CITY OF MELBOURNE

Transport Strategy refresh

Background paper: Walking

March 2018

Contents

Authors

This paper was prepared by MRCagney for the City of Melbourne. MRCagney are committed to providing advice that helps create well connected, vibrant and liveable places, giving people better, more sustainable travel choices. The consultancy views transport planning as an enabler of a broad range of positive outcomes and look at the impacts of transport on factors such as town centre economic vitality, community health, housing affordability and environmental performance. MRCagney has a depth of experience in advising cities and towns throughout Australia, New Zealand and internationally on public transport, land use planning, walking and cycling.

This paper was prepared by Karl Baker, Steven Burgess, Branwell Travers at MRCagney's Melbourne office with review from Kent Lundberg at MRCagney's Auckland office.

Executive Summary

This paper has been prepared by MRCagney to inform the City of Melbourne's refresh of its transport strategy. It focuses on the issues and opportunities within the municipality for walking as a means of transport, and particularly on emerging challenges that have become evident since the publication of the City of Melbourne's Walking Plan in 2014. The paper is intended to provoke thinking, discussion and further analysis by the City of Melbourne and its community.

The importance of walking and the growth challenge

Walking is the most overt expression of life in any city. Places with high levels of walking activity reflect concentrations of social and economic activity and are locations where the public life of the city is most vital. Most of us walk every day and the routine nature of walking can detract from its significance as part of the transport system. Within the City of Melbourne local government area, 66% of all internal trips are on foot (VISTA 2016), highlighting the role walking plays for local connectivity.

Melbourne is growing fast. Being at the centre of a growing metropolitan area, the municipality is experiencing growing transport demands on its streets. Approximately one in seven Victorians now access the municipality on a daily basis as a resident, worker or visitor (ABS 2017b). Between 2004 and 2016 the average daily population of the municipality has increased from 680,000 to 900,000 and is projected to top 1.4 million by 2036. This will be accompanied by significant growth in walking activity and substantial intervention will be required to accommodate forecasts for 2.5 times more walking activity over current levels by 2030.

Key problems

The City of Melbourne developed a walking plan in 2014 to articulate the importance of walking to the city and to set long-term objectives to improve and support walkability in the future. With accelerating recent growth, there is now a renewed urgency to act and resolve increasingly acute problems. This paper identifies four key challenges for the walkability of the municipality as it grows and evolves to 2050:

A. Crowding and delay – that threaten the basic functionality of walking movement throughout the municipality

B. Walking connectivity – that impacts on the economic productivity of the municipality

C. Inclusive spaces for life in the city – ensuring that vulnerable and marginal groups including women, children, people with disabilities and the elderly are well accommodated at all times of the day and night

D. Safety and security of the walking environment – reducing road crashes and responding to emerging security threats.

Global best practice

After assessing evidence for key problems for walkability in the municipality, the paper turns to four international case studies where cities are adopting innovative measures to improve walking environments and enable better planning processes for walking. These cities are acknowledging the powerful benefits of a walkable city for economic prosperity and quality of life and offer lessons for the City of Melbourne:

- Dublin – where the city council has recently introduced a 'Slow Zones' policy that reduces default speed limits to 30km/h, bringing benefits for street amenity and road safety.
- Barcelona – where the council has adopted a 'superblock' concept that rationalises traffic circulation and allows for repurposing of road space for walking and an enhanced public realm.

- Auckland – where Auckland Council is experimenting with innovative methods for calculating the economic cost of pedestrian delay at signalised intersections within its city centre, helping to build a robust case for adjusting signal cycles to reduce delay for people walking.

Interventions

Building on the review of global best practice, the paper identifies a series of potential interventions that can address emerging problems for future walkability. The focus is on tools within the jurisdiction of the City of Melbourne including:

- Space for walking – interventions such as widening footpaths and pedestrian space at intersections and new shared spaces that overcome crowding problems while providing a more generous public realm.
- Time for walking – interventions that increase the allocation of signalised intersection time to walking.
- A connected walking network – initiatives that support a permeable, fine-grained network of pedestrian routes, including pedestrian crossings and planning tools to ensure new developments have good walking connectivity.
- Safe and secure walking – measures such as traffic speed management and infrastructure treatments that address ongoing road safety problems for pedestrians and the safety of walking at day and night particularly for more vulnerable groups such as women, children and the elderly.
- Rationalising traffic circulation – traffic management interventions that can allow for reallocation of road space and intersection time for improved walking conditions.

Policy approaches for Melbourne

While the range of tools available to the City of Melbourne for improving walkability is clear, the key decisions for Council to 2050 will be the level of ambition, the speed of implementation and the degree to which trade-offs with other street users are accepted while prioritising walkability. There is a spectrum of strategic-level responses available, from incremental improvement to radical transformation. This section briefly outlines the benefits of challenges of three different approaches:

- React – respond to acute problems, resulting in incremental improvements
- Anticipate – plan ahead and provide for forecast growth in walking, resulting in consistent improvements ahead of major problems occurring
- Transform – accelerate the transition to world-leading walkable city that makes the very best of the city's potential for human-centred places.

Recommendations

The concluding section offers nine key recommendations for the City of Melbourne as it refreshes its transport strategy and builds on its 2014 Walking Plan. A bolder and faster approach to reallocating space and time for walking will be important for managing the profound growth in walking activity expected during the coming decades, particularly around public transport hubs. The recommendations identify a need to simultaneously consider the functional requirements of growing walking demand, together with the need for generous provision for the public life of the street that relies on people space. Managing traffic speeds and rationalising traffic circulation with the central city will be crucial for a more attractive and safer walking environment.

Cities exist for people, not machines. Having recognised the importance of walking, the challenge for the City of Melbourne is to make the bold interventions that will be required to maintain Melbourne's unique identity and its reputation as one of the world's premier cities.

A note on terminology - *The City of Melbourne local government area is generally referred to as 'the municipality' in this paper while the Council is referred to as 'the City of Melbourne'. The 'central city' refers to the area encompassing the Hoddle grid and Southbank.*

1. Defining the problem

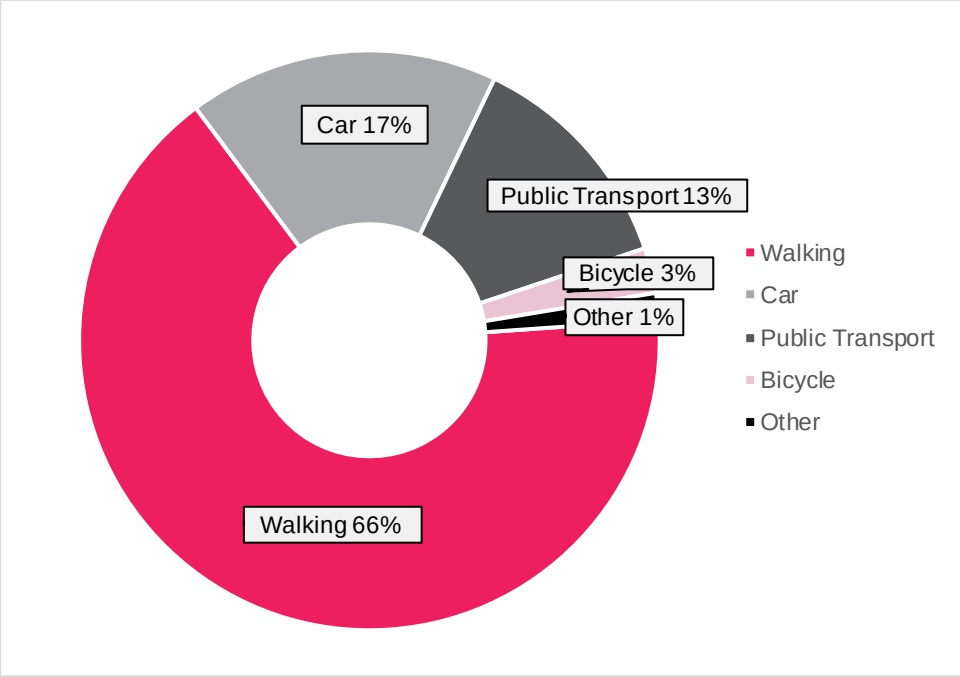
The importance of walking

Walking is fundamental to our everyday experience of the city. Most of us walk at some point of the day, from the train station to work or from a parked car to the shops. In Melbourne's central city (defined as the area including the Hoddle grid and Southbank), walking is the primary way by which residents, workers, shoppers and other visitors move around.

The City of Melbourne's streets and laneways are intrinsic to its distinctive character and identity. Walking on grand Collins Street, lively Bourke Street Mall, bustling Errol Street or through the dense network of laneways and arcades is a major part of our experience of the city. The quality of this experience colours our perceptions of the quality of the broader Melbourne metropolitan area as a place to do business, to work, shop, visit or reside.

The everyday or routine nature of walking can detract from its significance as part of the transport system, and its place in supporting connectivity for social and economic purposes. Within the municipality, walking is the most important means of transport, with 66% of trips being on foot (see Figure 1, VISTA 2016). On an average weekday there are an estimated 324,000 walking trips within the municipality, far outnumbering the 61,000 private vehicle or 42,000 tram trips (Victorian Government 2016a).

Figure 1: Trips within the City of Melbourne by mode, average weekday 2015/16



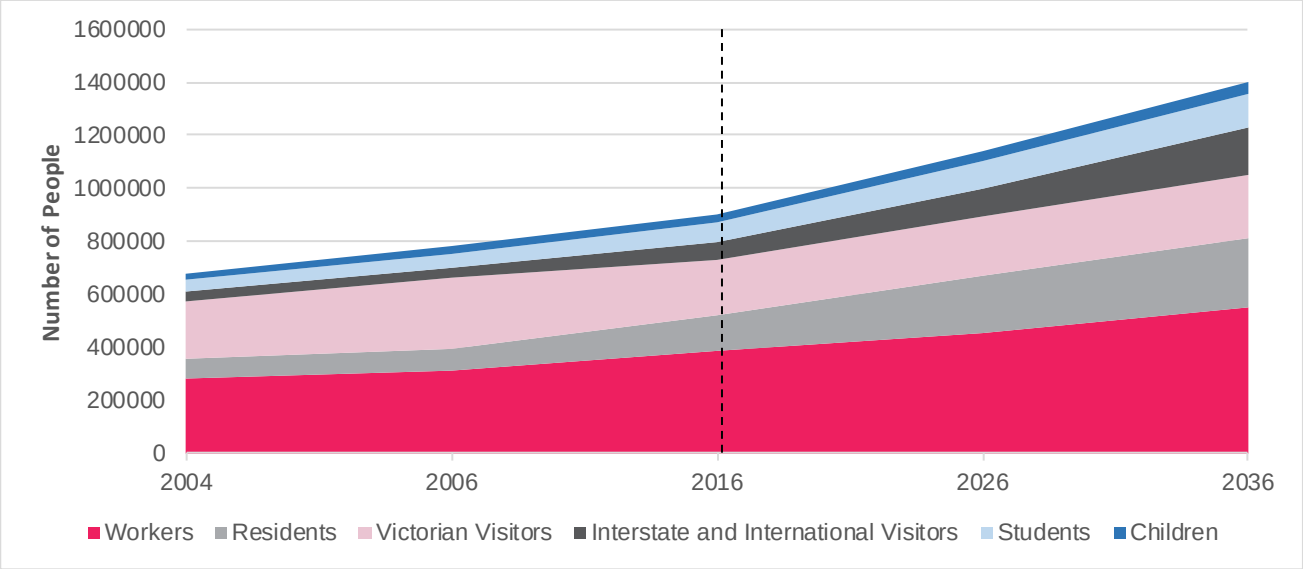
Source: Victorian Integrated Study of Travel and Activity (Victorian Government) 2016.

The growth challenge

The municipality is experiencing significant change and growth that exacerbates challenges for walkability but also opens up new opportunities. Growth has recently accelerated, and since the City of Melbourne's 2014 Walking Plan, increasing walking activity means that problems such as pedestrian crowding have become more acute.

Between 2004 and 2016 the average daily population in the municipality has increased from 680,000 to 900,000. It is projected to top 1 million people by 2021 and reach 1.4 million by 2036 (see Figure 2). Growth projections have been revised upward since the estimates that informed the 2014 Walking Plan. Increased daily population is expected across all groups, with the highest numbers of additional people to 2036 being workers (+165,000 above 2016 levels), residents (+127,000) and international visitors (+106,000).

