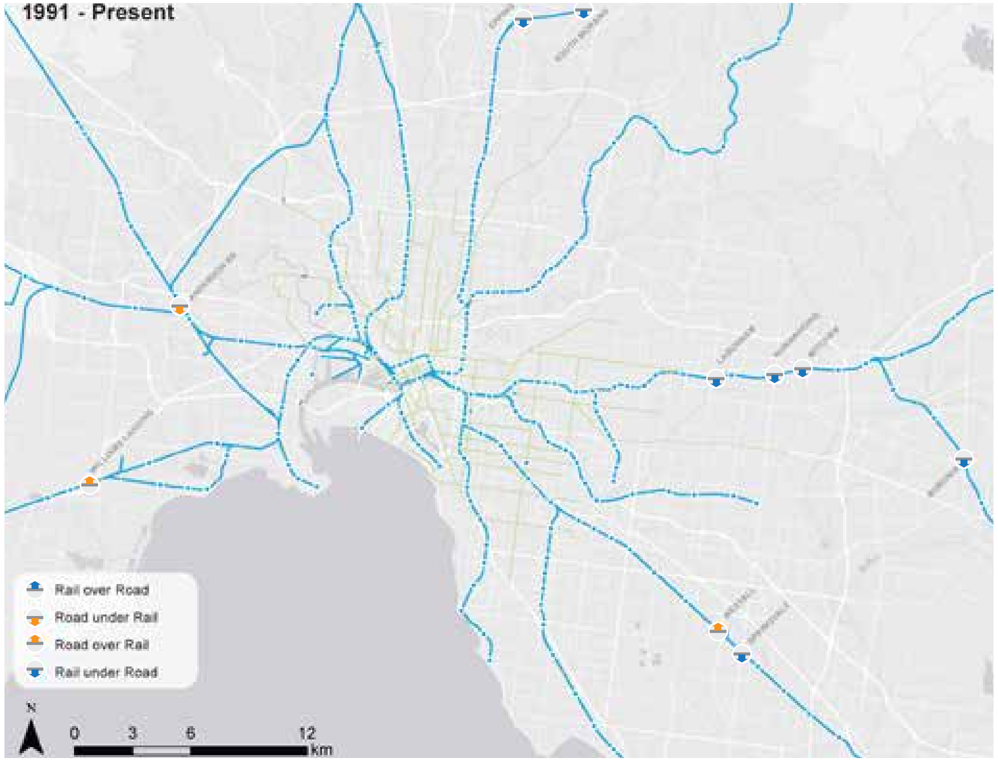




Railway bridge, Carlisle St. near Balaclava Station, 1923

Williamstown Road overpass at Newport Station (Constructed 1960; Photo: 2015)





Elsternwick Station, re-graded below Glenhuntly Road 1960 (Photo: 2015)

Boronia Station, grade separated below Boronia and Dorset Rds., 1998 (Photo: 2015)

GRADE SEPARATIONS & INTERMODAL TRANSFER

Given the constraints that road traffic congestion places on rail service frequencies, the potential to achieve the benefits of the improvements proposed in PTV's Network Development Plan 2012 will be put at risk without significant numbers of level crossing removals: this long range plan for Melbourne's rail system not only covers the Melbourne Metro and a number of line extensions, duplications and re-alignments, but more crucially for the issues in this report, is premised on substantial increases in the number of train services on all lines. In addition, as explained earlier, there are severe limits on the reliability and consistency of bus and tram services that can be achieved with level crossings in place.

Many transport planners have proposed that increasing the frequency of buses is the most cost-effective way to improve access to public transport across a dispersed metropolitan area like Melbourne. Many bus services in Melbourne operate at frequencies of between two and three an hour, and shut down in the evenings and on weekends. The efficiency of Melbourne's buses, measured in passengers per service kilometre, is extremely poor by world standards. The growth in ridership of the 'Smart Bus' lines, which provide a modest improvement in frequency and directness and have a common brand, indicates a positive direction for bus reform. Notably, Smart Bus routes largely avoid level crossings.

Balaclava Station, 2015

However, it is questionable whether higher bus frequencies could ever be reliably delivered without buses being given road space priority. Level crossing removals are central to enabling this. This is especially true during peak periods, when boom gates are down at some level crossings for between 30 and 87 minutes between 7.00 and 9.00 am (Josh Gordon 'Busiest boom gates down for two-thirds of morning peak time for commuters', The Age, 7 May 2015). The limits to on-road public transport imposed by level crossings have a direct impact on the effectiveness of railway stations as transfer nodes in an intermodal network. Of Melbourne's 169 interchange stations, 107 (i.e. almost two–thirds) have adjacent level crossings.

The complex relationships between level crossings, stations, intermodal transfers and service frequencies required to achieve the desired 'network effect' provide a new way of thinking about how level crossing removal fits into a broader strategic perspective. Looking across the network, there are many places where level crossings used by buses occur quite close together, meaning that to make the most of investments in grade separation, a corridor approach to re-grading is indicated. Thus, the usual place-based focus on singular grade separation projects and their related station upgrades needs to be (re-)conceived strategically to think about them as corridors.

Corridor thinking has many benefits in terms of planning for land use and public transport integration, because it means considering a wider set of spatial relationships along rail lines as much as at the stations themselves. In addition, different design approaches and methods of constructing grade separations have varying implications for the ways that an interchange might work in the future, and assessment criteria used to make decisions about where and how grade separations should be constructed need to consider the outcomes in terms of overall 'network effects'.

Station entrances and Myki

If the intention of new station design is to facilitate pedestrian connectivity to other transport modes, to adjacent community facilities or businesses, or simply into the surrounding urban realm, policies of public transport agencies on ticketing, 'revenue protection' and operation of the Myki system will need to be re-assessed.

Currently, station design is constrained by a requirement that entry points be restricted. In many cases, only one entry point is permitted. This is to reduce the number of Myki entry gates and, at staffed stations, to minimise costs of keeping entry points under direct surveillance.

Clearly, this is in direct conflict with the need encourage pedestrian movements into and around the station. It is not an insurmountable problem. There are many precedents from around the world where 'smart card' ticketing systems have been deployed in ways that free-up the potential that stations have to provide multiple access points to the surrounding local area.

Elsternwick Station, 2015

Springvale Station, 2015

PERFORMANCE PARAMETERS

Intermodal transfer and passenger experience

A simple definition of transfer or 'interchange' is when: people transfer from one mode to another, or between two services of the same mode. In addition, people join or leave the public transport system on foot, by bicycle, motorcycle, and car (Mayor of London 2002, p. 3).

In some places this happens because the services or modes are located close to each other ('proximity interchanges'), other places have been intentionally designed to foster this behaviour ('formal interchanges') (Mayor of London, p.3).

This distinction appears simple, but it is significant because in formal interchanges an emphasis has been placed on the interchange experience from the perspective of the user.

Much has been written about the criteria for enhancing interchanges to ensure that passengers are safe, comfortable, can find their way easily, have direct and short transfer routes and so on. In Australia, less has been made of the potential to enhance the transfer experience in terms of two related aspects: first, the potential for expansion of the station and its intermodal facilities, and second, the inclusion of complementary, non-transport uses within stations.

Stations as multi-functional transport interchanges

Recent scholarship in Australia has begun to promote the idea that stations can and should be multi-functional places where commercial and community uses build a virtuous cycle with the high levels of footfall that transit attracts (Coxon, Burns and Debono 2008; Maher and Skinner 2011; Hale and Miller 2012; Hale 2013; Woodcock and Wollan 2013).

This growing literature suggests that rather than simply considering stations as opportunities for higher-density residential development, non-residential uses such as retail, commercial, recreational, community and public space are more conducive to realising the benefits of intermodal mass transit (Mees 2014).

The more stations and their immediate precincts become destinations in their own right, the more reason travellers will have to choose public transport over the private car to reach them.

Three key criteria: connectivity, expansion and integration

This approach to stations as interchanges suggests that three key additional criteria need to be added to the list when assessing grade separations where station upgrades are involved:

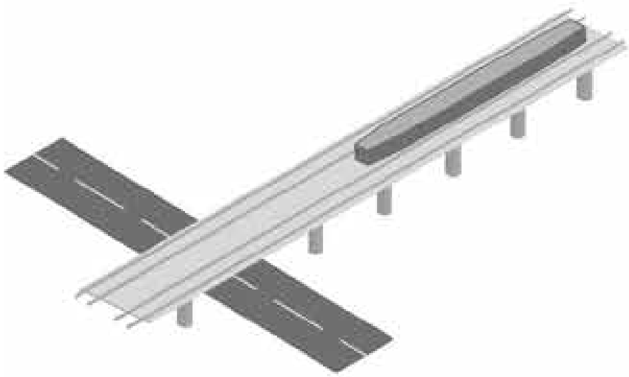
1. CONNECTIVITY - which type of grade separation provides the greatest improvement in local ground-level connectivity for communities on either side of the rail line that goes beyond simply creating a roadway free of rail lines?

2. EXPANSION - Does the type of grade separation chosen allow space for potential expansion and upgrade of intermodal transfer facilities?

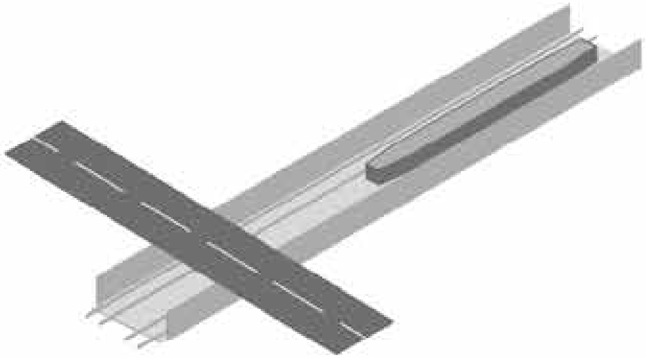
3. INTEGRATION - Does the type of grade separation chosen provide the maximum potential for integration of complementary non-transit land uses both within and in close proximity to the station?

TYPES OF ROAD-RAIL GRADE SEPARATION

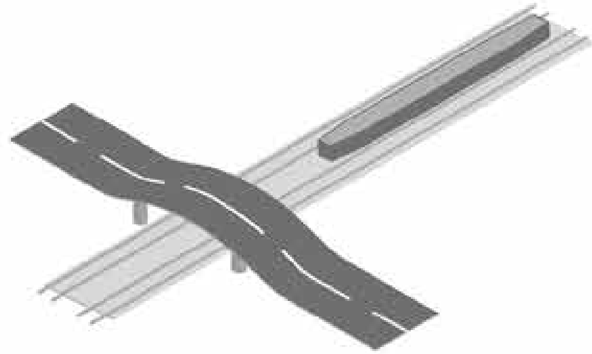
Rail Over Road



Rail Under Road



Road Over Rail



COMPARISON OF GRADE SEPARATION TYPES

Road over or under rail

In residential and commercial areas, grade separations that involve putting the roadway above or below the rail line solve the issue of separating transport flows, but little else, and can actually degrade other aspects of the physical, social and economic environment.

As the legacy of these kinds of projects makes all too clear, this singular focus has been of significant detriment to pedestrian and cyclist amenity, with negative impacts on immediately adjacent economic activity, that are very difficult, if not impossible, to rectify.

Middle Footscray, 2015

These outcomes arise for several reasons. First, roads tend to be relatively wide compared to rail to achieve the required flow, meaning undercroft spaces are generally much more extensive than those for elevated rail. Second, the road geometry dictates the height and shape of the over or underpasses and prevents them from being turned into attractive urban environments that can be activated with suitable land uses. Third, improvements to intermodal transfer become more difficult and may even be made worse. Some of these effects may be mitigated if the station is re-located to sit immediately below or above the road to allow for a direct vertical passenger connection between modes. However, kerbside bus-stops on top of a bridge can be unsafe and bus-bays add significantly to the overall width of the structure. Because such stops are inevitably at some distance from any nearby street activity, they feel isolated and unsafe.

It is possible that road over or under rail grade separations can be visually improved with design treatments, for example as has been done most recently at Anderson Road, west of Sunshine. However, the visual amenity gained is mostly for the benefit of motorists, while cyclists and pedestrians paths are lengthened. Economic development along the sides is not viable, and where a lively retail strip may once have existed, an over or underpass will require removal of many of the buildings creating a substantial gap in the frontage.

Road overpasses have often lacked footpaths, the pedestrians being separated off from traffic flows into footbridges or narrow tunnels beneath the railway line. To make these kinds of grade separation functional, let alone attractive and lively as genuine urban environments, is close to impossible.
This approach is unsuitable for use with level crossing removals in suburban places that are or will soon become become activity nodes, at whatever scale, either through incremental change or through more intensive and planned urban renewal. Thus, these kinds of grade separations are not recommended for level crossing removals that involve stations or roads with land uses along them aimed at pedestrians or cyclists.

Trenched rail

The preceding analysis leaves the primary options for grade separations to those that either lower or raise the rail line in relation to the road. Both achieve the functional aspects of transport flow separation and allow road-based mass transit modes to be ideally located at the station entry.

However, 'rail under' in most suburban locations means a trench rather than a tunnel, the latter being far too costly for all but central city and other very high value locations.

On flat terrain, the overall length of the trench required for the operation of older suburban, regional or freight trains is of the order of 400-800m either side of the former level crossing, a total of up to 1.6km including a station, with vertical concrete retaining walls topped with anti-suicide fencing.

This situation creates little potential for improving the connectivity between the communities on either side of the railway line beyond the roadway where the level crossing was removed, and can result in a loss of pedestrian crossings because of the trenching and re-grading of the line. Furthermore, with projected increases in train frequencies, it is possible that pedestrian and cyclist crossings on the at-grade sections between stations could be closed for safety reasons.