Figure 2: Historic and forecast growth in the average daily population in the City of Melbourne, 2004 – 2036.

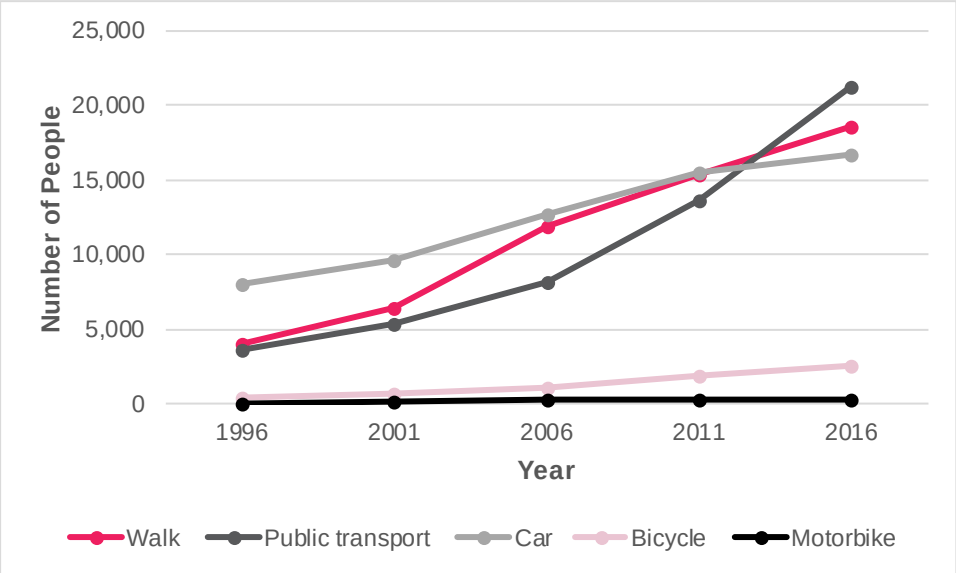


Source: City of Melbourne 2017c, Daily Population Estimates and Forecasts – 2017 Update.

The sheer increase in the number of people in the municipality in the coming decades presents a significant challenge for accommodating increased walking activity and increased demands on the use of footpaths as public spaces. The City of Melbourne has a target for 30% of all trips to be on foot by 2030 (to, from or within the municipality) (City of Melbourne 2012). This is a profound increase in walking activity. It represents over one million walking trips per day, an increase of approximately 2.5 times over current levels, or an extra 600,000 trips per day. Accommodating this level of increase will require substantial intervention and change from the status quo.

These growth forecasts and targets reflect recent trends toward central city intensification of living, retail and business activity. Approximately one in seven Victorians now access the municipality on a daily basis as a resident, worker or visitor (ABS 2017b). Among municipality residents, the number of people walking to work on an average day has more than quadrupled during the past 20 years, from around 4,000 in 1996 to 18,500 in 2016 (see Figure 3, ABS 1996 and 2016 Census). At the same time, the number of people using public transport to access jobs in the municipality from across the metropolitan region has more than doubled from 90,000 a day in 1996 to 219,000 in 2016 (ABS 1996 and 2016 Census). Growing public transport use has implications for walking, with each trip involving a walking trip at both start and finish and pedestrian crowding around key public transport hubs becoming a clear issue.

Figure 3: Method of travel to work, City of Melbourne residents (1996-2016)



Source: Victorian Government 2013, Victorian Transport Atlas 2013 and ABS 2016 Census of Population and Housing) by place enumeration.

The recent success of Melbourne's central city as an increasingly popular location for business location, residential living, tourist visitation, shopping and public life in many respects reflects the efforts to improve the walkability of the municipality. Ensuring that this positive trajectory continues will require ongoing focus on further improvements. While Melbourne has led the world during the past 30 years as an exemplar for revitalising a central city, international cities are quickly catching up and renewed efforts are required to cater to the sheer numbers of people expected to be walking and using public spaces as the city grows and to ensure the quality of walking space remains internationally competitive.

The City of Melbourne developed a Walking Plan in 2014 to articulate the importance of walking and to set long-term objectives to improve walkability in the future. While the existing Walking Plan identifies a comprehensive range of actions, the pace of implementation has been slow. With accelerating recent growth, there is now a renewed urgency to act and resolve increasingly acute problems. This section identifies four key challenges for walkability, as the municipality grows and evolves to 2050:

A. Crowding and delay – that threaten the basic functionality of walking movement throughout the municipality

B. Walking connectivity – that impacts on the economic productivity of the municipality

C. Inclusive spaces for life in the city – ensuring that vulnerable and marginal groups including women, children, people with disabilities and the elderly are well accommodated at all times of the day and night

D. Safety and security of the walking environment – reducing road crashes and responding to emerging security threats. Note: A, B and C also all relate to the safety of walking.

This paper focuses on problems and opportunities within the central city area of the City of Melbourne (the Hoddle grid and Southbank). Due to the intensity of walking activity in these locations, this is where issues for walkability are most acute. The range of interventions considered has broader applicability cross the municipality.

A. Crowding and delay

Crowding at footpaths and intersections

A major challenge for walkability in the central city is excessive crowding of people on foot on busy footpaths and at intersections. Crowding can be an issue in areas where there is a significant build-up in pedestrian volumes competing for limited footpath space. This contributes to an uncomfortable environment that does not meet the needs of all users of the footpath, detracts from the enjoyment of walking and can contribute to road safety risks.

The central city's footpaths and laneways are a legacy from historical plans and were not designed to accommodate the volume of people they carry today or support the intensity of land-use that exist at some locations. While the municipality's grid of wide streets and lanes has served the city well, the level of crowding and delay in many locations is reaching levels which impact on the basic functionality of walking infrastructure and the comfort, safety and efficiency of walking. Forecast levels of future growth will only compound the issue which will further put pressure on the quality, comfort and safety of walking.

The City of Melbourne has undertaken some initial research to quantify crowding using a 'Pedestrian Comfort Level' measure (City of Melbourne, 2017d). This compares pedestrian volumes with the area of space allocated to pedestrians and highlights particular congestion at Flagstaff Station and Chinatown-Swanston Street.

Pedestrian congestion is obviously most acute at signalised intersections where crowds of people walking build up to wait at traffic lights. However, there are also congested conditions between intersections due to narrow footpaths that are inappropriate for pedestrian volumes and intrusion of footpath clutter. Examples of very narrow footpaths on streets with relatively high walking activity are illustrated in Figure 4.

Figure 4: Narrow footpaths and congested walking conditions on Little Bourke Street (left) Flinders Lane (right)

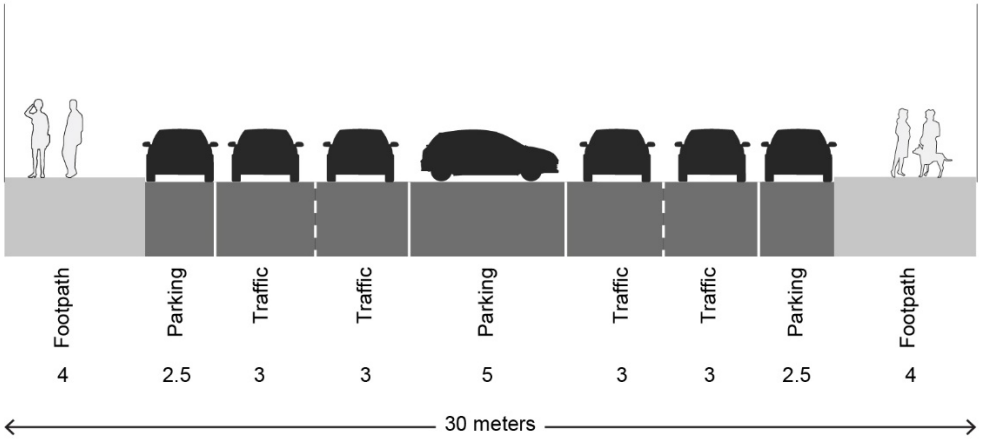
Source: MRCagney.

Pedestrian crowding often reflects a poor allocation of road space between transport modes. For example, insufficient space may be provided for high volumes of people walking while ample space is provided for relatively low traffic volumes. For instance, Russell Street carries approximately equal numbers of vehicles and pedestrians, yet over three times more street width is allocated to vehicles (parking and traffic lanes) than

pedestrians (see Figure 5). Russell Street around its intersection with Bourke Street carries approximately 24,000 private vehicles each day (VicRoads 2017) alongside 25,000 – 30,000 pedestrians (authors estimate from City of Melbourne 2017a, counts only available for west side of street).

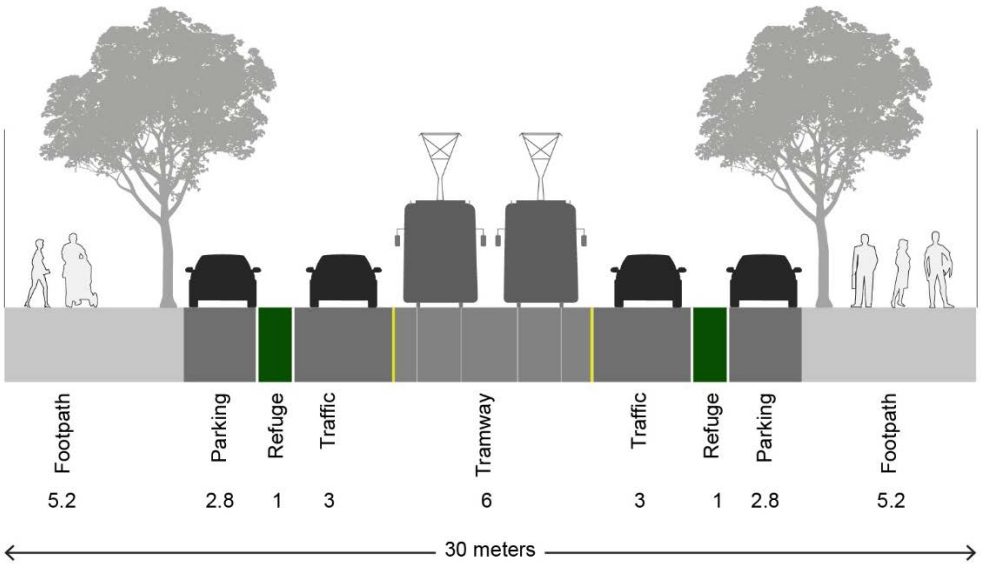
Russell Street's footpaths are relatively narrow at approximately 4 metres wide and in some locations alfresco dining and street clutter reduces the walkable width of the footpath to 2 metres. Around 8 metres of street width is allocated to walking against 22 metres for traffic and parking (see Figure 5).

Figure 5: Russell Street cross section (between Little Bourke and Lonsdale Streets)



In contrast, some locations within the central city have a more appropriate balance of space allocation between modes. Collins Street at Collins Place has average daily pedestrian volumes of approximately 20,000 people (City of Melbourne 2017a) alongside two-way vehicle volumes of approximately 16,000 (VicRoads 2017) and several busy tram routes. In contrast to Russell Street, pedestrians are provided with a more generous 10.4 metres of road width. Traffic and parking are provided with 11.6 metres while the tram corridor uses 6 metres.

Figure 6: Collins Street cross section (Collins Place, between Exhibition and Spring Streets)

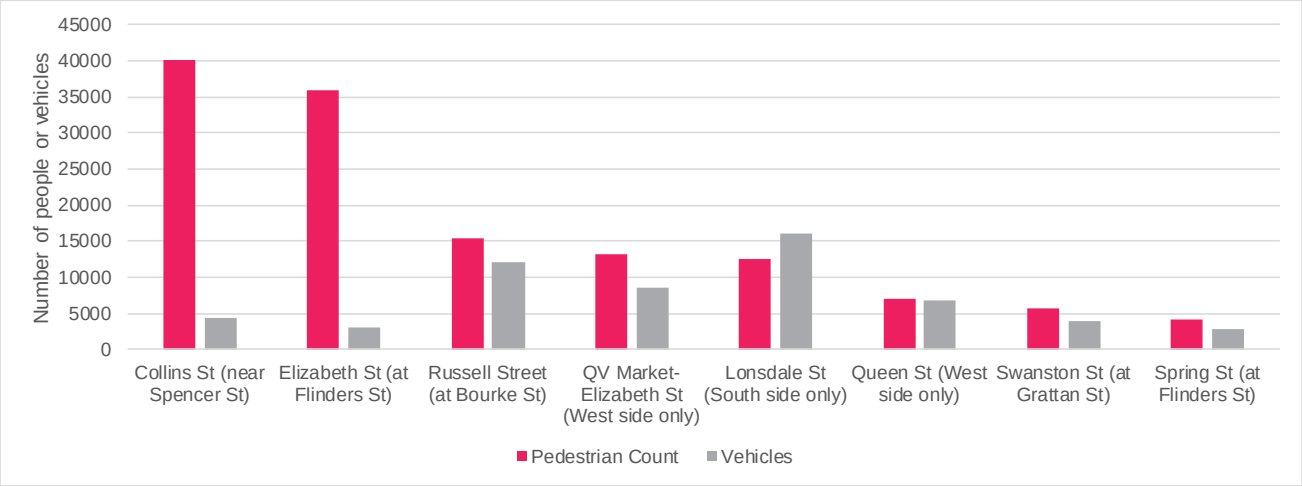


Swanston Street and Bourke Streets are among the municipality's busiest pedestrian thoroughfares carrying up to 74,000 people walking on an average day (Swanston Street around Flinders Lane, City of Melbourne

2017a). These streets provide a more generous pavement width alongside tram routes and provide exemplars of streets that move large volumes of people using space-efficient public transport and walking modes.

The importance of walking, particularly in the central city, means that on many streets within the Hoddle grid the number of people walking far exceeds the number of other transport users on the street. For instance, on Collins Street between Spencer and King Streets, there are approximately 40,000 people walking, around ten times the approximately 4,000 vehicles that use the street on an average day (see Figure 7). Likewise, on Elizabeth Street at its junction with Flinders Street the approximately 35,000 people walking far exceed the 3,000 vehicles using the street.

Figure 7: Average daily numbers of people walking and numbers of vehicles using selected City of Melbourne streets

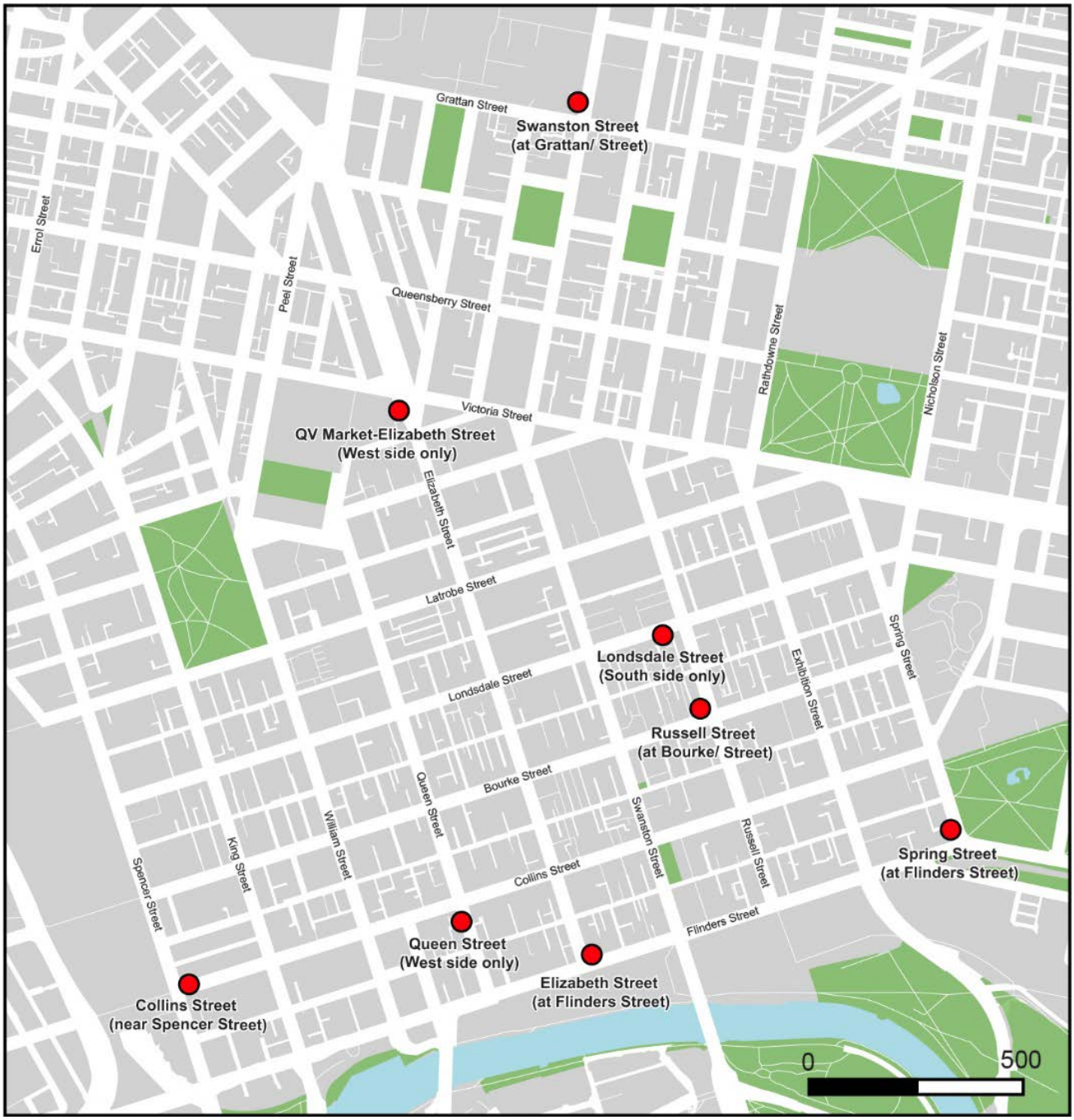


Note: Due to limitations in pedestrian count data, for all streets except Collins Street vehicle and pedestrian flows are only reported for a single direction Source: VicRoads Traffic Volumes for Freeways and Arterial Roads, 2017 and City of Melbourne 2017a, City *of Melbourne Open Data, pedestrian volume October 31, 2016 to October 31, 2017*, *available at:* https://data.melbourne.vic.gov.au/Transport-Movement/Pedestrian-volume-updated-monthly-/b2ak-trbp

Crowding problems are generally most acute at signalised intersections, where flows of people walking are halted and wait for time to cross. Footpath space at intersections can be insufficient to accommodate heavy flows of people walking and long signal phases can mean substantial build-up of pedestrian volumes, particularly at peak times and where pedestrian flows converge at key public transport stations, including rail stations and tram stops (see Figure 12). Figure 11 illustrates findings from a recent assessment of crowding levels at intersections within the Hoddle grid. Severe overcrowding is found at:

- Flagstaff Garden, outside Flagstaff Station (corner La Trobe and William Street)
- Spencer/ Collins Street, outside Southern Cross Station
- Collins/ King Street, where heavy traffic volumes intersect with high numbers of people walking
- Flinders/ Elizabeth Street and Flinders/ Swanston Street, outside Flinders Street Station
- Spring/ Collins Street, outside Parliament Station
- Elizabeth/ La Trobe Street, near Melbourne Central Station.

Figure 8: Location of pedestrian and vehicle traffic comparison detailed in Figure 2 and Figure 7



These findings highlight the interaction between walking and public transport use, with every public transport trip involving walking trips at both origin and destination. There has been strong recent growth in public transport trips to, from and within the municipality with an extra 117,000 trips completed per day by public transport between 2009 and 2016 (Victorian Government 2016a). Forecasts suggest that this growth will continue, with an estimated additional 690,000 public transport trips per day by 2030 with origins or destinations in the municipality (City of Melbourne 2012). This growth in public transport use will exacerbate problems of pedestrian crowding around stations.

Impacts of Melbourne Metro Rail Tunnel

The Melbourne Metro Rail Tunnel is a transformative and city shaping project which will run through the heart of the municipality and provide additional capacity for 39,000 more passengers to use the rail system each peak period. The construction of the Melbourne Metro Rail Tunnel and its accompanying stations at North Melbourne, Parkville, State Library, Town Hall and Anzac will redistribute pedestrian demand around new station entrances and without additional space for walking will likely lead to increasing numbers of severely crowded intersections.

New pedestrian traffic generated by the Melbourne Metro Rail Tunnel will create high volumes of pedestrian movement in locations where activity previously had been lower or more dispersed. The growth in pedestrian activity will also compound existing overcrowding issues at Flinders Street and Melbourne Central stations. The table below summarises the number of people accessing the new Melbourne Metro Stations in the central city during the PM peak in 2031 (AJM Joint Venture 2016).

Station	**Total number of passenger entrances and exits (PM Peak, 2031)**
Anzac Station	8,780
Town Hall Station	20,809
Flinders Street	54,771
State Library Station	14,590
Melbourne Central	21,870
Parkville Station	12,930

Figure 9: Busy pedestrian crossing at the Town Hall tram stop at the corner of Swanston and Collins Streets

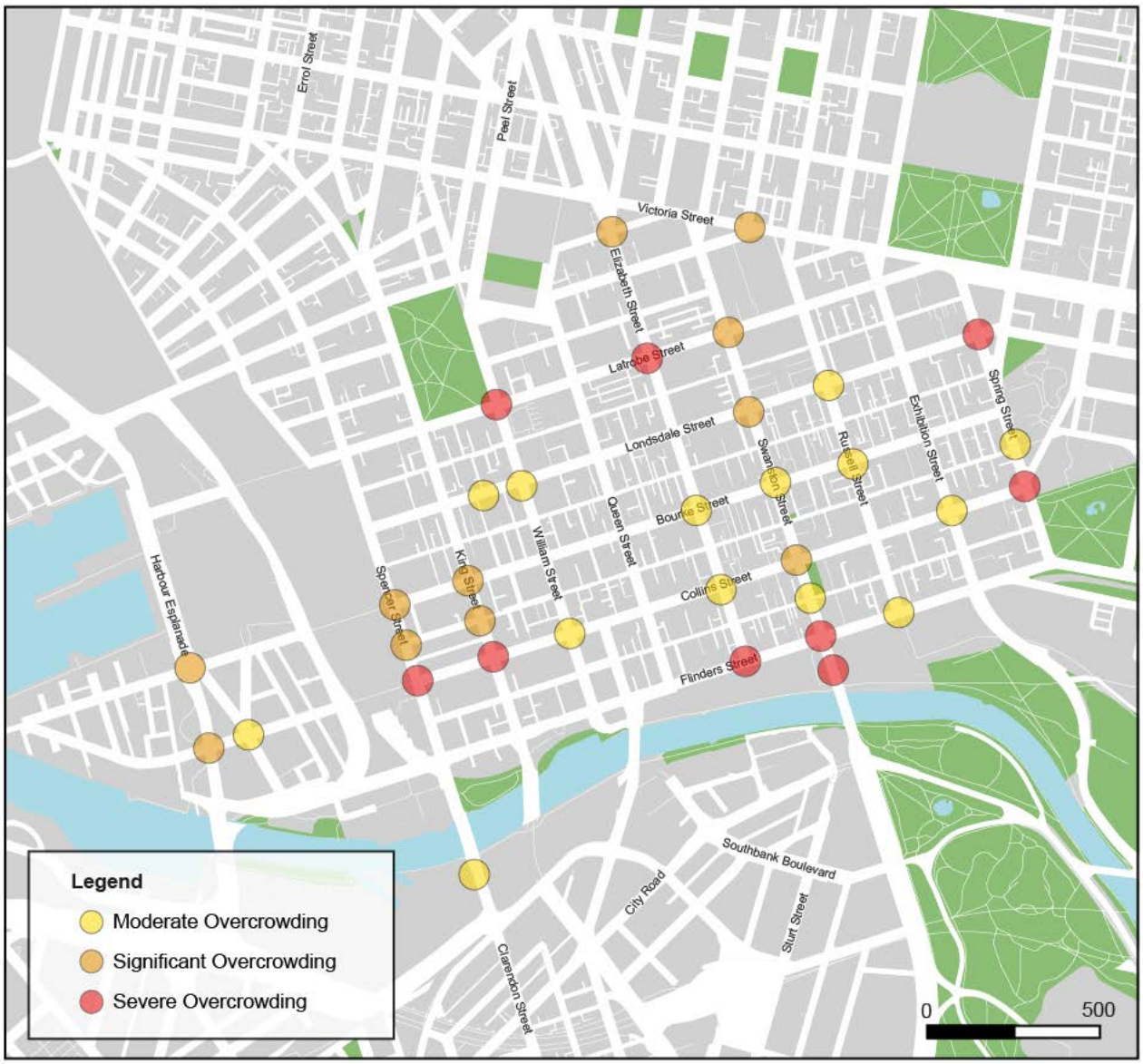
Source: MRCagney

Problems of crowding are being exacerbated in many locations, particularly in the central city, due to increasing competition for footpath space from other uses such as motorcycle parking, kerbside cafes, facilities such as rubbish bins and street furniture and forms of street 'clutter' such as inappropriately located signage and bollards and (see Figure 10).