The maximum area of connectivity that could be made available at ground level would be via decking over the platform area at the station itself, a maximum area of about 0.4 Hectare, about half a soccer pitch (since the trench either side cannot be decked over because the inclined tracks require clearance for trains). However, this is a prohibitively expensive way to create public open space, and constrains the potential for future expansion and upgrade of intermodal transfer facilities.

Malvern Station, 2015

In addition to the limitations of trenched grade separation listed above, land values in most suburbs are too low to enable development to be economically viable on such decking without it being at heights many times that of surrounding buildings. There are important questions about whether the public purse should subsidise private development on top of stations of any kind and whether social outcomes such as affordable housing and locally needed community facilities have a stronger claim before profit-making ventures. Furthermore, there are very real questions about how much development would be needed to make the decking pay for itself. Arguably, if the rationale for trenching is to facilitate development over the top, then any additional costs of trenching compared to other methods should be factored into the costs of the development, not the level crossing removal itself.

Notably, few trenched suburban stations in Melbourne have anything other than the station building directly connected to them. While Box Hill station has a shopping mall above it, and Boronia Station has a ground level car park over it, the financial model of development used in those instances is unlikely to be economically viable by contemporary standards of valuation and cost-benefit analysis.

Another downside of trenched rail is that the boundaries to the properties abutting the rail reserve are most likely to become blank or dead frontages rather than active ones due to lack of public access. Over time, development occurring along the edge of the rail reserve will turn its back on the trench, just as it has done along trenched and surface rail to date. This constrains the value of the land and the type of development it can potentially foster: more socially attractive incremental or organic forms of development become less likely.

In short, in order to achieve ground-level connectivity and to realise any value capture potential with trenched rail, highly complex arrangements need to be made. These include a major act of property consolidation and mass demolition, combined with a deck over the trench, if this is feasible. Planning schemes need to be revised to accommodate the likely significant increases in height required. These are immense barriers to overcome, and have long thwarted the realisation of some key land-use and transport integration ambitions of past metropolitan strategic plans.

Comparison of Grade Separation Types cont.

Elevated rail

In contrast to all of the preceding methods, 'rail over road' or 'elevated rail' grade separations release the public land formerly occupied by the railway tracks.

The area of public land opened up can be maximised through the use of viaduct structures rather than embankments. Most of this land is potentially usable except at either end of the viaduct where the headroom is too low as the railway ramps down.

For an average station, the area of land released would be about 1 hectare minimum (two and half times that of the maximum sized deck over trenched rail, almost the area of a small AFL oval).

This newly available land not only maximises the potential for ground-level connectivity, it also allows for potential future expansion and upgrade of intermodal transfer facilities directly beneath the viaduct. Furthermore, the land released allows for a multitude of land uses at different scales and costs to be developed over time to complement the station facility, enhancing the transfer experience and its utility in the everyday lives of travellers as well as local residents and workers.

Glenferrie is a very good example of an elevated rail grade separation that shows how a large station building can be integrated into a sensitive local context. It provides direct intermodal transfers and incorporates a range of complementary land uses of differing grain size (from a supermarket to a take-away coffee kiosk) that integrate the station into a thriving retail strip.

Railway bridge at Auburn Station, 2015

Another upside with elevated rail when compared to trenched rail is the potential it has to provide value uplift to the private land along the boundary of the rail reserve.

In many instances, because the private land can become accessible from the rail reserve at ground level, there is the potential for active frontages to develop where previously they could not. The value of many land parcels would rise due to an increase in the length of frontage and accessibility.

Incremental re-development and renewal would be more likely with the right kind of land use zoning to encourage higher densities and mixed uses adjacent to the station and the rail reserve at ground level.

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Elevated rail bridge near Glenferrie Station at Swinburne University campus, 2015

Elevated rail bridge at Patterson Station, 2015

CASE STUDIES

We have selected a range of case studies to demonstrate what we believe are the most important comparative qualities between the main types of grade separation. In saying this, however, it is important to acknowledge that all stations and indeed, grade separations are different and pose unique problems and opportunities.

While we believe some general principles can be derived from these case studies, the extent to which they may apply to new situations will vary.

All but one of the case studies is of a grade separation that involves a station. This is because the issues we are researching relate to how grade separations affect public transport network performance, in particular, how stations work as intermodal transfer points.

Public transport networks are only as good as the nodes that join them together; stations are where networks succeed or fail.

Each case study provides an overview of conditions before and after the grade separation, sometimes many years either side of it, given that historical information on this topic is not always readily available.

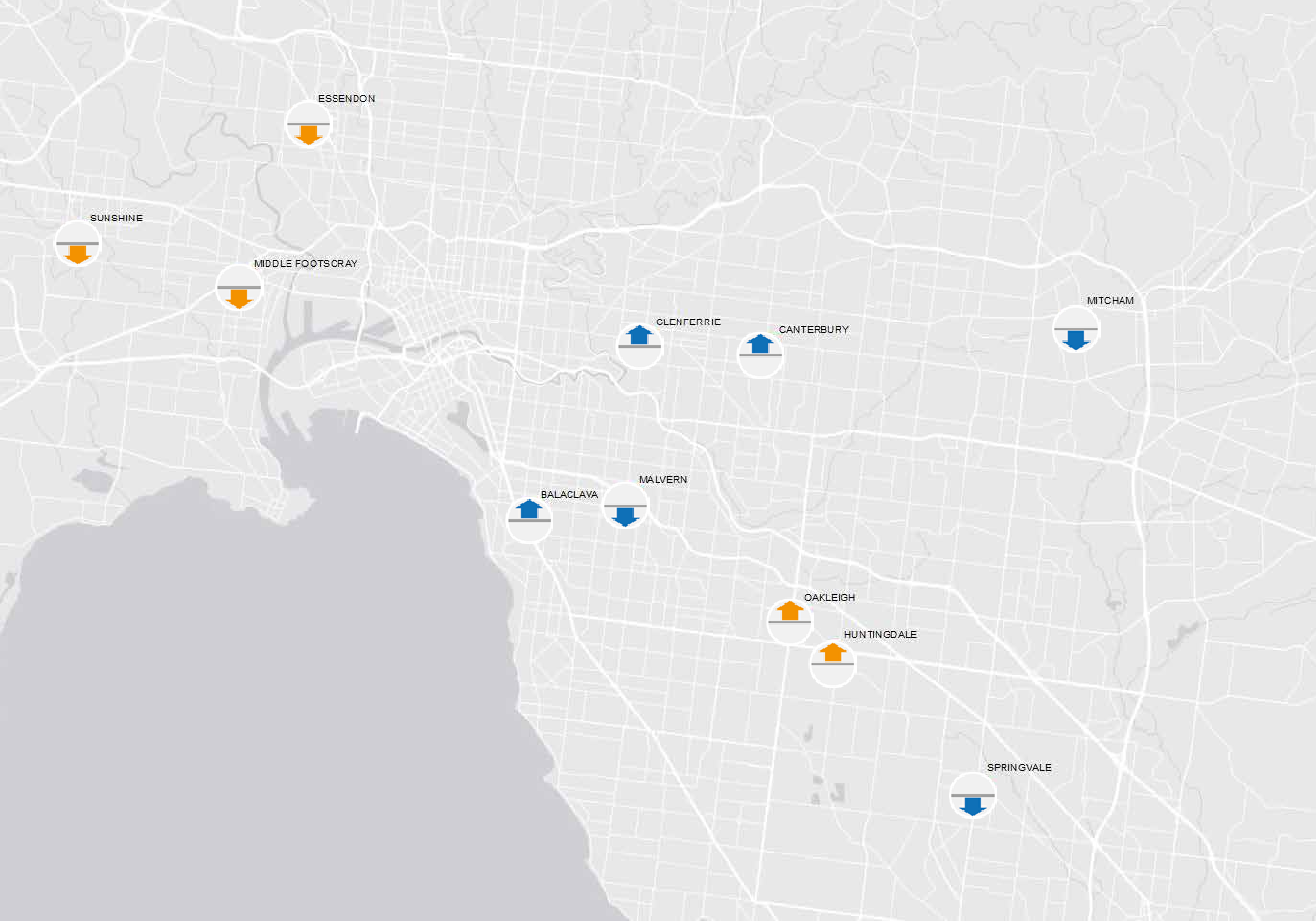
While there are many historical publications about Victoria's railways, none of them specifically focus on grade separations and so this is a work in progress. Therefore the information we have used as the basis for our analyses is derived from various combinations of archival maps, plans, aerial photography, street photography and fieldwork.

Where there are errors, we would be very grateful to be advised of them.

The case studies are as follows:

RAIL UP	Glenferrie, Canterbury, Balaclava
RAIL DOWN	Malvern, Mitcham, Springvale
ROAD OVER	Oakleigh, Huntingdale
ROAD UNDER	Essendon, Middle Footscray, Anderson Rd

Note: We do not think any of these case studies are perfect, and so where we think it is useful we have included some comments on possible improvements


ESSENDON
SUNSHINE
MIDDLE FOOTSCRAY
GLENFERRIE
CANTERBURY
MITCHAM
MALVERN
BALACLAVA
OAKLEIGH
HUNTINGDALE
SPRINGVALE

ASSESSMENT CRITERIA

Current grade separations

The following six broad criteria were used to assess the eleven case studies of older and more recent grade separations. The assessments are summarised in the table on the opposite page to allow comparison between cases.

Assessments were made via fieldwork observations and analysis of historical and contemporary maps, planning schemes and aerial photographs.

01 Connectivity

- What is the relative increase in ground-level connectivity (easy walkabilty, universal access, use by pedestrians and cyclists) after the grade separation?
- How easily can the new space integrate nearby land uses?
- How well does the design facilitate and encourage inter-modal transfer?

02 Universal accessibility

- Does the design meet accessibility standards for all users? This includes those with mobility, vision, hearing or cognitive impairments as well as people with children in prams or with heavy shopping and luggage.

03 Intermodal access:

- How direct are the paths between trains, buses and trams?
- How clear is the route?

04 Safety

- How safe are the spaces created for all users?
- What levels of safety can they provide for pedestrians, cyclists, public transport users and those with mobility issues in particular?

05 Economic Development

- What non-residential land uses have developed around the station/grade separation? How well integrated are they?
- How have they changed?
- What future change is likely?

06 Amenity

- How easily can new public space be created?
- How well can it be activated for community and recreational uses, both passive and active?

SUMMARY TABLE

TYPE	NAME	CONNECTIVITY			UNIVERSAL ACCESSIBILITY		INTERMODAL ACCESS	SAFETY				ECONOMIC DEVELOPMENT	AMENITY
		Pedestrian accessibility	Connect communities	Integrate nearby land uses	Current	Future potential	Ease of transfer	All	Pedestrians	Cyclists	PT users	To what extent has development occurred? What future potential is there?	Public space activation potential
RAIL UP	Glenferrie	GOOD	GOOD	GOOD	OK	OK	GOOD	GOOD	GOOD	OK	GOOD	EXCELLENT	GOOD
	Canterbury	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	GOOD
	Balaclava	OK	OK	GOOD	OK	OK	GOOD	OK	OK	OK	GOOD	GOOD	GOOD
RAIL DOWN	Malvern	POOR	POOR	POOR	POOR	OK	POOR	POOR	POOR	POOR	OK	POOR	POOR
	Mitcham	OK	POOR	OK	OK	OK	OK	OK	OK	OK	OK	POOR	OK
	Springvale	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
ROAD UP	Oakleigh	VERY POOR	POOR	POOR	POOR	POOR	OK	POOR	POOR	POOR	OK	VERY POOR	VERY POOR
	Huntingdale	VERY POOR	VERY POOR	VERY POOR	VERY POOR	VERY POOR	OK	POOR	POOR	POOR	OK	VERY POOR	VERY POOR
ROAD DOWN	Essendon	POOR	POOR	POOR	POOR	POOR	OK	OK	OK	OK	OK	OK	POOR
	Middle Footscray	VERY POOR	VERY POOR	VERY POOR	VERY POOR	VERY POOR	OK	OK	OK	OK	OK	VERY POOR	VERY POOR
	Anderson Rd (Sunshine)	VERY POOR	VERY POOR	VERY POOR	VERY POOR	VERY POOR	*NA*	OK	OK	OK	*NA*	VERY POOR	POOR

RATING SCALE

- EXCELLENT
- GOOD
- OK
- POOR
- VERY POOR

Rail UP

GLENFERRIE
STATION

Glenferrie station was re-built in 1918 as part of the re-grading and upgrading of the corridor from Hawthorn to Camberwell to enable rail services to operate more efficiently. The re-grading created an elevated section with the line between Glenferrie and Auburn on vegetated embankments, and a trenched section to Camberwell. Glenferrie station incorporates spaces for retailing and refreshments within the station building and immediately adjacent, allowing Glenferrie Road to become a continuous retail strip beneath the railway bridge.

SUGGESTED IMPROVEMENTS

Ground level connectivity could be improved by cutting through the embankment in more places, along with providing more direct access from the station to the interior of the Swinburne University campus.

These two changes would improve the amenity of the public realm significantly. Artwork and soundbarriers could also be combined to improve the amenity of the rail bridge.

Level access tram stop and pedestrian crossing outside station entry would improve intermodal transfer.

INTEGRATION OF STATION INTO THE LOCAL AREA

The station is right in the heart of the activity centre; access to the station is part of the pedestrian network connecting the Glenferrie Rd retail strip to the Swinburne University campus, through which the rail line runs on an embankment.