Figure 10: Motorcycle and bike parking utilising the narrow footpath space on Flinders Lane

Source: MRCagney

Figure 11: Pedestrian crowding at intersections, Melbourne central city



Source: City of Melbourne 2014a, Walking Plan 2013-2017

Delay at intersections

Related to problems of crowding, people walking also face delays waiting at intersections. This can impact on the attractiveness and efficiency of walking as a transport choice. Frustration associated with excessive delay can lead to safety problems as people ignore lights. Pedestrian delay is primarily caused by the management of signalised intersections. Signal cycle times, walk duration and the application of 'auto-on' pedestrian phases can all influence the level of pedestrian delay.

Cycle times: Traffic signal cycle times that are long or that over-allocate time to traffic can result in excessive pedestrian delay and crowding at intersections at peak periods. A typical two-phase intersection with a 100 second cycle time provides for 30 seconds of walk time with 70 seconds of wait time resulting in an average pedestrian delay of 24.5 seconds and a maximum delay of 70 seconds (Traffinity, 2014). Typically, signalised intersections in the Hoddle grid operate on 90-second cycles during peak periods (City of Melbourne 2014a). Prior to 2013, intersections at King and Spencer streets operated at longer cycle times (110 and 120 seconds) which significantly disadvantaged pedestrian movements (City of Melbourne 2014a).

Walk duration: The duration of the walk phase has a strong relationship to the number of people who can complete a crossing within a cycle and has been identified as a major influence on pedestrian delay (Traffinity 2014). The time afforded to pedestrians to complete a crossing also has implications for people with mobility issues who may take longer to walk across an intersection. Analysis of central city signal data suggests that extending the walk duration of intersections by 4 seconds, while keeping all other signal aspects unchanged, would reduce pedestrian delay by an average of 3 seconds at each intersection (Traffinity 2014). While this would result in a minor improvement to individual walking times, when this is aggregated across large volumes of pedestrians it can add to a substantial collective benefit.

'Auto-on' signals for pedestrians (where a pedestrian does not have to push a pedestrian operated signal to initiate a green pedestrian phase) are used throughout the central city but are not universal throughout the municipality. The absence of auto-on can unnecessarily delay pedestrians because the pedestrian operated signal is pushed after the point at which the walk demand is registered for the upcoming phase resulting into additional delay for pedestrians.

Allocating time at signals can introduce trade-offs with other modes including private vehicles and trams and buses. While there have been recent improvements to signal management, particularly in the central city, there are likely to be multiple intersections where signal management can be further optimised to improve multi-modal efficiency and increase the attractiveness of walking. At intersections such as outside Flinders Street or Southern Cross stations the allocation of signal time does not favour walking, resulting in excessive crowding and delay for people on foot.

Building a strong case to justify re-allocation of time at intersection and reduced cycle times will require more precise quantification of pedestrian delay, and techniques used to do this in international contexts are explored further in Section 2, Global Best Practice (Auckland case study).

Impacts of crowding and delay

Excessive crowding can negatively impact on the attractiveness of the central city as a place to spend time and to gather with friends, colleagues or family. Furthermore, excessive crowding threatens the efficiency, function and desirability of walking as a viable transport mode.

Currently, there is no clear evidence to suggest that crowding has reached a level in the central city that could thwart walking activity, however there are some genuine social and economic implications associated with the future levels of crowding that should be understood, managed and monitored.

The central city risks losing its competitive advantage to alternative inner urban locations if overcrowding is not managed with consideration to attracting and maintaining innovative and knowledge intensive industries. Failure to support and nurture the urban realm of the central city in line with population growth and demand for services risks undermining the benefits associated with intensification and agglomeration economies. It also risks reducing the attractiveness of central city streets as places to linger, shop and dine by reducing footpath space available for these functions. This can in turn reduce local consumer spending.

While consideration of delay for vehicle movement is central to economic evaluation of road and public transport projects, delay for people walking is not considered. In contexts such as the City of Melbourne, where 66% of internal trips are on foot (Victorian Government 2016a), this is a significant oversight. It means that a large proportion of transport-system delay is unmeasured when making transport planning decisions on the amount of space and time allocated to different modes in the city. Current practices are likely to exaggerate the economic benefits of speeding up vehicle movement while underplaying the economic significance of efficient walking connectivity.

A recent Auckland study found that the extent of delay for people walking at two central city intersection averaged 27- 37 seconds per person (Auckland Council 2017). Under an optimised signal phasing system, delay could be reduced to an average of 20 seconds contributing to travel-time cost savings of $1.5 million per annum at a single intersection. Extrapolating these figures across multiple signalised intersections each with heavy pedestrian flows suggests the economic impacts of inappropriate signal phasing are likely to be large.

Travel time savings are one approach to understanding the economic impacts of walking delay. More importantly, extended walking travel times from unnecessary pedestrian delay can impact on the potential connectivity of people and businesses in the central city, reducing the potential for agglomeration economies. Analysis conducted for the City of Melbourne by SGS Economics found that a 10% reduction in the connectivity of the pedestrian network (eg through extended waiting at signals) would reduce the value of the Hoddle grid economy by $2.1 billion (equivalent to a 6.6 per cent reduction in the value of the economy).

Together with economic impacts associated with crowding and delay, safety impacts should not be overlooked or underestimated. Poorly managed signalised pedestrian crossings can result in frustration for people walking and encourage non-compliance with traffic signals. Research indicates that impatience and non-compliance rises after 30 seconds of delay and increases when pedestrians must wait at signals at times of low vehicle flow (Turner et al, 2008). Likewise, crowded footpaths can prompt risky behaviours such as stepping into the vehicle carriageway.

Figure 12: Crowding of pedestrians and tram passengers at the corner of Collins Street and Swanston Street

Source: MRCagney

B. Walking connectivity

A second challenge for walkability in the municipality is overcoming shortcomings in walking network connectivity. This means resolving problems with impermeable street patterns, lack of mid-block crossings and other barriers, such as physical barriers, to easy walking movement. While connectivity is generally good across much of the central city, a key challenge over the next 30 years will be in reproducing this highly walkable street and laneway network within the municipality's emerging employment centres and mixed-use neighborhoods.

Micro-scale connectivity across the City

Predominant grid-type street patterns across the municipality generally provide an excellent foundation for walkability. Within the central city, the Hoddle grid, consisting of a rectangular grid of main streets and 'little' streets along with a network of laneways and arcades generally provides a strong foundation for pedestrian connectivity. The street network pattern limits connectivity in parts of the Southbank and North Melbourne, while in the north-west of the Hoddle grid, a lower density of north-south laneways and arcades means this area has lower walking accessibility.

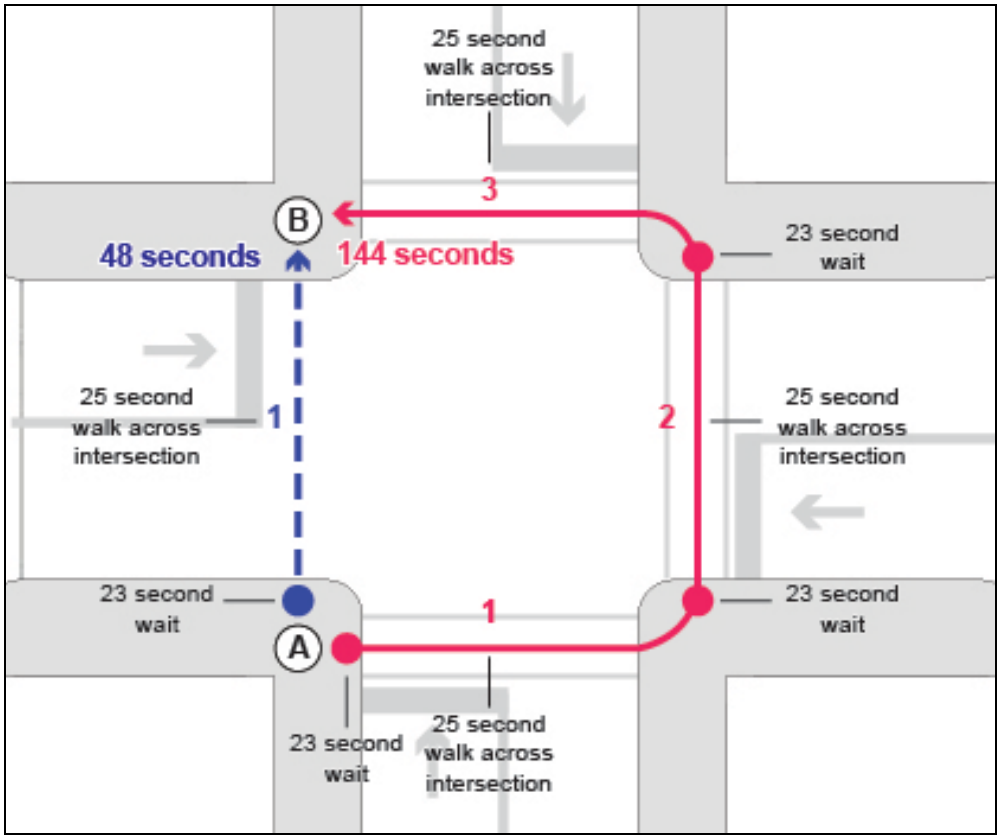
Within the existing intensively occupied areas of the municipality, problems of pedestrian connectivity generally relate to micro-scale deficiencies. For example, there are missing pedestrian crossing points on one of the four legs at some well-used intersections within the central city, such as the corner of Russell and Flinders Street, corner of Queen Street and Flinders Street, corner of Macarthur and Spring and the corner of Spring and Flinders Street. This limits crossing opportunities and increases the time and distance required of pedestrians to get to their preferred side of the intersection, requiring some pedestrians to complete three rather than one or two crossing movements.

Figure 13: Missing pedestrian crossing point on the corner of Russell and Flinders Streets

Source: MRCagney

For example, at the corner of Russell and Flinders Streets the absence of a north-south pedestrian crossing on the western side of the intersection can add approximately 96 seconds to a pedestrian's journey compared to the time it would take if a crossing was included on this side of the intersection (144 seconds using three legs of a crossing rather than 48 seconds using a single leg, see Figure 14).