TRAM INTERCHANGE IS CLOSE, BUT LOW AMENITY

The footpath tram stops are directly infront of the station, beneath the rail bridge. However, the closest pedestrian crossing is 95m north, making it a 110m detour rather than a short walk across the street.

HIGH PERMEABILITY ON EAST SIDE, LOWER ON WEST
Ground level connectivity is highest around the station (east of Glenferrie Road), much less so on the west (Glenferrie oval).

ECONOMIC DEVELOPMENT
There has been significant intensification of land use around Glenferrie Station, with retail, commercial and tertiary education uses, as well higher density residential for students and non-students. Although there are few large parcels of land, rising height limits mean that further development potential exists.

KEY

Underutilised land

Rail reserve

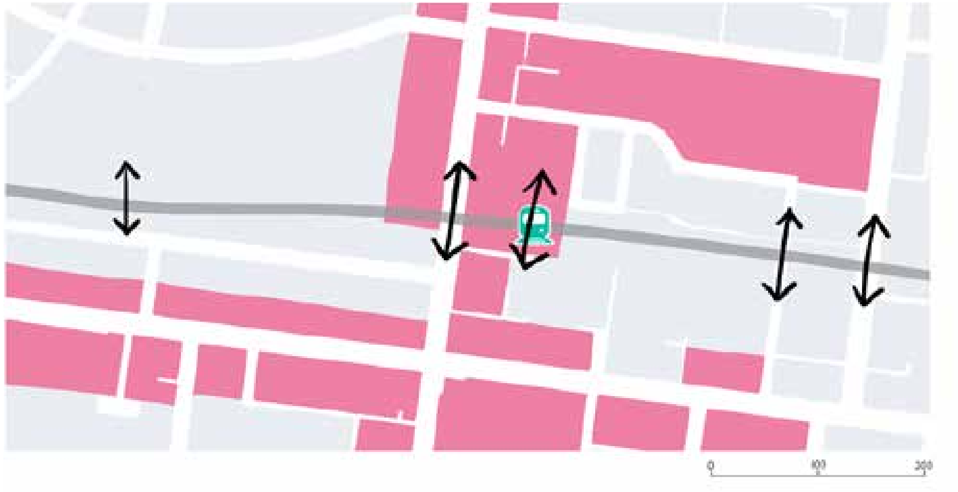
1 Image marker

Map showing Glenferrie Station and surrounds

RETAIL & POINTS OF CROSSING

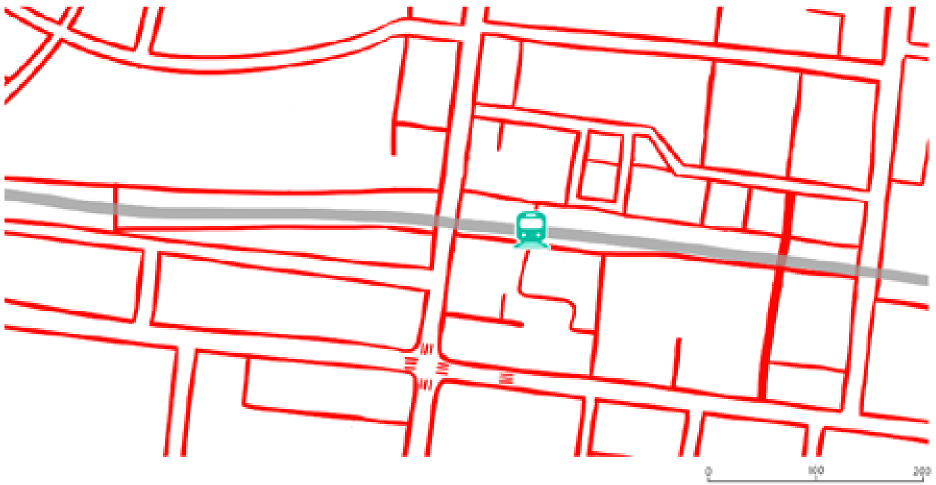
1915

2015

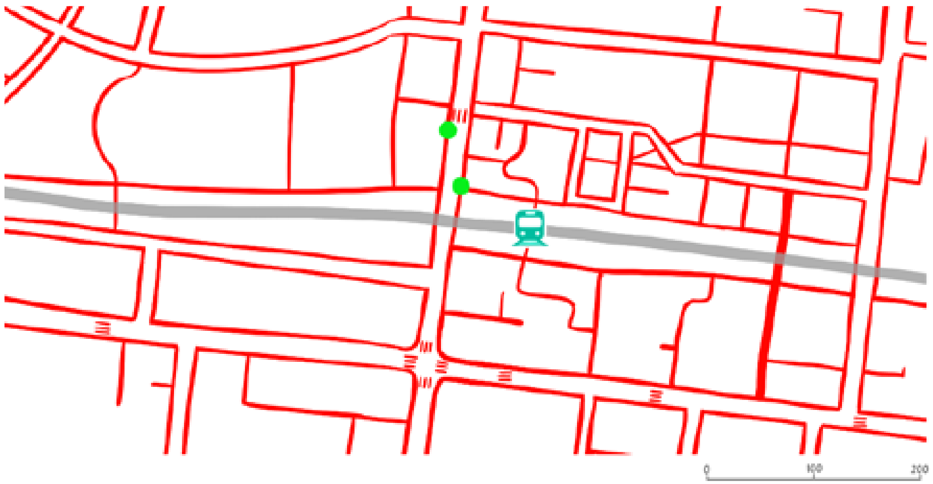


PEDESTRIAN ACCESS & NEAREST TRAM STOPS

1915



2015




SOLD
3

Rail UP

CANTERBURY
STATION

Canterbury station was re-built in 1967 as a result of grade separation and upgrade of the line to improve railway operations. The elevated line sits on an embankment, with access to the station from beneath an extension of the rail bridge over Canterbury Road, and to the third platform from the north side. The design has constrained the potential to extend the Canterbury road commercial frontages beneath the railway, and connectivity could be improved with pedestrian passages through the embankment. The adjacent Maling Road strip is a vibrant local activity centre.

STATION ENTRY
The station is not marked architecturally very well, though the viaduct makes its location clear. The space beneath the viaduct next to the access ramps is landscaped and decorated with community art projects.

TORTUOUS STATION ACCESS
Two of the 3 platforms are accessed via ramps adjacent to Canterbury Road, but setback from it. Platform 3 is only accessible via a ramp from the car park on the northern side, so access between platforms can be tortuous.

INTERCHANGE: NEAREST BUS CONNECTION 150m AWAY
Transfers between bus and train require crossing at least one major road. The bus stops require a walk of between 150 and 200m, depending direction of travel.

ECONOMIC DEVELOPMENT

Economic activity has not been constrained by the grade separation. The Maling Road strip is highly successful, despite the loss of one footpath across the tracks west of the station.

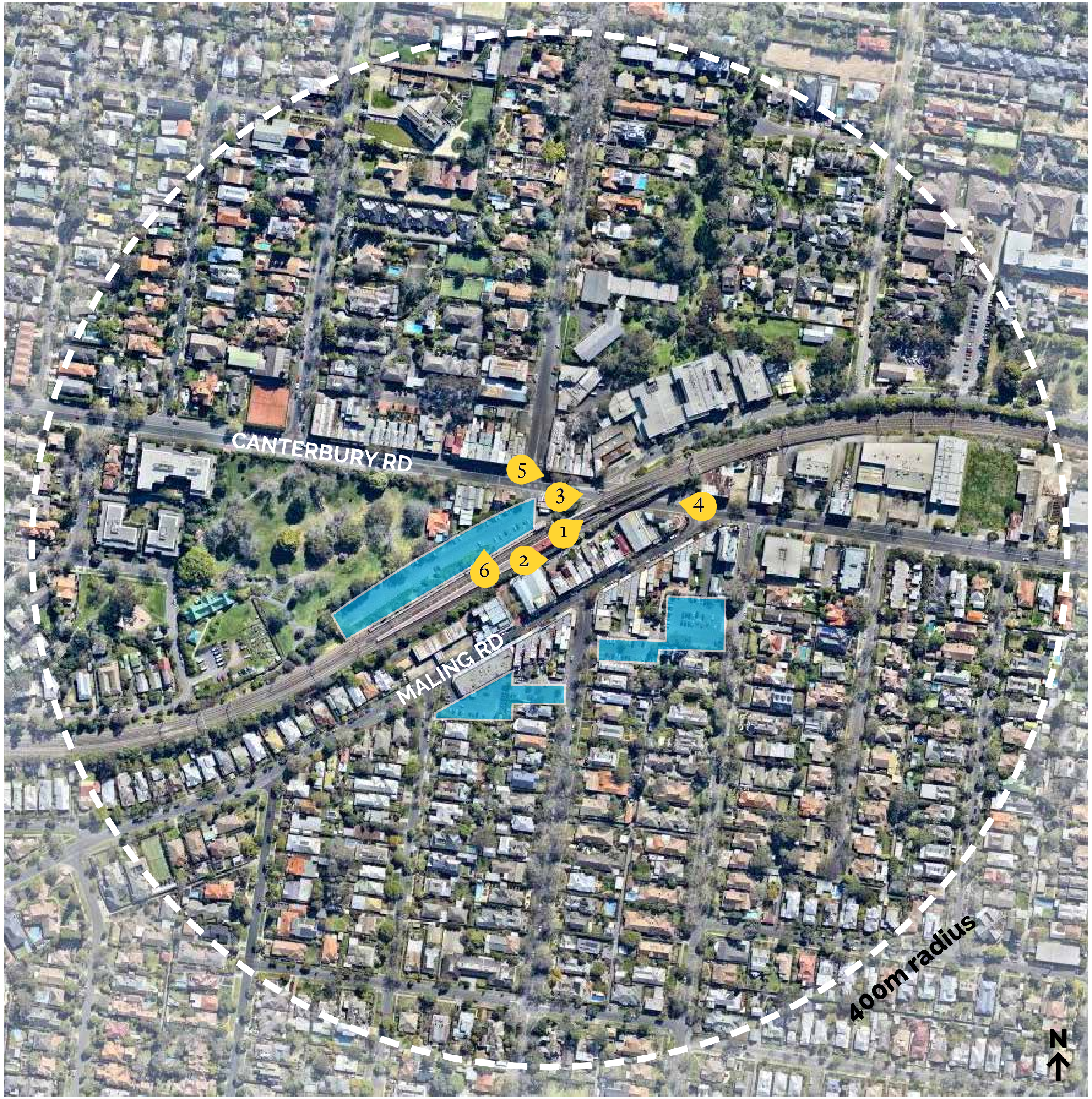
Cutting through the embankment at the station would improve access, allow the land around the station, including the car park and undercroft, to extend the Canterbury Rd strip, improve pedestrian amenity in the station precinct and provide a better station entry. A viaduct would have made this kind of renewal easier. There is also some developable land behind the Maling Road retail strip. However, planning controls in the area make this kind of development unlikely in the immediate future.

KEY

Underutilised land

Rail reserve

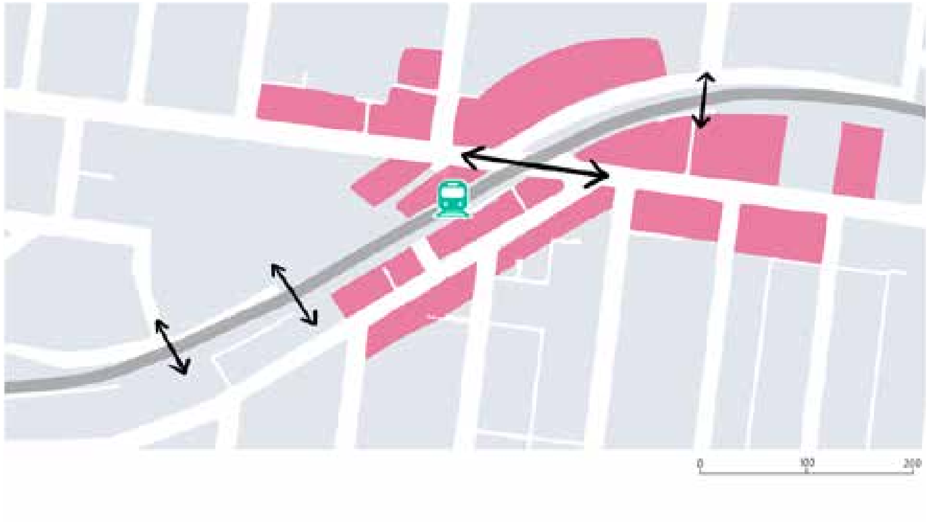
1 Image marker



Map showing Canterbury Station and surrounds

RETAIL & POINTS OF CROSSING

1945



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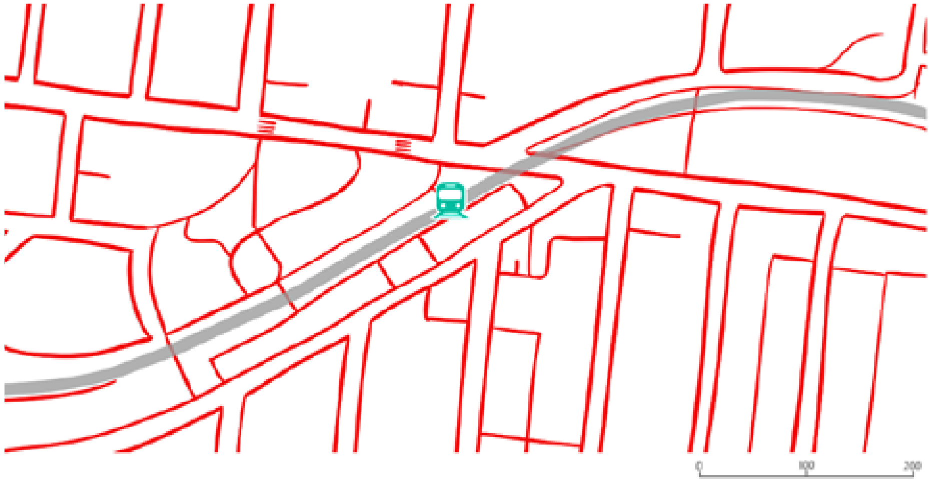
PEDESTRIAN ACCESS & NEAREST BUS STOPS

1945

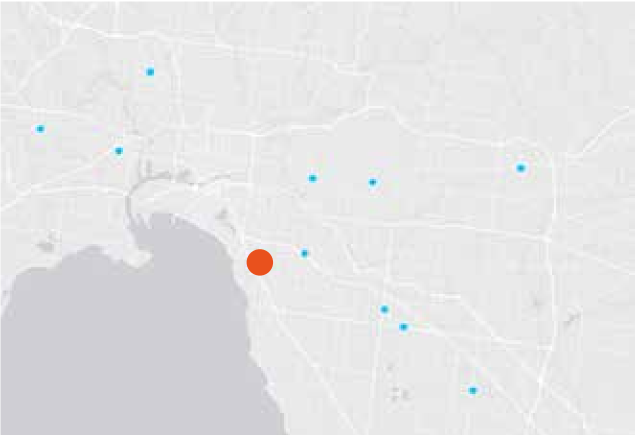


2015

6

Rail UP

BALACLAVA
STATION



Balaclava is one of the earliest examples of a station on a line elevated on an embankment, dating as far back as the early 1880s when the line was duplicated. The embankment restricts east-west ground level connectivity for the numerous small streets either side and cutting through it would improve local pedestrian access. However, the interface with Balaclava Road allows the continuity of the retail strip and excellent interchange with trams, evidenced through flourishing economic activity.

CLOSE ACCESS FROM ACTIVITY CENTRE TO STATION
The station is right in the heart of the strip-based activity centre, and is accessible by ramps.

RECENT UPGRADE
Access to the station was recently upgraded, unfortunately did not include coordination installation of level access tram stops and pedestrian crossings.

TRAM CLOSE, BUT LOW AMENITY
Though the tram stops are just outside the station, they are not pleasant places to wait.

One tram stop is across the road, and though pedestrians often cross against traffic, there are no formal crossings for 100-150m in either direction.

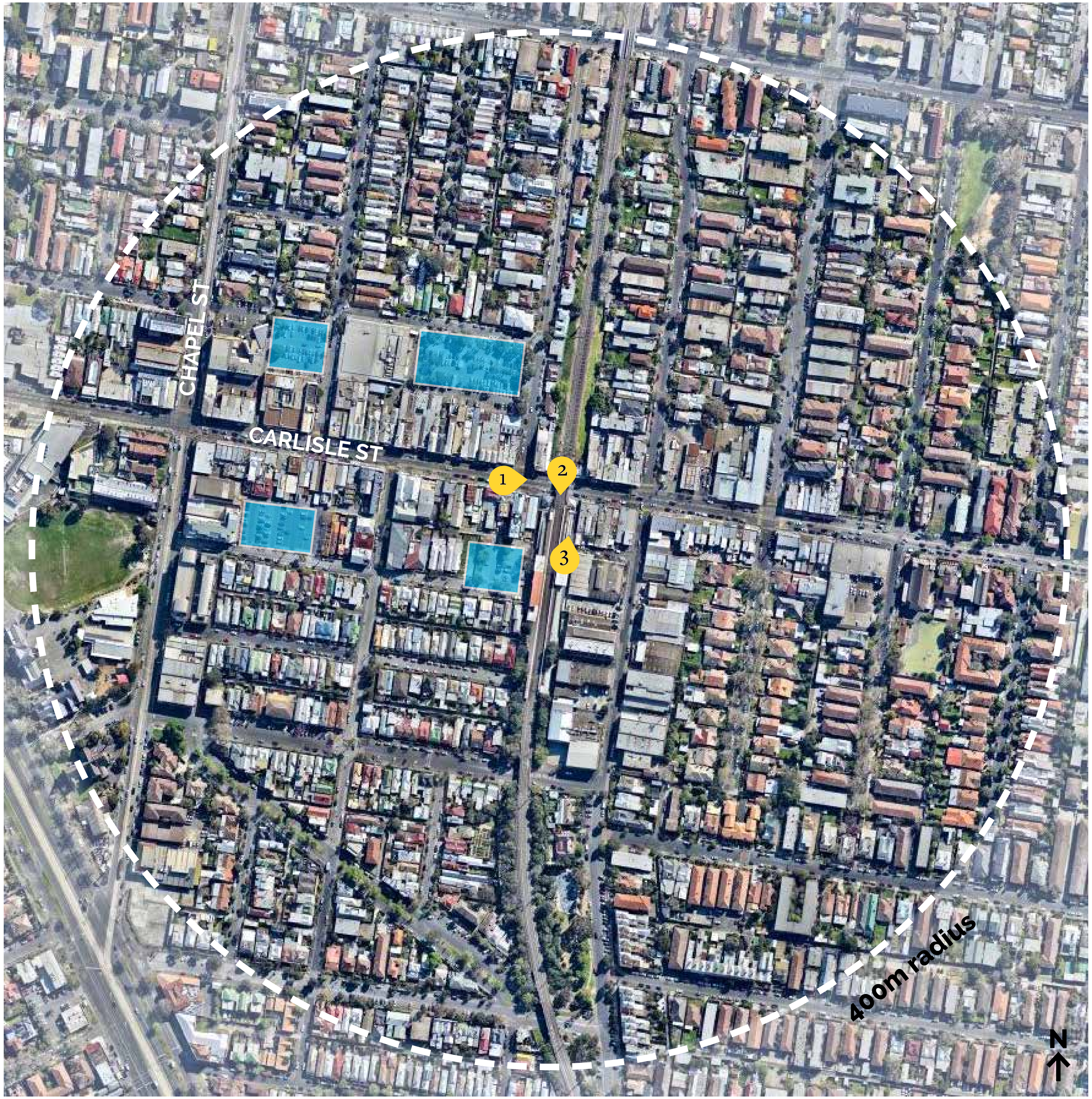
Activity on the street

KEY

Underutilised land

Rail reserve

1 Image marker



Map showing Balaclava Station and surrounds

RETAIL & POINTS OF CROSSING

2015

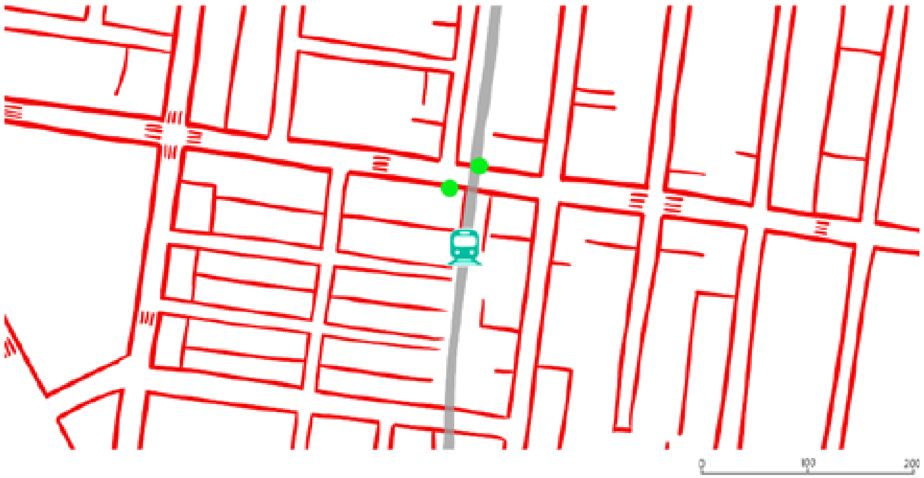
ECONOMIC DEVELOPMENT

Although ground level connectivity is not as good as it could be, the elevated station is well-integrated into the activity centre and the wider neighbourhood it serves. Being an inner-city suburb with a long history, mixed uses are still apparent. Retailing is strong along the Carlisle St tram corridor that intersects with the station, and the elevated rail line allows activity to occur without interruption on the street. There are a number of surface level parking areas (marked in blue below) that present future redevelopment opportunities, including the station car park.

Air-rights development has already occurred, indicating both viability and demand in this sought after area. Also, immediately to the east of the station is a street of light industrial buildings whose development potential would most likely be improved if there were better east-west connectivity to the station through the embankment. To the west, the main opportunity is air-rights development over the station car park.

PEDESTRIAN ACCESS & NEAREST TRAM STOPS

2015



NB: there is no 'before' for Balaclava as the grade separation was completed so early in Melbourne's railway histrory

Socially engaged art project at Balaclava station laneway July-Nov 2015 (Source: City of Port Phillip / Urban Laboratory; artist: Ben Cittadini)


LOW CLEARANCE 3.8m
1

Rail DOWN

MALVERN STATION

Malvern Station was re-built in 1902 as part of the major re-grading and track upgrade between South Yarra and Caulfield to improve rail capacity. Most of the corridor was placed in a wide trench. The streetscape is discontinuous across the railway trench and the station is poorly integrated with it nor easily accessible to its trams.

VERY LIMITED CROSSINGS ACROSS ROADS
The station is surrounded by roads which must be crossed in order to access it. This creates an unpleasant environment for pedestrians.

TRANSFER BETWEEN TRAIN AND TRAM IS NOT EASY
The nearest tram connection is 150m away. However, there are very limited pedestrian crossings if you need to reach the tram on the other side of the road, making it a 250m walk.

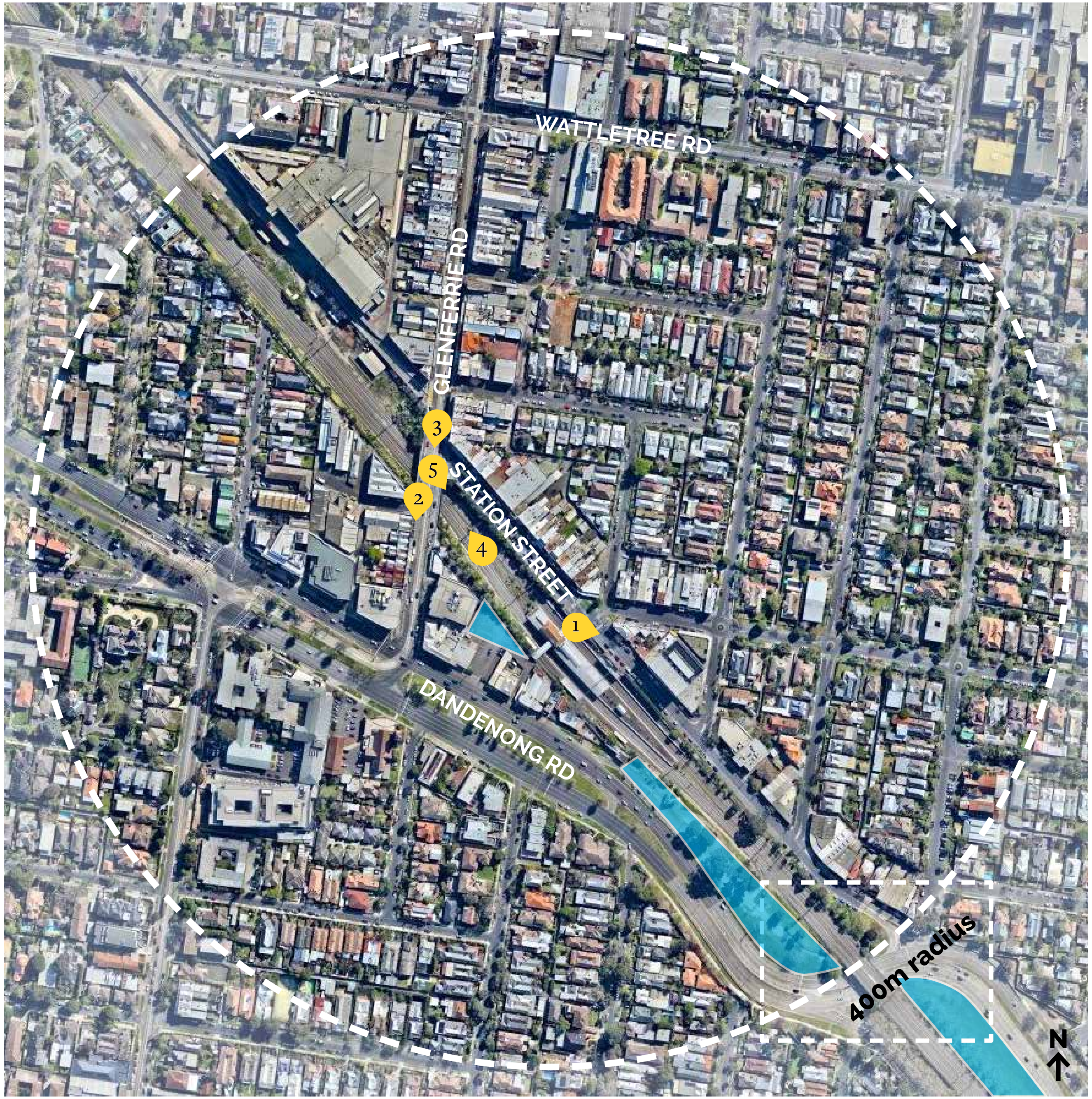
NEXT ALTERNATIVE CROSSING IS FAR SOUTH
The next available place to cross south is under the rail line, 350m away.