Figure 14: Impact of missing pedestrian crossing leg on intersection crossing times for people walking

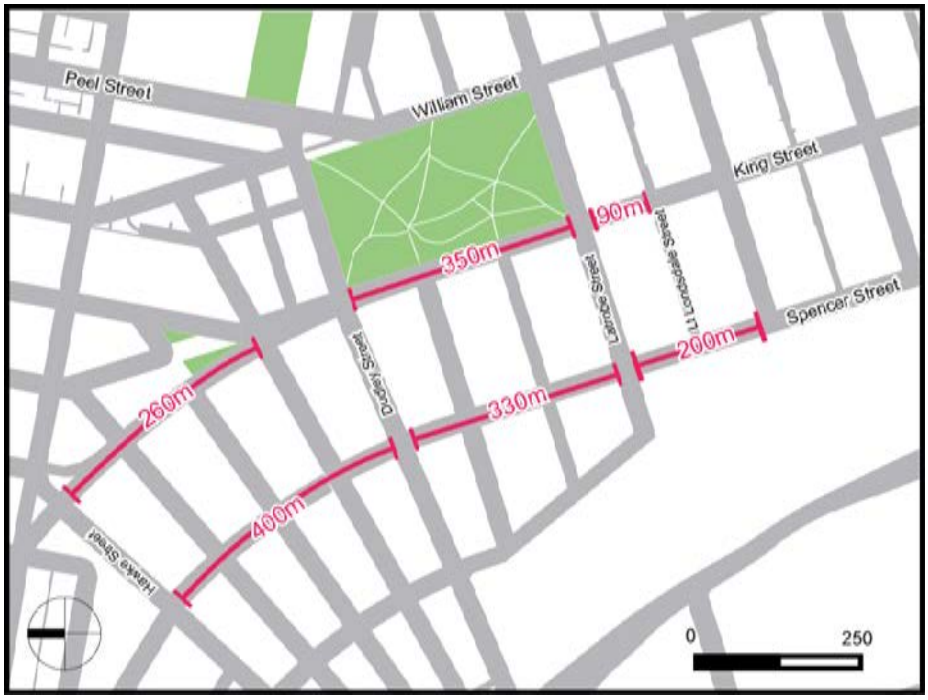


Source: Figures used for time to walk across intersection and waiting time at intersection are derived from Review of Signal Operations for Pedestrians in the City of Melbourne (Traffinity 2014) which estimate that the average pedestrian wait time at a typical signalised intersection in the Hoddle grid with a 90 second cycle times and a standard two-phase split, is 23 seconds and the average walk time across an intersection is 25 seconds.

In other parts of the municipality, such as Southbank and West Melbourne, there are instances where distances between formalised, safe crossing points can be too long. It is recommended that in areas of intense central city retail and pedestrian activity that the optimal distance between crossing opportunities is 60-70 metres and the minimum acceptable distance is every 100m (Siksna 1997).

As identified in Figure 15 there are many examples of significant breaks between pedestrian crossing opportunities across the municipality. For instance, it is 350 metres between crossing points on King Street between Dudley and La Trobe Street; 400 metres between crossing points on Spencer Street between Dudley Street and Hawke Street; 260 metres to cross King Street between Rosslyn Street and Hawke Street; 635 metres to cross City Road between Linlithgow Avenue and Fanning Street. This can severely constrain pedestrian connectivity and almost guarantees that pedestrians will cross at potentially dangerous informal crossing points on these streets. It is noted that the City Road Masterplan and the West Melbourne Structure Plans seek to address the permeability of the pedestrian network in these locations.

Figure 15: Distance between crossing points on King and Spencer Streets, West Melbourne



There are other locations where strong pedestrian desire lines for a street crossing are present but where no formal crossing exists. This is common at T-intersections such as the intersection of Chapter House Lane at Flinders Street, the intersection of Little Collins Street and Spencer Street and the intersection of A'Beckett Street and Williams Street. It is also common at mid-block locations such as La Trobe Street at Bowen Street. The absence of crossing points in these locations encourages informal crossing of the street at non-signalised locations. While informal street crossing activity is appropriate in locations with high levels of pedestrian activity, narrow street widths and slow traffic speeds, in locations with dense pedestrian activity and heavy traffic volumes on wide streets, formalised mid-block crossings may be necessary.

Tram stops in some locations act as barriers to mid-block pedestrian crossings. This is notably the case at the platform access tram stops on Elizabeth Street at Collins, La Trobe and Bourke Streets, where stops run to a length of approximately 85 metres and take up the entire length between intersecting streets, limiting informal crossing opportunities. However, it should be noted that the provision of platform access stops generally enhances pedestrian connectivity by providing more formalised mid-block crossing points, especially where installed on the east/west streets where there can be 200 metres between formal crossings at intersections.

Impacts of walking connectivity on economic performance

Melbourne's economy is increasingly based around the knowledge sectors, industries for which easy walking connections are vital. This enables the productivity benefits or 'agglomeration economies' that come with proximity and easy face-to-face interaction between businesses and their clients, partners, suppliers and customers.

What are agglomeration economies?

Agglomeration economies are economic benefits that result from the close proximity of people and businesses, facilitating better interaction and exchange of goods, ideas and labour. These benefits of spatial proximity underpin the advantages of large urban centres as locations for economic activity. Key mechanisms driving agglomeration economies are labour market pooling (firms access to larger and more diverse range of employees within urban areas allowing better skill matches), knowledge spillovers (benefits from sharing and learning new ideas for workers and firms) and input-output

linkages (advantages from proximate access to a large and diverse range of suppliers and customers) (see Marshall 1890 and Duranton and Puga 2004).

Recent growth in employment in the municipality has been concentrated in professional, scientific and technical services (+30,000 jobs since 2002), accommodation and food services (+22,000 jobs since 2002) and financial and insurance services (+18,000 jobs since 2002) (City of Melbourne 2017b). Future forecasts see a continuing orientation toward a service-based economy with an additional 233,000 jobs forecast to be located in Inner Melbourne by 2031, predominantly in the knowledge, financial services, healthcare and public administration sectors (Victoria State Government 2017). These are all sectors that thrive in highly walkable places, driving innovation and cross pollination of ideas.

Research underpinning the 2014 Walking Plan revealed the economic importance of walking connectivity in the municipality. Face to face connections between businesses, universities and other organisations enable the generation and sharing of knowledge and the solving of complex problems. Being within walkable distance of services and attractions opens up myriad opportunities for networking, collaboration and social activities, something a dense environment like Melbourne's central city has benefited from over many years.

Walking connectivity can be measured by 'Effective Job Density', a measure of the number of working people that can be reached within a 30-minute walk. The Melbourne research found a statistically significant correlation between Effective Job Density and labour productivity. Locations within easy walking distance of high densities of workers (e.g. locations within the Hoddle grid) enjoyed a productivity benefit (SGS 2014, p. 24). Conversely, barriers to walking connectivity can have significant economic costs, with estimates that a 10% reduction in walking activity within the Hoddle grid would result in losses of $2.1 billion.

Since the Melbourne study, other international studies have made similar findings on the economic benefits of walking connectivity. In Auckland's city centre for example, there is also a positive correlation between Effective Job Density and productivity. The Auckland study identified the role of high-quality walking environments and public realm as a platform for the exchange of knowledge and social interactions which support economic productivity (MRCagney 2017b). Research in London on the locational preferences of businesses confirms that businesses value the 'business ecology' that accompanies dense networks of suppliers, clients and partners within easy walking reach (Ramidus Consulting 2016).

There is also evidence that walkability is increasingly a key consideration for global business location decisions. A recent study in the United States documented over 500 companies that relocated or expanded offices in 'downtown', walkable locations between 2010 and 2015 (Smart Growth America 2015). In Auckland, interviews with executives of business service companies on their drivers for business location decisions, revealed the value of locating in walkable locations:

> "Locating "in the centre of things" also means it is easier to meet people more often; whether it be a quick catch up coffee, a meeting with a number of people from different organisations, or simply bumping into people on the street – it is easier and less time consuming" (Gravitas, 2011).

The City of Melbourne is at the heart of Victoria's economy, accounting for 25% of Victoria's Gross State Product (City of Melbourne 2017b). The quality of the street environment and the micro-scale connectivity enabled by walking in the central city area has significance for the economic performance of the state and even the country. Conversely, a failure to maintain quality streetscapes and the connectivity of the walking network, particularly as the population grows, could hinder economic performance and erode Melbourne's advantage as a desirable location for businesses to establish.

C. Safety, inclusion and security

A third and final problem for walking in the municipality is the safety, inclusivity and security of the walking environment. This includes a range of distinct issues including problems with continuing high numbers of pedestrian-related road crashes, problems with perceptions of walking safety and emerging problems of vehicle-based terrorism.

Comfortable walking for all

The quality of the walking environment and public spaces in the central city does not always provide for its most vulnerable and marginal user groups including women, children and elderly people and people with disabilities.

Perceptions of the safety of walking in the municipality are a threat to realising the opportunity of a more walkable place. A VicHealth survey of City of Melbourne residents found that while most people (96%) felt safe walking alone during the day only two-thirds (67%) felt safe walking alone in their local area after dark (VicHealth 2016b). The difference between the number of men and women feeling safe walking alone at night is stark, with 52% of women feeling safe compared to 80% of men.

Recent research from Victoria Walks finds that among young people aged 15-20, just 15% of women and 54% of men feel safe walking alone after dark across metropolitan Melbourne (Victoria Walks 2017). The findings indicate that many young women avoid walking alone in public places at night, restricting their independence and participation in public life. Plan International, a survey of Australian girls and young women aged 15 to 19 asking their views on personal safety and gender equality, including their sense of security in public spaces, found that many girls and young women are internalising widely-held beliefs that public places are unsafe for them, particularly after dark, and that it is their responsibility to modify their behaviour (Plan International 2016).

A second issue is the comfort and safety of walking for the elderly. More than 10 per cent of the municipality's residents are over 60 years old and this age group is growing faster than any other (City of Melbourne 2014b). Accommodating walking among an aging resident and visitor population needs to address growing problems such as pedestrian falls. Hospital admissions for falls while walking in the street or in transport environments number over 1,600 per year, equivalent to the number of injuries from pedestrian-vehicle collisions (Victoria Walks 2016). While trips and falls can affect all, the risk of injury with a fall is higher for the elderly due to their greater frailty and reduced tolerance to injury compared to younger adults. The quality of the walking environment and details such as kerbs, pavement quality and resting spaces can impact on the level of falls.

In 2012, 19 per cent of Victorians reported having a disability (City of Melbourne 2014b). The prevalence of disability increases with age and almost one in four (23 per cent) people over 65 need personal care and healthcare support (City of Melbourne 2014b). Walking accessibility and inclusion for people with a disability will become increasingly important with an ageing population. The specific needs of people with disabilities in the community must be understood and responded to. For example a person who is visually impaired will have different needs to a person with impaired physical mobility.

Traffic and pedestrian safety

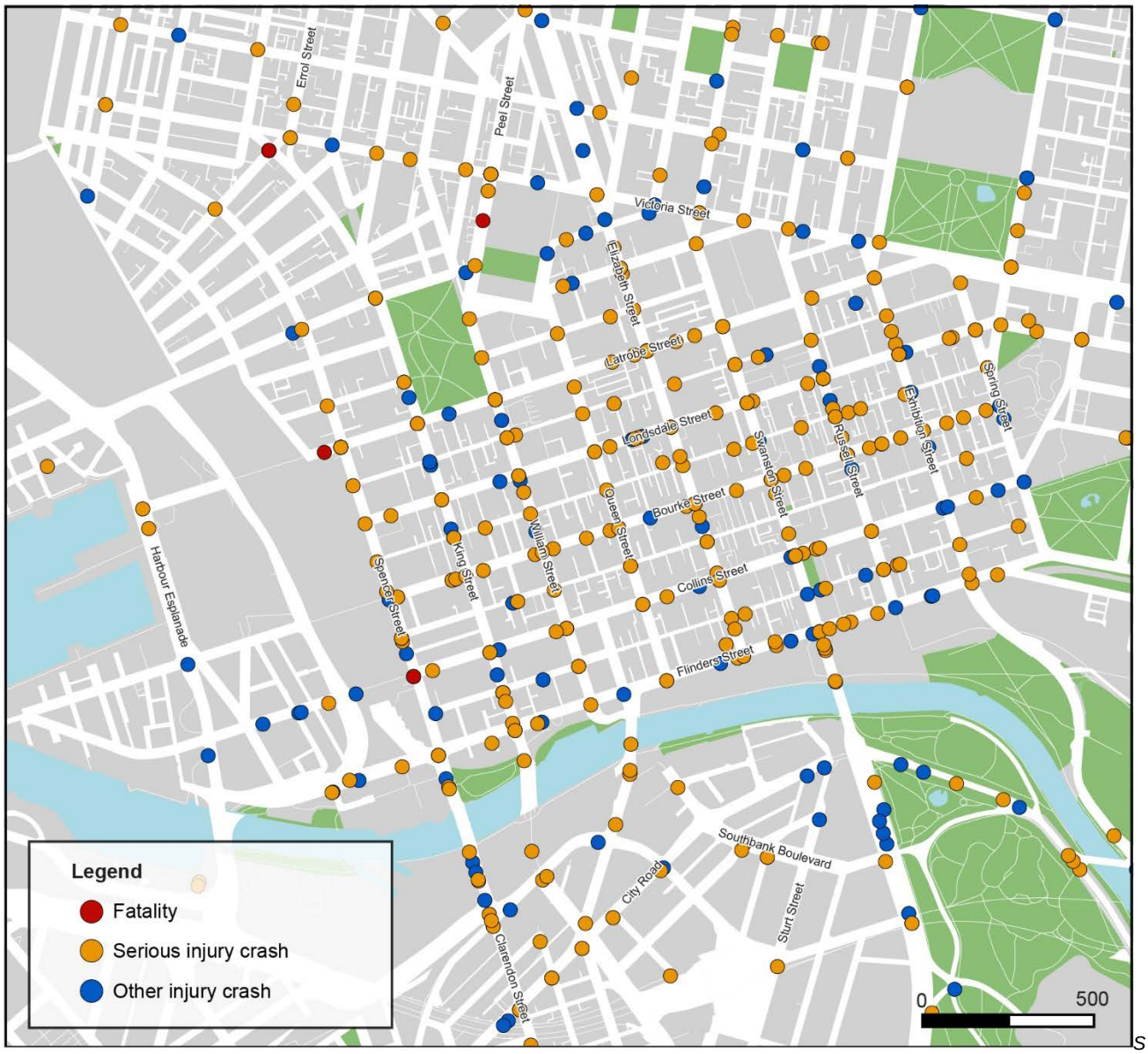
An unacceptable number of people walking continue to be injured or killed in crashes with vehicles across the municipality. Recent road crash records (2012 – 2016) show that on average approximately 46 pedestrians are seriously injured and one pedestrian dies each year on roads across the municipality (VicRoads 2016). Over the past 5 years pedestrians have accounted for 22% of all people seriously injured and 31% of deaths on City of Melbourne roads.

The number of serious injury and fatal crashes among pedestrians has varied during the 2012 - 2016 period. As shown in Figure 16, crashes involving pedestrians are distributed across the network and within the central city are predominantly on arterial roads. Clusters of pedestrian-related injury and fatality crashes have occurred at:

- Streets within the central city with high volumes of vehicular movements including King; Lonsdale, Russell, Flinders and Spencer Streets
- Streets with high pedestrian movements with inadequate pedestrian infrastructure such as Flinders Lane and Little Bourke Street

- Streets towards the fringe of the municipality with high volumes of vehicular traffic such as Flemington Road, Royal Parade and Victoria Street.

Figure 16: Location of pedestrian-related injury and fatality road crashes, City of Melbourne, 2012-2016



ource: VicRoads 2016, Crashes Last Five Years, https://www.data.vic.gov.au/data/dataset/crashes-last-five-years

Despite Melbourne's central city area becoming a 40km/h zone in 2012 (City of Melbourne 2017f), road crash impacts on pedestrians remain too high. While traffic speeds are lower than most roads across metropolitan Melbourne, there may be opportunities to reduce road crash impacts through further speed reductions. These interventions are further discussed in Section 3.

2. Global best practice

Cities around the world are increasingly taking walkability seriously, acknowledging the powerful benefits of a walkable city for economic prosperity and quality of life. This chapter looks to three case studies where local governments have effectively intervened to improve the urban walking experience.

Reducing traffic speeds in Dublin

The Dublin City Council has introduced 30km/h speed limit zones across Dublin including the city centre. A series of 30km/h 'Slow Zones' have been phased in across the city since 2005; initially covering the shopping and central business area of the city before being extended to a 12 square kilometre area covering the entire city centre and several inner-urban suburbs (City of Dublin 2017a). In 2017 the City has plans to extend 30km/h speeds zones to the entirety of the municipality (City of Dublin 2017b) which is approximately 115 square kilometres in size.

Under the Slow Zones policy, default speed limits have been reduced from 50km/h or higher to 30km/h. Arterial roads maintain faster speed limits of 50km/h or above (Dublin City Council 2017c). Parallel to the introduction of lower speed limits infrastructure interventions to support traffic calming such as additional street signage, tightening corners at junctions and installing speed humps have been implemented (City of Dublin 2017c).

The Safe Zones programme forms part of a safe systems approach to road safety. Speed limit reductions are seen as an important component of a wider programme for reducing the risk of injury or death from collisions between pedestrians and vehicles (City of Dublin 2017d). This approach is consistent with international research demonstrating that the likelihood of fatality in a road accident exponentially increases with the speed of impact, particularly for vulnerable road users such as pedestrians.

Figure 17 O'Connell Street Dublin

Source: (City of Dublin 2017c)

The programme has been successful in reducing traffic speeds, with 80 per cent of streets seeing a reduction in traffic speeds after implementation (Kelly 2017). However, achieving compliance with the 30km/h limit has been challenging with just two streets having average speeds below 30km/h. Impacts on vehicle-based journey times have been minimal, with modelling conducted for the Council finding that increases to journey times would be no greater than 1 minute and that the majority of motorists would see increases of less than 20 seconds (City of Dublin 2017d).

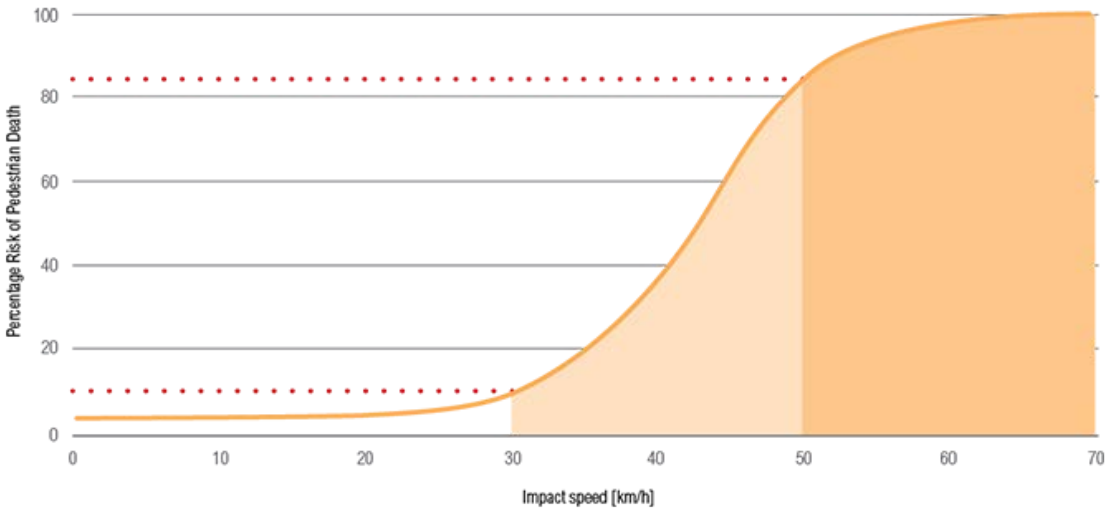
The introduction of 30km/h speed zones have been successful in a number of other European jurisdictions, including London, Edinburgh and Portsmouth in the United Kingdom (McKibbin 2014). Evidence suggests that in traffic environments where speeds are already low, changes to signage are sufficient in achieving speeds of 30km/h or less. In contexts where existing speeds are higher, however, traffic calming measures such as vertical shifts in the road carriageway (speed humps and raised intersections) or horizontal shifts (road narrowing and chicanes), are required to achieve compliance with the 30km/h limit (McKibbin 2014).

Relevance to the City of Melbourne

Safe Speeds are a key component of the Victorian Road Safety Strategy (Victorian Government 2016b), and the designation of speed limits is a key way Council can influence road safety outcomes. Lowering speed limits to 30km/h is particularly relevant for a city centre location where the potential for conflict between vehicles and vulnerable road users is at its highest. Increasing numbers of Victorian Councils are considering introducing 30km/h speed limits on local and arterial roads (Yarra 2017; Woods 2017).

Speed limits in the central city are presently set at 40km/h (City of Melbourne 2017f). While this is lower than most roads across metropolitan Melbourne, levels of pedestrian-related road crash injuries and fatalities remain unacceptably high with around 46 pedestrians injured and at least one fatality every year. Evidence on the relationship between vehicle impact speed and pedestrian deaths shows that reducing speeds further from 40km/h to 30km/h can bring substantial safety benefits. Chance of pedestrian death is 85% with vehicle impact speed of 50km/h, 40% at 40km/h and 10% at 30km/h (World Resources Institute 2017).

Figure 18: Relationship between risk of pedestrian death and impact speed of vehicles



Source: World Resources Institute 2017c.

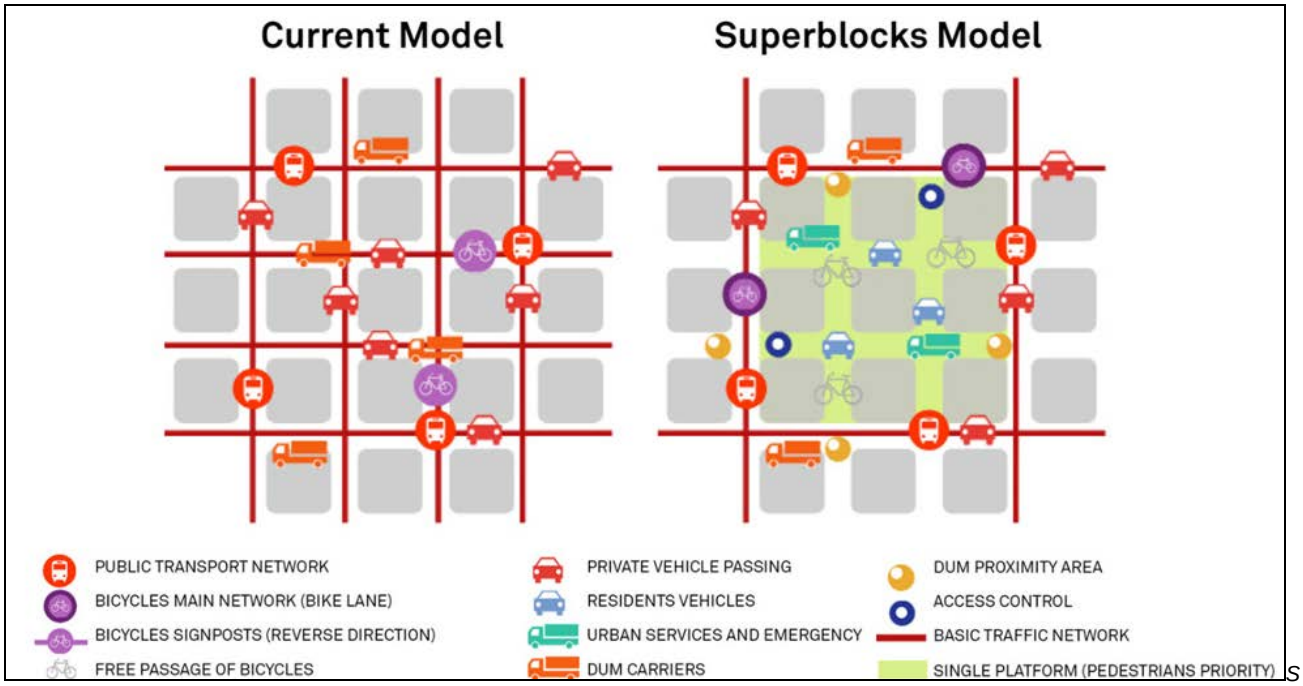
In addition to reducing the risk of pedestrians and cyclists being killed or injured on the road network, lower speed limits can transform high-speed roads to traffic calmed, people-oriented environments with lower levels of traffic noise and increased public realm amenity. There may be locations such as new shared spaces where even lower traffic speeds or 10km/h or 20km/h are more suitable.

Rationalising traffic circulation in Barcelona

The City of Barcelona is repurposing road space within the city centre with a concept known as ‘Superilles’, or ‘Superblocks’. The concept improves walkability and the streetside public realm by redefining how traffic circulates the city, allowing space previously used for vehicle movement to be repurposed for a wider range of functions to allow walking and social gathering in pedestrian prioritised locations (Ajuntament de Barcelona 2017a). Barcelona has implemented Superblocks across five neighbourhoods between 2014-2017 and intends to extend it to a further 120 intersections in the future, unlocking 23 hectares of former road space (Ajuntament de Barcelona 2017b). The superblock model is part of the City’s Urban Mobility Plan (UMP) 2013-2017 that targets reducing vehicular traffic by 21% and growing walking trip mode share from from 32% in 2013 to 35% in 2018.