ECONOMIC DEVELOPMENT

Since the grade separation was carried out, most of the economic development in the area has occurred away from the station itself. Retail development has related to the tram routes (that run between Malvern and Armadale Stations), on Glenferrie and Wattletree Road and High St. The Malvern Central Shopping Centre was developed on these streets well away from Malvern Station. The shopping centre is primarily designed for car access and like much of the development along the trench, faces away from the railway. Part of the station precinct is within a Major Activity Centre, but so far, intensification around the station has been minimal. The trenched line creates severance, and the vacant and underutilised land adjacent to the station have so far proved unattractive for development.

KEY

- Underutilised land
- Rail reserve
- 1 Image marker

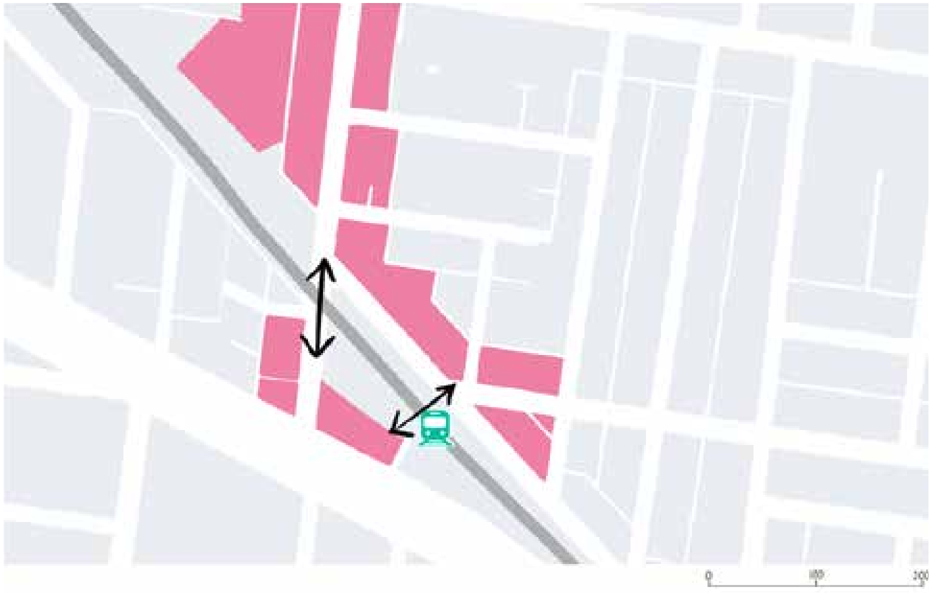


Map showing Malvern Station and surrounds

RETAIL & POINTS OF CROSSING

1902

2015



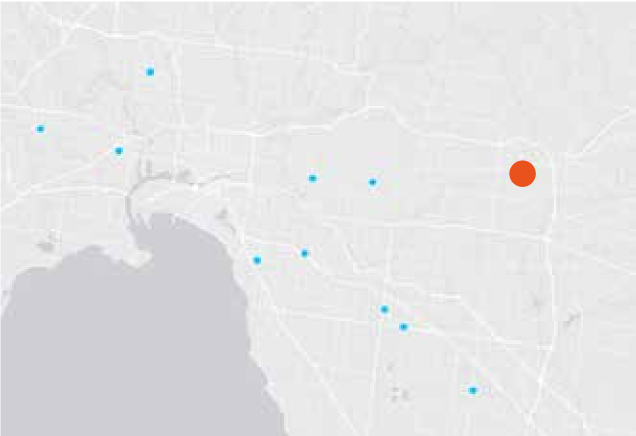
PEDESTRIAN ACCESS & NEAREST TRAM STOPS

1902

2015

Rail DOWN

MITCHAM
STATION



The line through Mitcham was grade separated in 2014. Being at the top of a hill, it was optimal for rail operations to lower the line into a long trench with three new road bridges. Some additional ground level connectivity for pedestrians and buses has been provided along with a new station building. The station is separated from the Mitcham activity centre by the 600m long surface car park, meaning that land use and transport will be poorly integrated until it becomes economically viable to redevelop the parking as mixed use connected to the station.

STATION SURROUNDED BY ROADS AND PARKING
The station is close to the main retail centre, but feels as though it is an "island".

ECONOMIC DEVELOPMENT
The disconnection of the station from the Mitcham Activity Centre could be remedied by redevelopment of the very large surface carpark. This would maximize integration between mixed land uses (retail, commercial, recreational, community and higher-density residential) and an important interchange station between rail and bus. This is a significant opportunity for value capture. However, for the foreseeable future, the trench will remain open due to the significant costs of decking over it.

KEY

Underutilised land

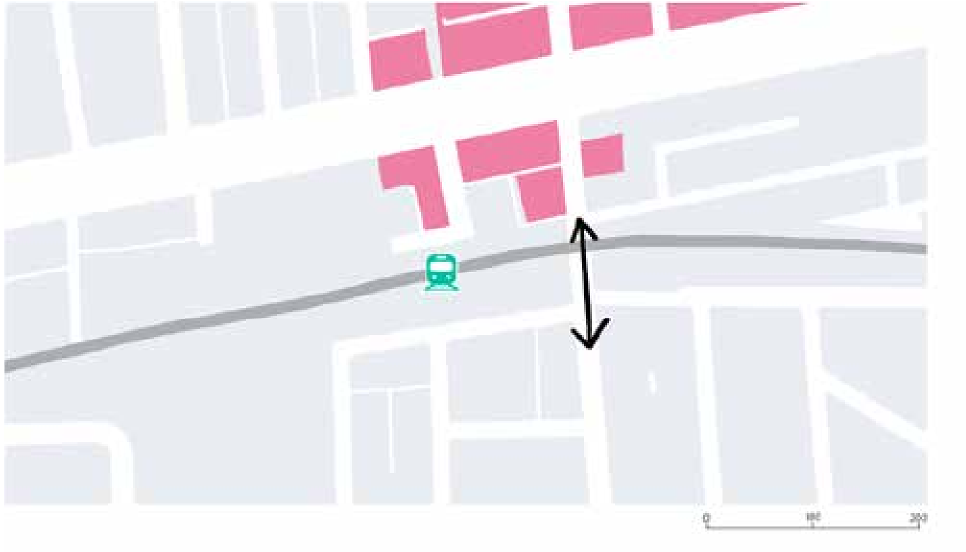
Rail reserve

1 Image marker

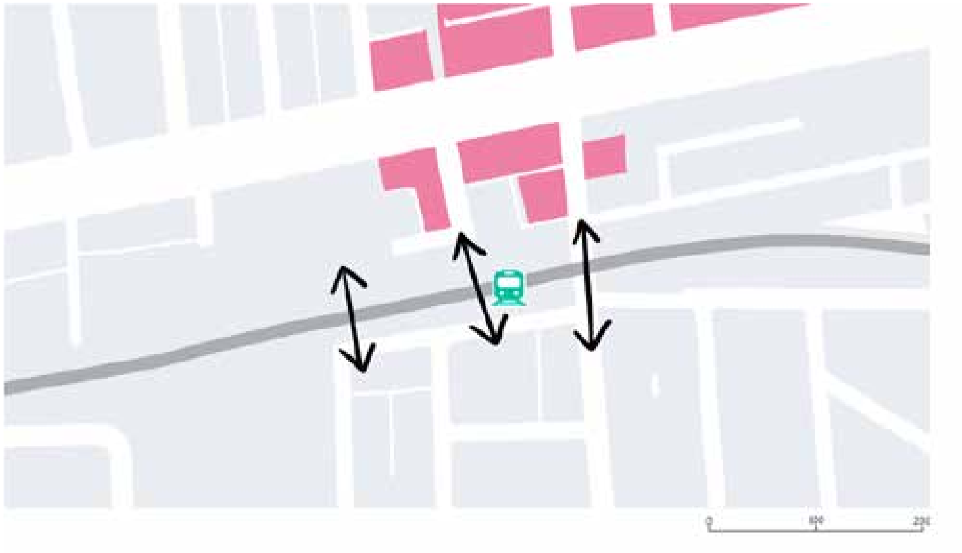
Map showing Mitcham Station and surrounds

RETAIL & POINTS OF CROSSING

2013

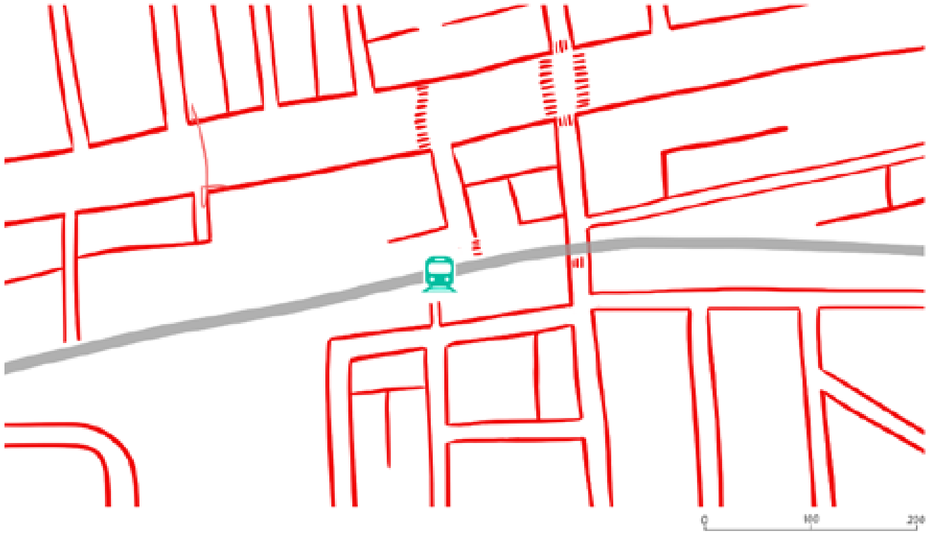


2015

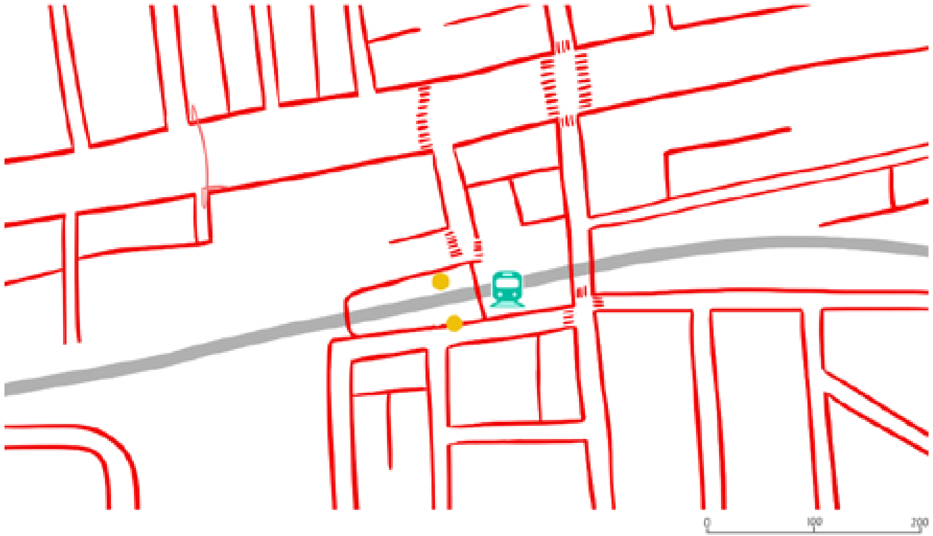


PEDESTRIAN ACCESS & NEAREST BUS STOPS

2013



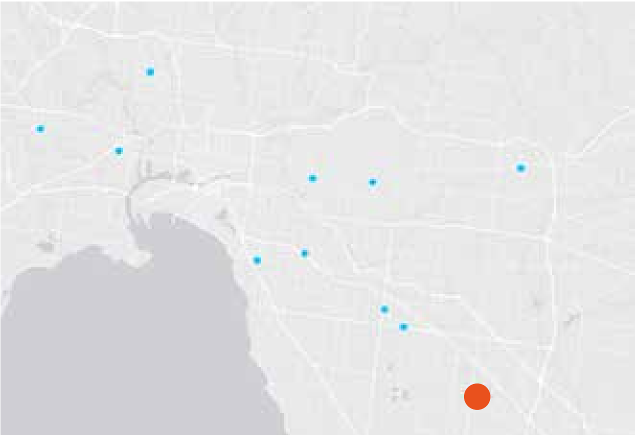
2015




5

Rail DOWN

SPRINGVALE
STATION



Springvale was grade separated in 2015 using a trench. A new road bridge at the southeast end of the station has added some much-needed ground level connectivity, but the station is still separated from the Springvale major activity centre by arterial and other roads.

It would have been preferable to have provided station access on both sides of Springvale Road (as at Nunawading) rather than forcing pedestrians to cross this very busy road to transfer between bus and train.

Some new public open space has been provided in the rail reserve but unfortunately this is curtailed by the railway trench.

An elevated grade separation on a viaduct would have created more open space and maximised ground level connectivity around the station allowing for the local area to be better integrated in the short and longer term.

BUS CONNECTIONS

The south-bound bus stop is right outside the station, and easy to find and access.

The north-bound bus stop is on the other side of the busy highway, and crossings are difficult and time consuming to get to.

ECONOMIC DEVELOPMENT
Springvale is 23km from the Melbourne CBD and developed as a township in its own right. The railway bisects the commercial corridor either side of Springvale Road. The main opportunity at Springvale would have been to create greater connectivity across the rail alignment for the commercial blocks 100-200m back from Springvale Road. This would allow the thriving activity centre a greater opportunity to expand northwards and to better integrate the station and its important bus interchange with it.