The typical superblock is an area of 400m by 400m defined by four exterior arterial roads containing a further nine blocks in a rectangular internal grid of 120m by 120m (BCN Ecologia 2017a). Under the scheme, through traffic and on-street parking is removed from internal streets and restricted to the exterior arterial roads. Internal streets are reconfigured to prioritise public uses and active transport. Vehicle access is restricted to local traffic accessing off-street parking and deliveries at reduced speeds of 10km/h.

Figure 19: The superblock concept

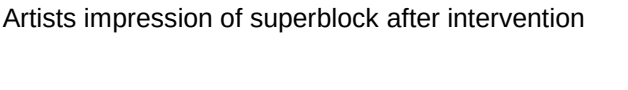


S

ource: Ajuntament de Barcelona 2017b

Figure 20 Artists impression of a Barcelona street after superblock intervention

Example of city street before Superblock intervention



Artists impression of superblock after intervention

Source: Ajuntament de Barcelona 2017c

Relevance to the City of Melbourne

The scale of one of Barcelona's superblocks is comparable to the area land bounded by Swanston, Drummond, Queensberry and Grattan Streets in Carlton or the area between Flinders, Bourke, Swanston and Elizabeth Streets. The central city's block structure and combination of 'big' and 'little' streets within the Hoddle grid lends itself to reproduction of the superblock concept. Both cities enjoy a variety of commercial and residential land uses in their inner cores, although the higher density of activity in Melbourne's central city may place more intensive demands on the street network than is experienced in the Barcelona contexts. This may make implementation more challenging.

A similar intervention in Melbourne could involve discouraging through-traffic circulation from certain streets through use of various access control devices that prevent direct vehicle travel and force more convoluted paths for vehicles in all areas outside of designated priority traffic routes (for example, see Figure 23). This could free up pockets of pedestrian-only spaces and enable widening of footpaths and shared spaces while allowing access to properties and deliveries.

Recent experience with reallocation of road space from private vehicles to people and pedestrians across the municipality has typically seen a more ad-hoc and opportunistic approach to reclaiming space than that presented by the Superblock concept. The City of Melbourne has typically held a preference for incrementally extending pedestrian space in defined locations rather than removing vehicular movements on a widespread precinct basis (City of Melbourne 2017e). The Superblock model could assist in formalising the central city's core traffic network while clarifying that on remaining streets other users are the priority. At present, the overall framework for determining vehicular access in the central city does not support the rationalisation of vehicular circulation and supports a more diffused distribution of traffic utilising all available road assets (VicRoads 2012).

The introduction of shared spaces in Australian cities is still in its infancy with road authorities adopting a risk-averse approach to shared spaces with a preference for more clearly defined separation between modes of transport in road design. This may present challenges for implementation. Other challenges will be in reducing traffic volumes on streets that have numerous vehicle access points.

Barcelona's superblocks demonstrate that a step change in reducing vehicular traffic across a precinct is entirely possible and highlights the possibility to prioritise pedestrians and cyclists over private vehicles while maintaining essential vehicular access at low speeds. This approach also aligns with Council's objectives in relation to increasing the amount of public open space and extending the urban forest for biodiversity and climate change adaptation purposes.

Measuring pedestrian delay in Auckland

Auckland Council recently completed an innovative study into the cost of pedestrian delay in Auckland (Auckland Council 2017b), helping build a robust economic case for allocating more time to pedestrians at signalised intersections in its city centre.

As in Melbourne, Auckland has experienced significant growth in walking trips in its city centre, reflecting growth in residential population, employment and visitor numbers. There are an estimated 300,000 – 500,000 walking trips undertaken on an average weekday within the city centre (MRCagney 2017). Queen Street is the city's key pedestrian thoroughfare and the subject of this study, accommodating approximately 30,000 pedestrians on an average weekday (MRCagney 2017 and Heart of the City 2017). Queen Street is of comparable scale and function to Melbourne's Swanston Street which is a popular spot for dining and retail as well as home to cultural attractions which are significant to the city. Queen Street is a key inner-city corridor for bus connections, much like Swanston Street is for trams.

Waiting at signals or completing multiple movements across an intersection increases the amount of time pedestrians take to undertake journeys by foot. To a casual observer this level of delay may represent only a minor inconvenience. However, when this delay is considered in the aggregate it constitutes a major economic cost from reduced connectivity and reduced potential for agglomeration economies. Delay associated with work-related walking trips (eg between meetings) can be particularly costly with a Sydney study estimating the value of work-related walking delay at $39/hour (Aecom 2011).

The value of travel time for vehicle-based travel is well understood and underpins conventional economic appraisal and cost-benefit analysis of transport projects. Pedestrian delay, however, is rarely measured (MRCagney 2017). The Auckland study provides a framework for measuring the economic cost of walking delay, enabling the Council to quantify the benefits of walking improvement projects.

The study recorded pedestrian movements across two selected intersections on Queen Street, calculated the average length of pedestrian delay and quantified the economic cost of delay using New Zealand guidelines for economic evaluation of transport projects. It found that at a single intersection on Queen Street the value of pedestrian delay translates into an estimated annual economic cost of $2.2 million, relative to free-flow conditions. Extrapolating the findings across all intersections on the Queen Street corridor suggested total annual costs of pedestrian delay of $11.7 million per annum (see Figure 21). While 'free flow' conditions for walking are not a realistic outcome at signalised intersections, testing of an optimised signal phasing regime with increased allocation to pedestrian time showed that delay for walking could be reduced by 26 – 46%, resulting in benefits for pedestrians.

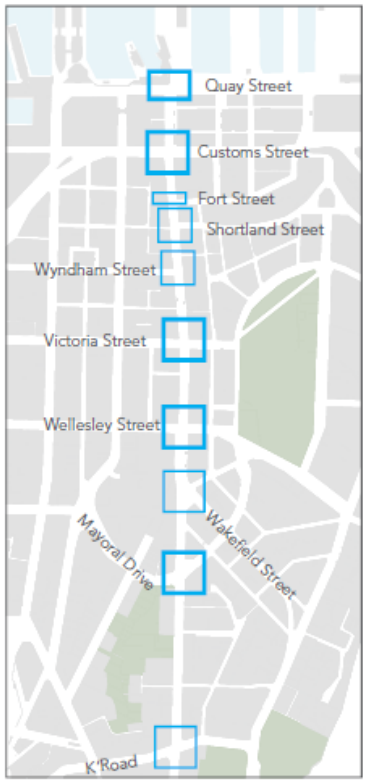
Relevance to the City of Melbourne

There is a need for a rigorous evidence base to justify reallocation of time and space to pedestrians. The approach used in Auckland for measuring and valuing the cost of pedestrian delay may provide a useful framework for assisting decision-making on allocation of time at signals in Melbourne's central city. The framework builds on similar conceptual foundations to existing work completed by the City of Melbourne on valuing pedestrian connectivity (SGS 2014). It can allow for comparison of delay at intersections among vehicle and walking users. While proponents of maximizing vehicle movement efficiency often quantify the costs of vehicle delay, this framework allows for a more holistic multi-modal approach to optimising intersection management.

Using a robust approach to economic evaluation to justify intervention is similar to the City of Melbourne's valuation of trees as part of the Urban Forest Strategy which assisted in fostering public support and understanding of the value of urban forest (City of Melbourne 2014).

Figure 21: Estimated cost of delay under existing traffic signal arrangements, Queen Street, Auckland

Street Name	Intersection Type	Estimated Cost of Delay/Year
1. Quay Street	Barnes Dance, Midblock Crossing, Very High Ped Volumes.	~$2M
2. Customs Street	Barnes Dance, T-Intersection, Very High Ped Volumes.	~$2M
3. Fort Street	Barnes Dance, Midblock Crossing, High Ped Volumes.	~$.5M
3. Shortland Street	Barnes Dance, T-Intersection Crossing, High Ped Volumes.	~$.9M
4. Wyndham Street	Barnes Dance, T-Intersection Crossing, High Ped Volumes.	~$.9M
5. Victoria Street	Barnes Dance, X-Intersection, High Ped Volumes.	$2.2M
6. Wellesley Street	Barnes Dance, X-Intersection, High Ped Volumes.	~$2.2M
7. Wakefield Street	Barnes Dance, T-Intersection, Med Ped Volumes.	~$.5M
8. Mayoral Drive	Phased, X-Intersection, Med Ped Volumes.	~$.7M
9. Karangahape Road	Phased, X-Intersection, Med Ped Volumes.	$.7M
		~$11.7M
		NPV = ~$186M



Source: MRCagney, 2017b

3. Interventions

Addressing the key challenges for a more walkable municipality as outlined in the previous chapter will require actions on the part of the City of Melbourne and other public and private actors that influence the quality of the walking environment. There are a wide range of tools available, many of which have been identified by the City of Melbourne's 2014 Walking Plan. This chapter builds on the opportunities identified by the existing plan and summarises a set of tools for consideration in refreshing the transport strategy. The focus is on tools within the jurisdiction of Council and are organised under the following headings:

- Space for walking
- Time for walking
- A connected walking network
- Safe and secure walking
- Rationalising traffic circulation.

Space for walking

Making more space for walking will be essential in addressing problems of crowding and safety. With forecasts for 150% growth in walking volumes to 2030, substantial intervention will be required. Wider footpaths, shared and pedestrian-only spaces can not only improve the functionality of the walking environment but also improve livability, making it a more attractive place for residents, businesses and visitors. Allocating more space for walking almost always involves making trade-offs with other users and functions of the street – as space for walking generally needs to fit within the existing footprint of the street corridor. Road space allocation decisions are highly contested, but in many locations in the central city it is clear that the importance of walking is not being reflected in the space it is allocated. The reallocation of space for walking can be integrated with other programs such as the City of Melbourne's urban forest concept and the implementation of water sensitive urban design treatments in order to extract the maximum benefit from public realm investments.

City of Melbourne's 2014 Walking Plan identifies a number of actions for increasing space for walking and for making decisions on street space allocation among various users. Actions include:

- Establishing a typology of street designs including 'streets as places', 'walking streets' and 'shared zones', and identifying locations for implementation of these improved street designs. Each of these typologies involves increased space for walking (actions 2.4, 2.5 and 2.7).
- Identifying locations for incremental space reallocation such as footpath widening around key public transport stations and kerb outstands at intersections (actions 3.1 and 3.4).
- Identifying tools to help decision-making on street space allocation including using the Smart Roads framework to identify streets with high pedestrian priority and developing tools to assess crowding levels against standards (actions 2.1 and 3.1).

A comprehensive range of actions for increasing space for walking are included in the Walking Plan. Table 1 summarises how the range of tools available for increasing walking space addresses the key problems and opportunities identified in Chapters 2 and 3 of this paper. Key trade-offs that need to be considered in implementing the intervention are also listed.

Table 1: Potential interventions that increase space for walking

Potential intervention	Rationale	Key trade-offs
Widen footpaths	Addresses crowding problems and associated issues with discomfort, efficiency and safety of walking.	Space for on-street parking, vehicle deliveries and kerb-side pick-up, space for traffic and cycling lanes. Can impact on traffic congestion, efficiency of deliveries and quality of facilities for cycling.
Expand pedestrian space at signalised intersections	Addresses crowding problems and improves safety.	Space for turning lanes and cycling lanes, efficiency of traffic movement. Can impact on traffic congestion.
Manage street clutter	Contributes to addressing footpath crowding problems	Space for motorcycle and bicycle parking, space for advertising, on-street dining and street furniture. Can impact on convenience of parking for people using bicycles and motorcycles and on retailing businesses.
Develop new shared or pedestrian-only streets	Provides a high-amenity and safe walking environment that improves both functionality of the walking network and the public realm.	Connectivity of street network for traffic, space for vehicle deliveries. Can impact of efficiency of vehicle movement through.
Expand tram platforms, add mid-block entries	Improve tram loading/unloading efficiency	Traffic and cycling lanes. Can impact on traffic congestion and quality of provision for cycling.

Potential impacts to consider are impacts on kerbside delivery, space for cycling network infrastructure and on the efficiency of traffic movement at intersections. Locations across the municipality that are likely to be the focus of these type of interventions include:

- Crowded intersections, particularly around the central city's existing and future rail stations
- Locations with very high pedestrian activity
- Locations where existing footpath widths are result in overcrowding.