Much of the land remaining in the rail reserve could potentially be developed. However, to increase connectivity, it would require decking over the trench to provide sufficient frontages without significantly reducing the amount of open space that has been created. As decking is very costly, this is unlikely for the foreseeable future.

KEY

Underutilised land

Rail reserve

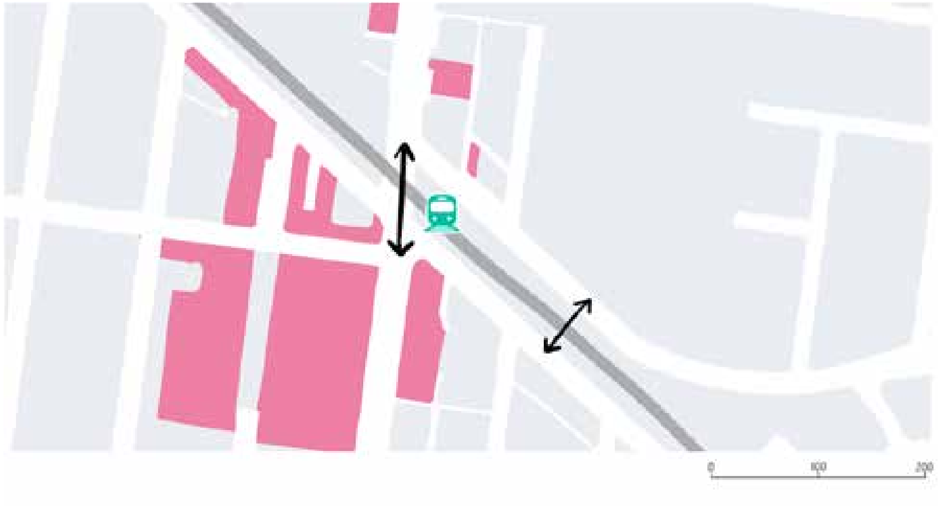
1 Image marker

Map showing Springvale Station and surrounds

RETAIL & POINTS OF CROSSING

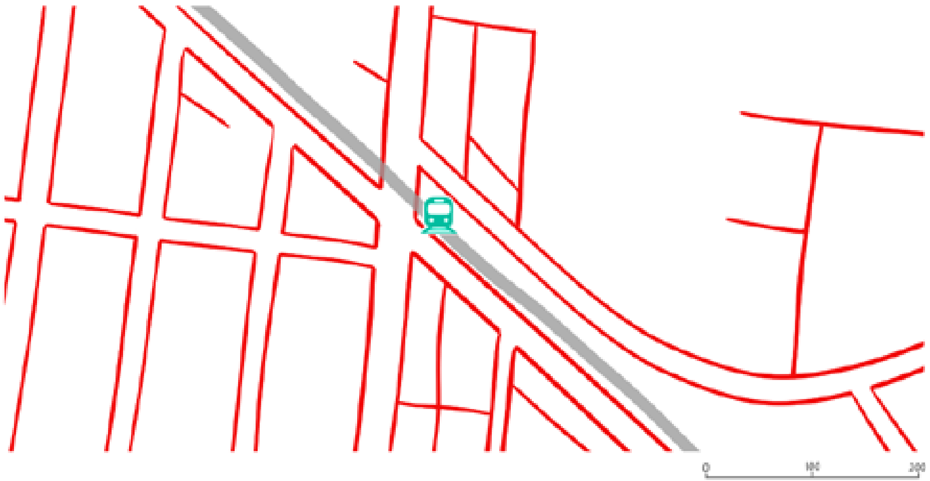
2014

2015



PEDESTRIAN ACCESS & NEAREST BUS STOPS

2014



2015

Road UP

OAKLEIGH
STATION

Warrigal Road was made into an overpass in 1968, with pedestrians confined to a narrow underpass beneath the station, or extremely long ramps over the tracks. Retailing adjacent to the overpass has suffered leaving many shops vacant, while the centre of Oakleigh has shifted east, away from the overpass with the redevelopment of former railyards into an indoor shopping centre. Pedestrian and cyclist access to Oakleigh station, the bus interchange and Oakleigh major activity centre is very poor from the south and west as a result. The grade separation divides communities either side of the rail corridor for many kilometres.

PEDESTRIAN ACCESS IS VERY LOW AMENITY
From either north or south, access means crossing a road and going down into a tunnel, or following a tortous route over a 450m pedestrian overpass.

FLOOD RISK IN TUNNEL
The tunnel may be subject to flooding which puts pedestrians at risk, and cuts off station access.

ECONOMIC DEVELOPMENT

Oakleigh is a major activity centre with many parcels of industrial land lining the rail corridor that would be ready for redevelopment under the right conditions. The main constraints on development in the precinct are the heritage-protected station buildings, the road overpass and the lack of ground level connectivity due to the railway.

Undoing the overpasses at Warrigal Road and Hanover Street would enable a broader re-thinking of the grade separation strategy to encourage re-integration of the activity centre and stimulate urban renewal along the corridor. Elevated rail on viaducts rather than embankments would free up the land in the rail corridor and create new frontages to adjacent property, create new public open space and maximise ground level connectivity. This would ideally be planned as part of a corridor including Huntingdale station.

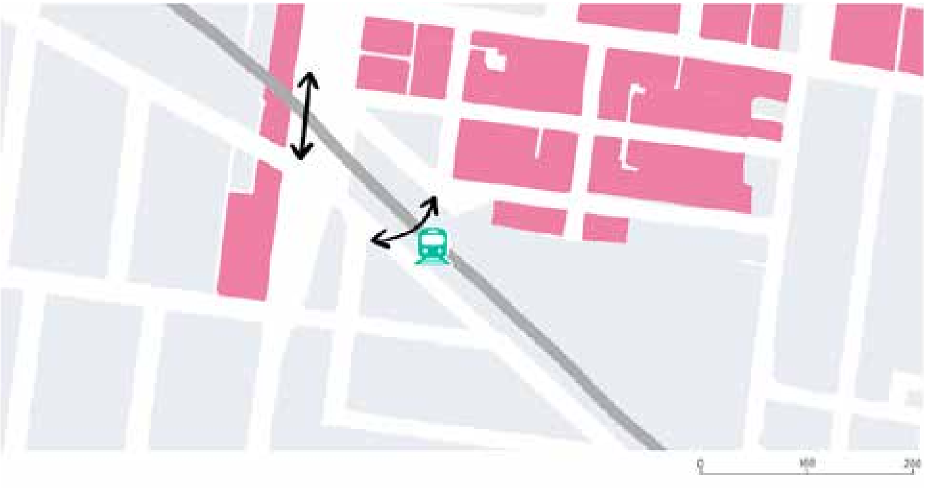
KEY

- Underutilised land
- Rail reserve
- 1 Image marker

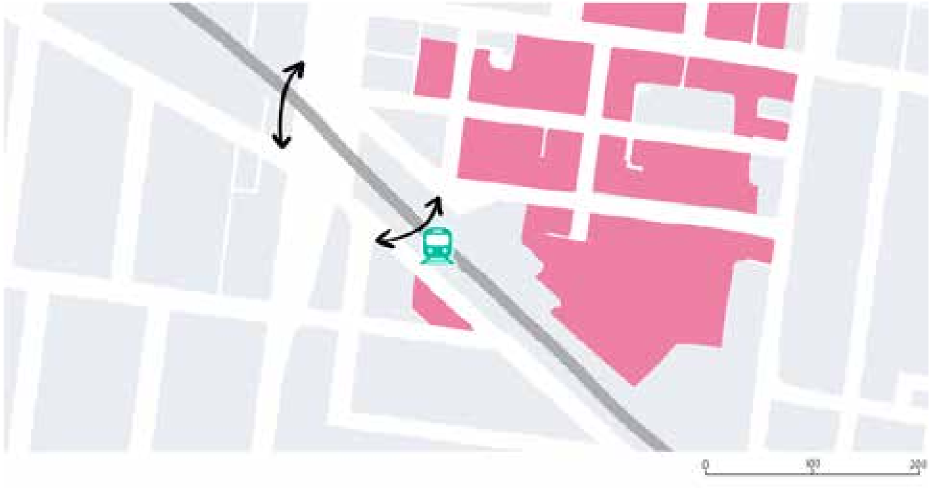
Map showing Oakleigh Station and surrounds

RETAIL & POINTS OF CROSSING

1945

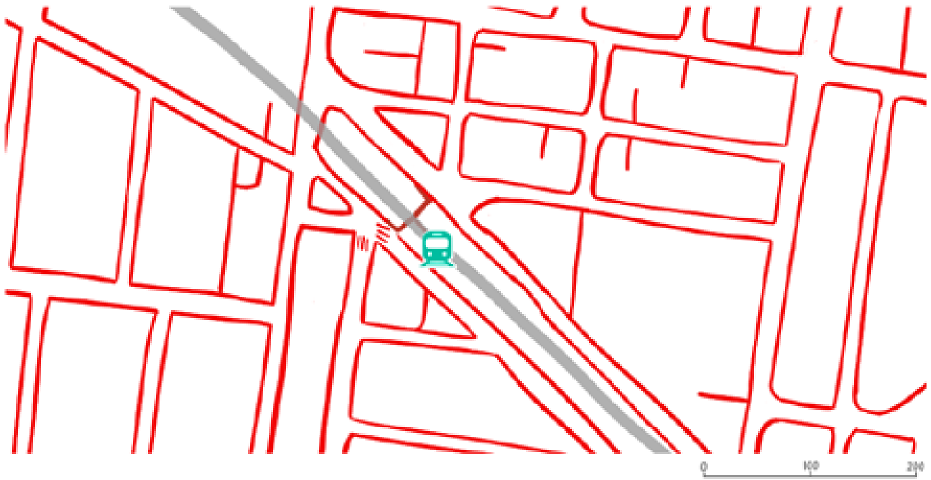


2015



PEDESTRIAN ACCESS & NEAREST BUS STOPS

1945



2015


www.hotrod.com.au
4


4

Road UP

HUNTINGDALE
STATION

The level crossing at North Road was removed in 1972 by creating a road overpass and re-routing Huntingdale Road onto it by circuitous on-ramps. The pedestrian tunnel beneath the station is the only place to cross the tracks in the 3.4km stretch between Oakleigh and Clayton. The combination of road and rail severance creates a number of divided communities and a very low amenity pedestrian and cycling environment.

LIMITED, AWKWARD ACCESS
From either east or west, access means crossing a road and going down into a tunnel.

THE ONLY WEST SIDE ENTRANCE IS HARD TO FIND
There is no other access across the rail line or to the station in any reasonable distance.

BUS CONNECTION IS CLOSE, BUT LOW AMENITY
Though the bus stops are just outside the station car park, they are not pleasant places to wait.

Huntingdale has one of the highest bus-rail transfer rates in the metropolitan area due to the link with the Monash employment cluster.

KEY

Underutilised land

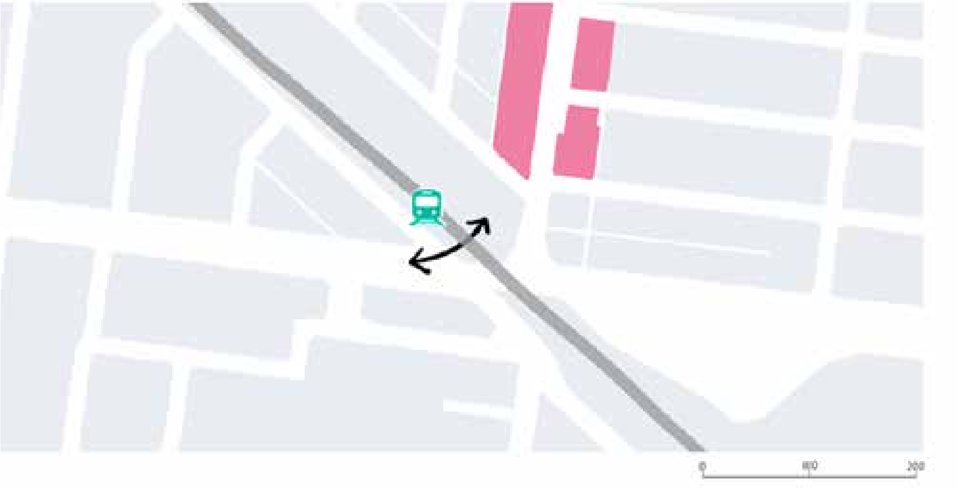
Rail reserve

1 Image marker

Map showing Huntingdale Station and surrounds

RETAIL & POINTS OF CROSSING

2015



ECONOMIC DEVELOPMENT

Huntingdale's proximity to the Monash employment cluster is significant. However, any potential for transit-oriented urban renewal that the industrial area around Huntingdale station may have is severely constrained by the severance created by road and rail infrastructure in the station precinct. Options to completely re-plan the precinct would arise if the grade separation was demolished and the ground plane reconstructed. Elevating the railway on a viaduct (as part of a corridor including Oakleigh) would release the land in the rail corridor, maximize ground level connectivity and vastly improve the amenity of the transit interchange. With improved connectivity and pedestrian amenity, redevelopment of the large surface carpark at Huntingdale station could realize the value capture opportunities of a mixed use development at such an important node on the transit network.

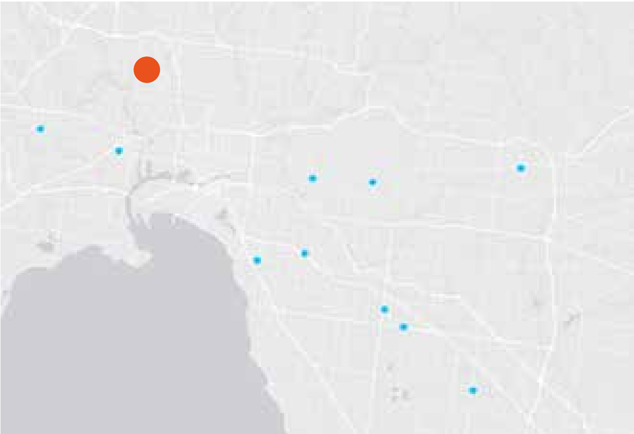
PEDESTRIAN ACCESS & NEAREST BUS STOPS

2015


6
601
PT>
Huntingdale Station
900
704
SmartBus

Road
DOWN

ESSENDON
STATION



The underpass that takes Mt Alexander Road under the railway line just north of Essendon Station was one of the earliest grade separations in Victoria's history. It was carried out in 1872, in the first decade of Melbourne's railways, but the at-grade rail line has created severance between the east and west sides of Essendon. Essendon is one of Melbourne's busiest suburban interchanges between rail, bus and tram, but the access between modes is poor. Activity is concentrated in the southern section, but the pedestrian tunnels constrains amenity.

Existing station entry

TWO TUNNELS UNDER THE STATION
Two flood prone tunnels create slightly more permeability than one, but the land on the north side of the station is still extremely inaccessible.

ROAD UNDERPASS
The road underpass beneath the rail bridge nearby allows easy access for cars and trams on Mt. Alexander Road, but is an unpleasant space for pedestrians and cyclists..

BUS CONNECTION CLOSE, BUT LOW AMENITY
Though the bus stops are just outside the station, they are not pleasant places to wait.

TRAM STOPS IN THE MIDDLE OF A ROUNDABOUT
Neither close to the train or the buses, the trams are disconnected from the other modes of transport as well as retail.

KEY

Underutilised land

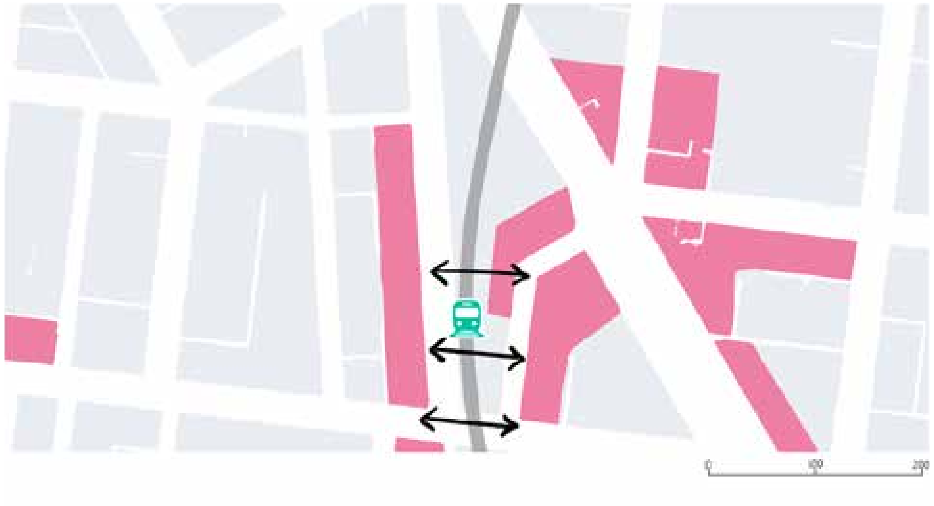
Rail reserve

1 Image marker

Map showing Essendon Station and surrounds

RETAIL & POINTS OF CROSSING

2015



PEDESTRIAN ACCESS & NEAREST BUS STOPS

2015

NB: there are no 'befores' for this site, as it was a rail terminus before the grade separated line was built to connect it to the northern region

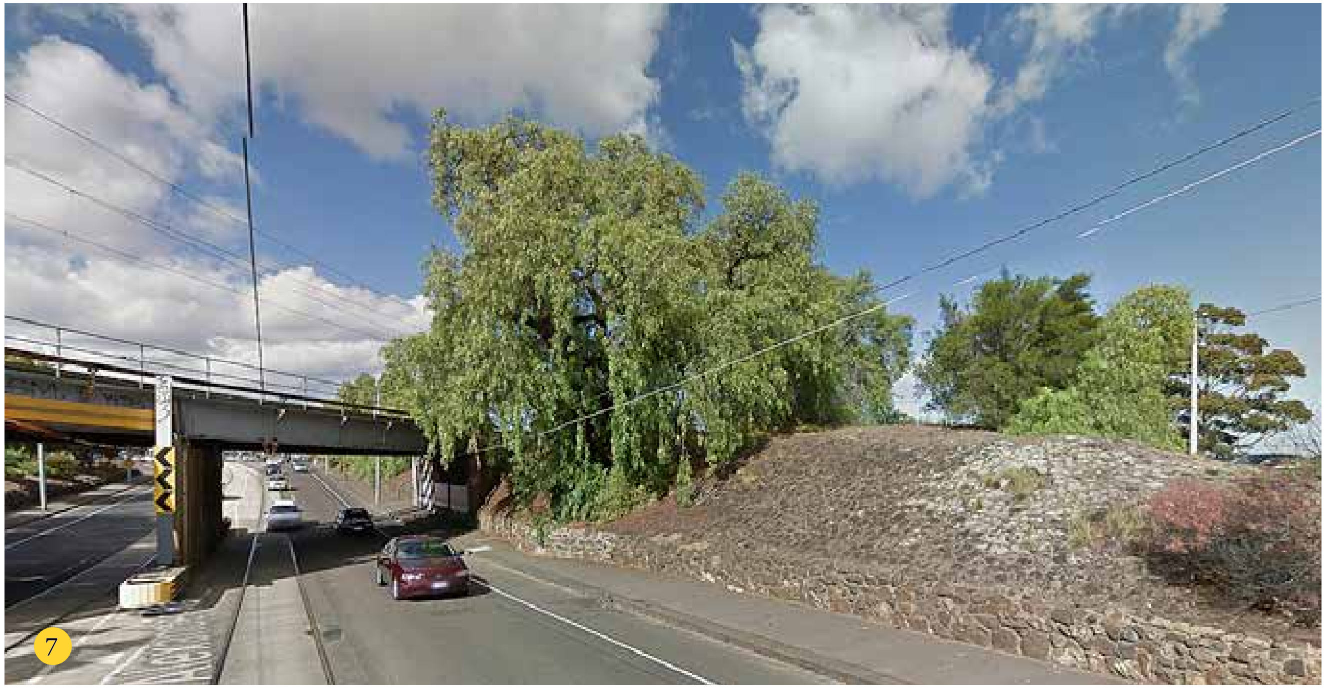
WALKABILITY AND ACCESSIBILITY

The map shows the 800m walking catchment of the station. On one hand, the catchment is roughly circular, which suggests that accessibility is almost optimal for the area. The map doesn't take into account impediments to walkability such as amenity, safety, and the location and timings for pedestrian crossings on busy roads. The streetscapes around Essendon station tell a very different story, where the retail area is fragmented and interchange between trams and trains and between trams and buses is poor. Furthermore, when compared to the aerial image on p. 66, it is clear that at the heart of this apparent walkability is a very large surface carpark around the station. This indicates enormous potential for economic development that is currently totally inconsistent with the urban design of the precinct

ECONOMIC DEVELOPMENT

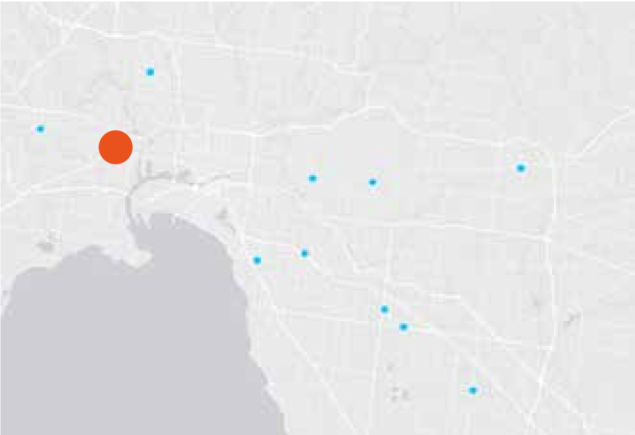
There are very large surface car parks with enormous potential for value capture as mixed use development linked to better intermodal interchange facilities. Realising this potential would mainly depend on securing greater ground level connectivity created by grade separation. The total value proposition would be a trade off between the enormous costs of full underground railway tunnels or a carefully designed elevated railway viaduct, both of which would be accompanied by substantial mixed use development of a larger scale than the current context, integrated with the transport interchange.

Station underpass (left); Underutilised land lies at the heart of Essendon around the station, with low amenity (Top, Bottom).



Road
DOWN

MIDDLE FOOTSCRAY
STATION



Middle Footscray Station is typified by the large fence built along its southern edge to prevent any crossing. The grade separation has favoured only cars along one road, and nearby activity has suffered due to the division. Station access is poor, with only one entrance, and bus connections are difficult.

Below: VICTORIA STREET, 1927, Underpass under construction
(Photo: State Library of Victoria)

Current station entry

LIMITED STATION ACCESS

From either north or south, access to the station is limited to one entrance, located below the bridge. There are fewer connections from north to south since the grade separation and retail activity has shrunk.

BUSES DIFFICULT TO REACH, LOW AMENITY

The bus stops are around the corner outside the station, and require a significant walk. One stop requires crossing over two busy roads. Moreover, they are not pleasant places to wait, facing busy roads with few nearby facilities or cover.

ECONOMIC DEVELOPMENT

The grade separation was done to ease traffic congestion while also part of upgrading the track capacity. There has been a shift of economic activity away from the station precinct, in part due to the demolition of buildings to widen the rail corridor. There is significant severance caused by the rail corridor, affecting amenity and development potential at its edges.

KEY

Underutilised land

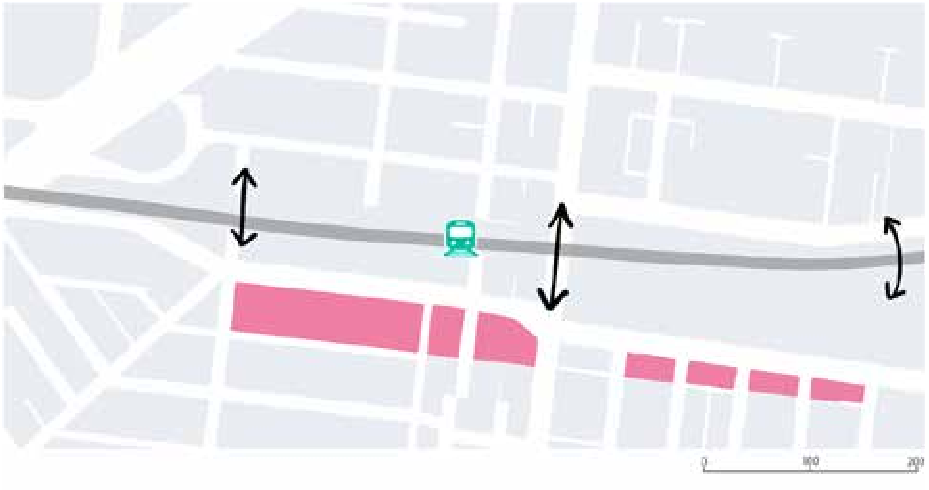
Rail reserve

1 Image marker

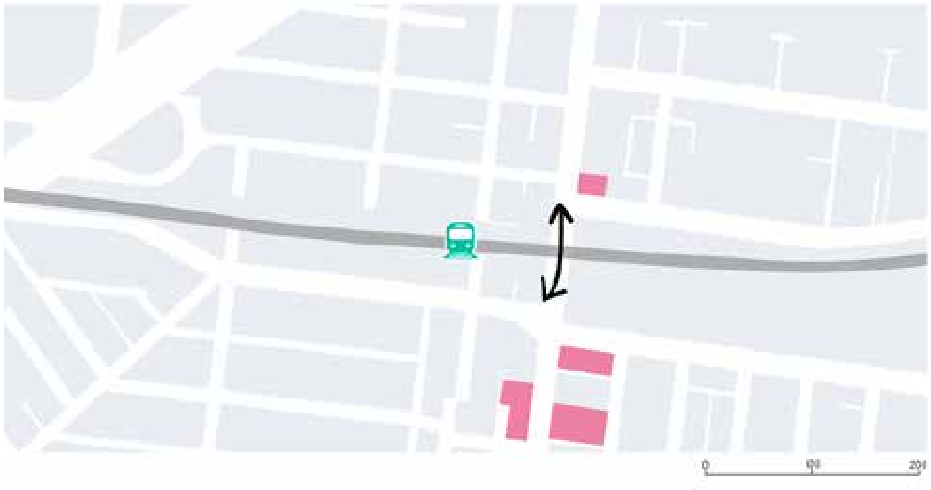
Map showing Middle Footscray Station and surrounds

RETAIL & POINTS OF CROSSING

1919

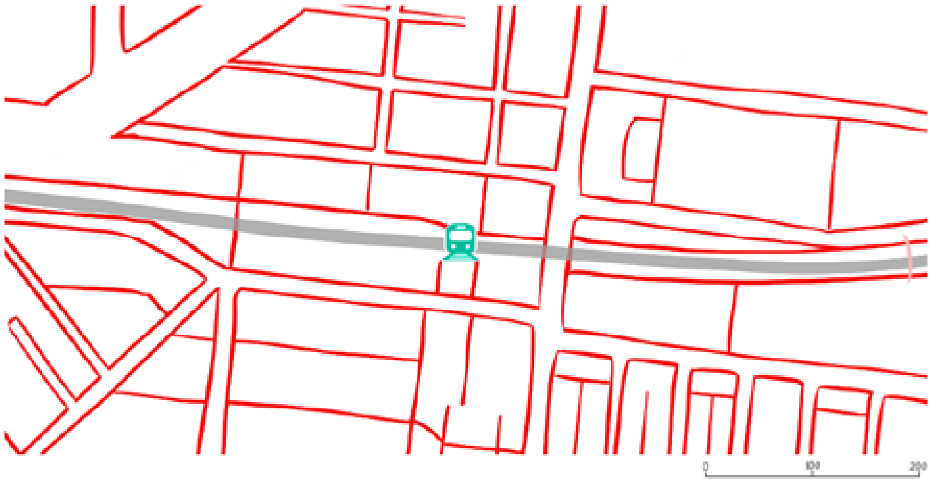


2015

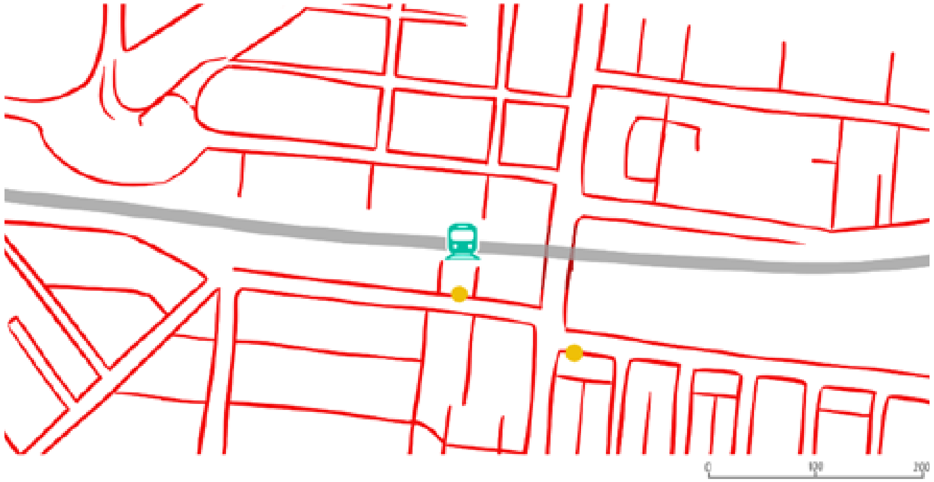


PEDESTRIAN ACCESS & NEAREST BUS STOPS

1919



2015



1

Road DOWN

ANDERSON
ROAD (Sunshine)

Anderson Road was grade separated in 2014 as part of the Regional Rail Link project to create a seaparate railway line for regional trains. Anderson Road is a difficult site at which to improve urban amenity through grade separation. Extensive urban and architectural design treatments of the rail bridge and underpass have been used to create a more attractive environment for drivers, and to provide a buffer for pedestrians.

A LONGER PATH FOR WALKERS AND CYCLISTS

The grade separation has created a much more complex crossing for pedestrians and cyclists, who must travel much further to make the journey. To travel across this single crossing from the residential area to the shopping centre, the single path available takes pedestrians 500m in a loop over the road, under the road, and then back up to travel down to the carpark. The distance "as the crow flies" is only 170m.

ECONOMIC DEVELOPMENT

Anderson Road was not a retail strip prior to grade separation, and its chances of becoming one have not been enhanced since. Pedestrian access between the residential areas to the west and the retail and commercial centre of Sunshine has not been improved by the grade separation, with some routes becoming far more circuitous.

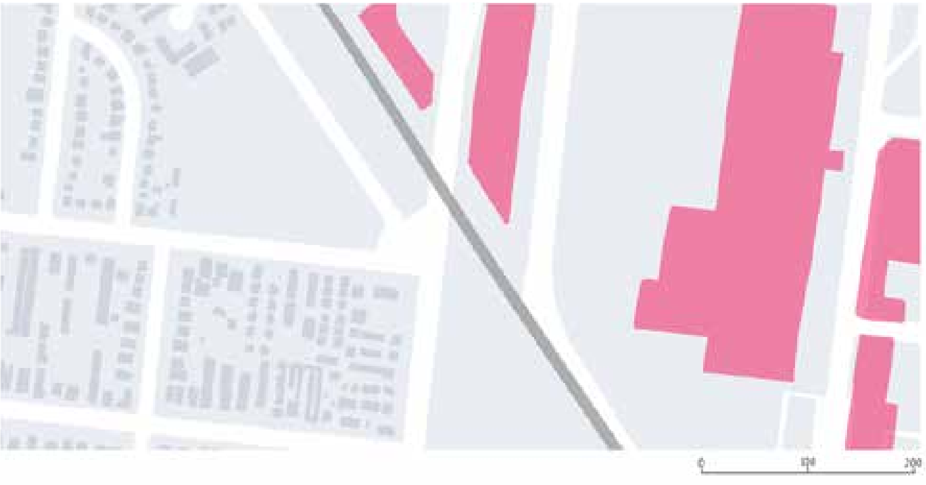
Map showing Anderson Rd and surrounds

KEY

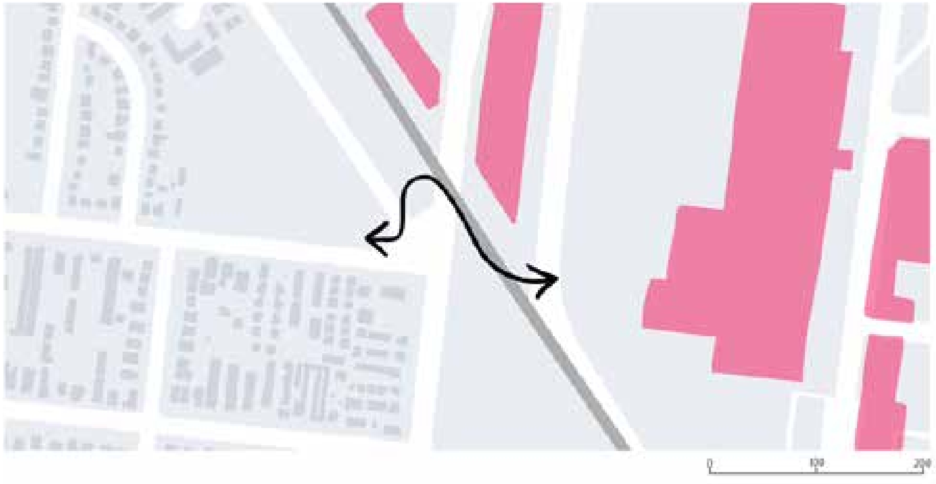
(light blue)	Underutilised land
(blue)	Rail reserve
1	Image marker

RETAIL & POINTS OF CROSSING

2012



2015



PEDESTRIAN ACCESS & NEAREST BUS STOPS

2012

2015

Removing the level crossing has resulted in cars, cyclists and pedestrians being separated from each other by walls. While this is safer, lowering the road has meant much longer distances for people to walk and ride to cross the railway line. The space beneath the railway is enclosed and dark with limited sightlines. A railway viaduct here would have felt much more open and created more opportunities for ground level connectivity and more walkable distances between the residential area to the west and the commercial centre of Sunshine.

OTHER TYPES

The focus of this study has been on four main ways of separating railways from roads each because that is what level crossing removal inevitably means. However, in some circumstances, grade separations may involve varying combinations of these types. For example, for technical or economic reasons, historically, roads have been partly lowered as part of an elevated rail grade separation to obtain the required grades. An example of this can be seen at Richmond Station where Swan St is been slightly lowered beneath the railway bridge.

Also, it is important to consider how pedestrian movements may be grade separated if the design does not integrate such pathways within and around the station. At many level crossings, pedestrian paths have been grade separated using various types of over and underpasses. Early examples involved flights of steps where space was limited, or where an alternative pathway was available at grade, albeit most likely adjacent to road traffic. There are many instances of stations where the only place pedestrians can cross the line is to cross the tracks next to vehicles. Ramps are used where there are no other paths pedestrians can take to cross the railway. The use of pedestrian underpasses and overpasses is common with road-over-rail grade separations, and has continued with more recent station projects (upgrades and new stations) adjacent to road-over-rail grade separations, though in many cases lifts are also included. Examples include: Sunshine, Roxburgh Park, Footscray West, Williams Landing. In these types, the station facilities have tended to be placed within the pedestrian bridge part of the design, often at some considerable distance from the surrounding streetscape context.

Sunshine Station (Top), West Footscray Station (Bottom): new stations as pedestrian overpasses, 2013-14 (Photo: 2015)

CONCLUSIONS

Our investigation of the history of level-crossing removals in Melbourne shows that there is a clear link between the motivation for doing them and the method used.

Generally, when the aim has been to improve the efficiency and capacity of rail operations, grade separations have involved either elevated or trenched rail.

When the aim has been solely to improve conditions for private vehicle traffic, then roads have been raised or lowered. This latter approach has damaged the urban fabric of the places where it has occurred. It is not recommended for any location where future development requires ground-level connectivity, such as activity centres of any type or size.

Through our case studies, we have shown that, if the objectives include a desire to improve rail services, it is better in residential and commercial precincts to raise or lower the railway.

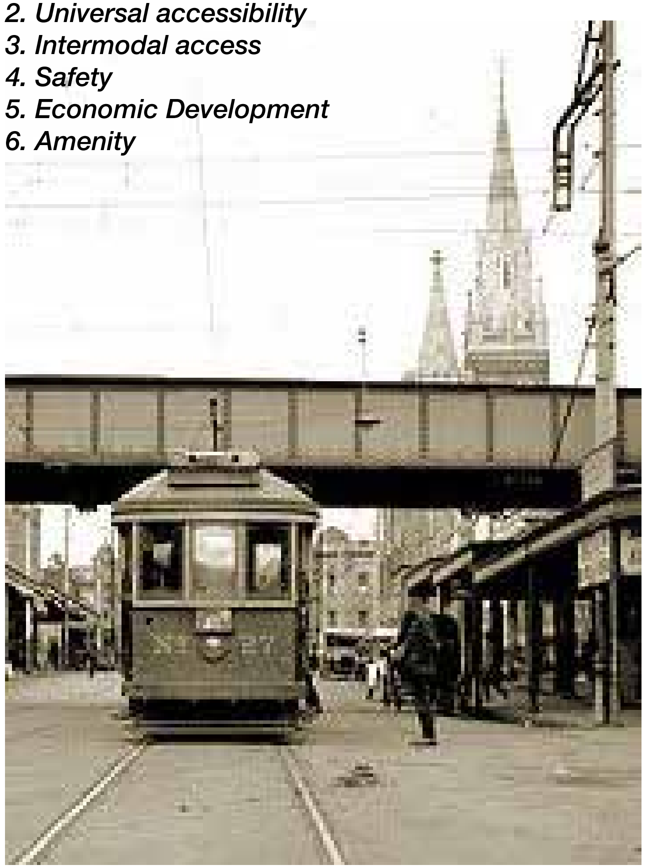
We have also shown that elevated rail is central to the effective design of Melbourne's best examples of public transport and land-use integration around stations.

This supports our view that elevated rail offers the greatest long-term benefits for level-crossing removals, in suburban locations except in places where it is technically infeasible from a rail operations viewpoint. At locations in the Melbourne CBD and other areas of very high land value tunnelling is most likely.

The criteria that we have used to assess Melbourne's historic level-crossing removals are equally relevant to evaluating new proposals that are emerging under the Government's plans to accelerate the pace of removals.

We encourage members of the community, professionals and politicians to use the questions from our assessment criteria on p. 31 when comparing the relative merits of any proposed designs. This will help to establish mutual understandings of the costs and benefits (in more than just financial terms). The assessment criteria cover these issues:

1. Connectivity
2. Universal accessibility
3. Intermodal access
4. Safety
5. Economic Development
6. Amenity



Rail bridge over Glenferrie Road c. 1920s

Other important considerations are:
7. 'Future-proofing'

- Does the design enable cost-effective responses to likely scenarios for the future?
- Can the design manage much greater demand for public transport, or shifts to active transport modes?
- Could access points to the station be added to support new land uses or take advantage of changes to ticketing systems?
- How can potential negative impacts of the design be minimised or managed?

8. Disruptions

- For how long will the movement of trains, buses, pedestrians, cyclists and other traffic be disrupted?
- How will construction-related mess, dirt and noise, including occupation of public land by contractors' plant, materials and spoil, be minimised?
- During construction and beyond, how will the project affect major utilities and drainage lines? What about flood risks and sea-level rise?
- How much disruption and damage would the design cause to heritage structures, significant trees and other vegetation, and remnant habitats and ecosystems?

9. Costs & benefits: the 'total value proposition'

- What are the construction costs of the design (including those related to its disruptiveness) relative to other options under consideration?
- What are the on-going maintenance costs, and how will they be met?
- What is the total value beyond construction cost? Does it create places of greater value than other options (taking into account effects on connectivity; provision of transport and complementary facilities; its ability to adapt to change over time, and its remediated and preserved landscape, vegetation and structures)?

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Windsor Station, 7 February, 1989. One of the downsides of trenched rail is not just difficulties with high water tables and re-locating sewerage, service lines and utilities, but also, flooding. This photograph shows the results of a severe storm causing flooding between Prahran and South Yarra that extended as far as Windsor and ended the service life of this unfortunate train. (Photo: Victorian Railways History http://victorianrailways.net/photogallery/suburb/windsor/windsor.html courtesy Jamie Della) Flooding at Windsor occured most recently in April 2011

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