While addressing crowding at very busy intersections is likely to be a high priority action, there are also numerous instances where mid-block footpath provision is inappropriate for the level of walking and public life activity. In both cases, interventions to expand pedestrian space should not seek to only maintain an efficient level of walking functionality but rather provide generous and dignified spaces that invite walking and lingering.

Time for walking

Closely related to the allocation of space for walking is the allocation of time between people walking and people in vehicles at signalised intersections. Optimising the distribution of signal time is important for improving connectivity via walking, reducing road safety risks associated with pedestrian frustration and improving the relative attractiveness of walking as a transport choice. In many contexts, reduced signal cycle times can also benefit trams, buses and bikes.

The 2014 Walking Plan identifies the following actions for improving the management of signalised intersections:

- Developing improved tools for assessing pedestrian delay at intersections and reducing signal cycle times where warranted

- Extending the implementation of the ‘auto-on’ signals for pedestrians to locations beyond the central city.

As the City of Melbourne refreshes it transport strategy, other tools that could be considered include removing pedestrian operated signals altogether from signalised intersections in areas with high pedestrian activity (eg across the Hoddle grid). While the recent change to ‘auto-on’ for the pedestrian phase of signals in the central city provides benefits for people walking, removing beg buttons altogether may be appropriate in sending a clear message that people walking are always allocated time at an intersection and do not need to ‘ask’ for it.

The key intervention proposed is optimising signal times to shorten overall cycle times and to allocate cycle time to better reflect the relative volumes of pedestrians and vehicles using an intersection. This can reduce maximum wait times for pedestrians and depending on context can benefit other street users. To support such changes, the City of Melbourne is likely to require more detailed assessment of pedestrian delay times at intersections, and comparison of delay times with other intersection users. Experimental approaches to measuring pedestrian delay and the economic implications of this delay have been recently tested in Auckland (see case study in Chapter 2). These types of tools will assist decision-making on priority locations for these types of interventions. Locations are likely to include areas of intense crowding outside the central city’s major rail stations.

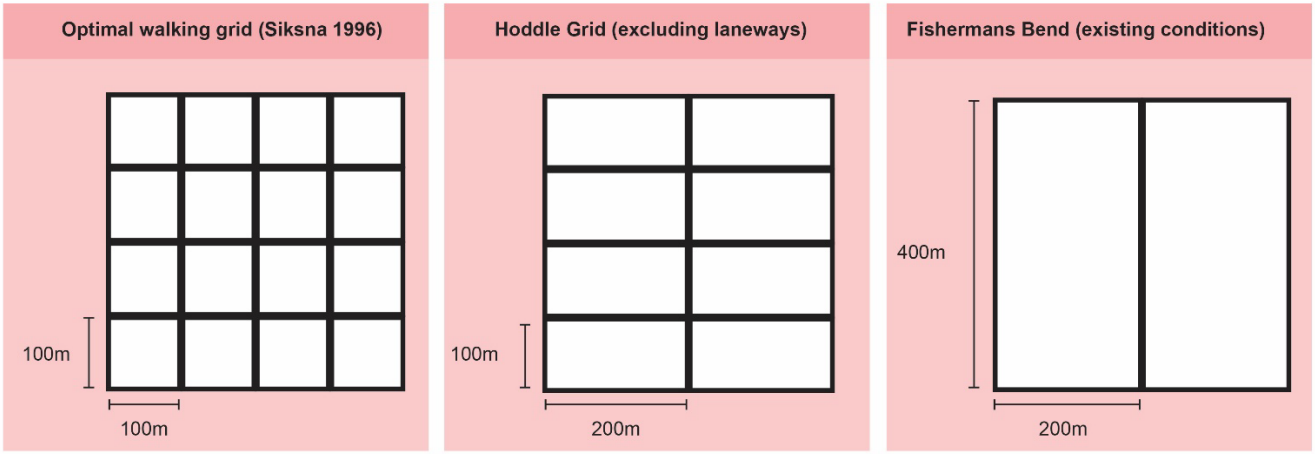
Another method for improving the time allocated to pedestrians is reducing the physical distance required to cross at an intersection through kerb build-outs. This can allow more pedestrians to cross the street within a signal phase or can enable the pedestrian phase to be shortened reducing the time between each cycle and reducing overall pedestrian delay. For instance, crossing Russell Street involves walking across 23 metres of carriageway width taking approximately 20 seconds to complete while a pedestrian on Collins Street is only required to walk across 19 metres of road space taking approximately 16 seconds to complete. Physical interventions such as wider footpaths or curb extensions can be implemented to reduce the distance between opposite sides of a pedestrian intersection. These interventions can be beneficial for not only reducing pedestrian delay but also for improving outcomes for people who may require more time to cross a street particularly the elderly, children and families and people with mobility issues.

A connected walking network

Interventions for improving the connectivity of the walking network include a range of tools, from statutory planning tools for improving connectivity as part of private developments to infrastructure interventions such as new street crossing points. In general, tools for connectivity need to support a highly permeable grid of appropriately-scaled blocks and opportunities for street crossings that allow for easy walking circulation (see Figure 22 for guidance on optimal block size for walkability and comparison with conditions across the municipality).

These types of interventions can address problems with poor connectivity at locations on the central city fringe, helping to realise the opportunity of expanded, high-quality spaces for business and innovation activity in the central city. At the micro-scale, improvements to connectivity such as new street crossing points can reduce walking journey times and improve safety. Table 2 summarises the range of tools that the City of Melbourne can consider for improving walking connectivity.

Figure 22: Comparison of optimal walking grid to typical Melbourne conditions



Source: Siksna 1996 and analysis of existing street grid in Melbourne.

Table 2: Potential interventions that increase walking connectivity

Potential intervention	Rationale	Appropriate locations
Statutory planning tools to require or encourage improved public walking connections and block permeability in new large-scale developments	Uses opportunity of redevelopment to increase the permeability of the walking network through creation of new mid-block walking links.	Locations across the municipality with large scale redevelopment activity.
Master-planning to establish a highly permeable walking network	Ensures that areas of comprehensive redevelopment are provided with walking networks of sufficient density.	Locations across the municipality subject to masterplanning – eg Fisherman's Bend.
Construction of new formal pedestrian crossings	Reduces walking time, improves connectivity and safety.	Intersections with 'missing' pedestrian crossing legs, mid-block locations where distances between existing formal crossing points are long (eg east/west streets in the Hoddle grid).
Integration of new formal pedestrian crossings with mid-block tram stops	Improves pedestrian connectivity with new mid-block connections and improves safety.	Mid-block tram stops.
Facilitation of informal street crossing opportunities	Reduces walking time and improves connectivity.	Locations with high pedestrian volumes and low traffic speeds.
Shared zones	Increases pedestrian permeability allowing for more informal crossing points.	Locations with high pedestrian volumes and low traffic speeds.

Safe and secure walking

There are a range of tools that which contribute to improving the safety and security of walking. This includes tools that aim to reduce road crashes involving pedestrians, tools that aim to improve the safety of walking in a range of locations throughout the day and night to more vulnerable groups such as women, children and the elderly and tools that aim to improve the security of walking against vehicle-based terrorist threats. Table 3 summarises the range of relevant tools.

Table 3: Potential interventions which improve walking safety and security

Potential intervention	Rationale	Appropriate locations
Reduce traffic speed limits	Lower traffic speeds reduce risk of injury or death from vehicle-pedestrian collisions. Also improves the amenity of the walking environment from reduced noise and visual impacts of traffic.	Locations with high levels of pedestrian activity (eg central city) and streets with low requirements for through traffic function (eg residential streets).
Traffic calming and speed management	Creates a physical environment that supports lower speed limits. Utilising a range of tools such as speed cushions and chicanes through to lane widths and line markings to establish a low speed environment where vehicles are encouraged by physical cues to travel at the signposted speed limit.	Locations with high levels of pedestrian activity (eg central city) and streets with low requirements for through traffic function (eg residential streets).
Road rule enforcement	Enforcement action which encourages compliance with road rules and speed limits.	Locations with high levels of pedestrian activity (eg central city).
Side street and intersection treatments including raised crossings, centre refuge islands, kerb outstands and kerb tightenings.	Reduces speed of turning vehicles at intersection locations where pedestrians are particularly at risk of collision with vehicles. Raised crossings and removal of kerbs can reduce trip hazards and slow traffic speeds.	Locations with high levels of pedestrian activity (eg intersection of 'little' and main streets of the Hoddle grid). Locations with complex intersections and long crossing distances.
Pedestrian-only areas	Removes risk of collisions between people walking and vehicles and minimises risks of vehicle-based terrorism.	Locations with high levels of pedestrian activity (eg selected streets in the city centre and areas adjacent to public transport hubs).
Improved street and pathway lighting	Improves perceived and actual safety for people walking at night.	Walking connections throughout the municipality in locations with poor existing lighting.
Active street frontages	Improves perceived and actual safety of walking through passive surveillance.	Central city and neighbourhood centres throughout the municipality.
Ensure connected laneways with sightlines between entrances and exits	Reduces safety risks associated with dead-end laneways, particularly at night, and improves way-finding and orientation for people walking.	Central city and neighbourhood centres throughout the municipality.
Vegetation management	Reduces safety risks associated with dense vegetation adjacent to walking routes.	Throughout the municipality.
Bollards and restricted vehicle access areas	Prevents vehicle intrusion into pedestrian spaces and separates traffic from pedestrians.	Locations with high levels of pedestrian activity.
Integration of security considerations with public space transformations.	Minimises risks of vehicle-based terrorism. Unobtrusive and integrated security measures may be more effective at responding to threats while minimising impacts on functionality and aesthetics.	Locations with high levels of pedestrian activity, and locations undergoing comprehensive design change.

Some of the interventions listed in Table 3 were included as actions in the 2014 Walking Plan, including an action to review speed limits and investigate new shared zones. For preparation of the City of Melbourne's refreshed Transport Strategy further attention could be given to improvements which address social safety aspects of the walking environment, bolder approaches to traffic speed reduction in the central city and attention to integrating pedestrian-only spaces with protection from hostile vehicles.

Many of these types of interventions need to be considered in an integrated way with other space reallocation and walking connectivity interventions described in this chapter. For example, interventions that secure spaces from hostile vehicles are considered to be more effective if integrated with public space design and traffic management (for example through installation of public art and level changes that act as physical barriers as opposed to bollard type solutions) (Designing Out Crime Research Centre 2014). There are considerable opportunities in space reallocation measures which reduce pedestrian crowding and improve safety to also contribute to more secure environments by preventing access by vehicles to crowded spaces.

Speed limit changes and accompanying traffic speed management are likely to be valuable tools in reducing road crash impacts on pedestrians (see Dublin case study in Chapter 2). Further investigation will be required on how speed limit changes could be implemented and the relative value of a consistent lower speed limit (eg 30km/h) or variable speed limits across different street types such as 40km/h speeds on major streets and lower 10 or 20km/h speeds on minor streets.

Rationalising traffic circulation

A strategic approach to traffic circulation could seek to limit the number of central city streets that accommodate through-traffic movement and rationalise traffic turning movements available at intersections, freeing up street space and intersection time for walking and an enhanced public realm. This approach could build on the Superblock concept used in Barcelona by establishing a network of roads for circulation and through traffic and identifying streets for local access and for other use non-movement uses.

The current approach to traffic circulation within the Hoddle grid is to generally accommodate traffic movement on all streets and to provide for a full range of turning movements for vehicles at all intersections. There are some exceptions to this such as the Bourke Street Mall and the closure of Swanston Street to through traffic. While existing arrangements provide for maximum flexibility of traffic movement, they also require significant road space to accommodate a full range of turning movements at all intersections. This also requires long signal cycle times that may not maximise the efficiency of the multi-modal system or the efficiency of overall people movement.

There is potential to establish a clearer street hierarchy for traffic function in Melbourne's central city area that would focus through traffic on a more limited number of routes and use various management devices to limit traffic circulation on remaining streets. Streets outside main traffic circulation routes could be prioritised for pedestrian movement and public life. Vehicle use of these routes would be for building access purposes only rather than traffic circulation and through movement. An indicative illustration of how traffic circulation could be managed within part of the Hoddle grid is provided in Figure 23.

Accompanying this, there are also opportunities to rationalise turning movements at intersections to reduce signal cycle times and simplify intersections for walking and other priority users. This may include removing turn phases from intersections or banning specific turning movements at certain locations.

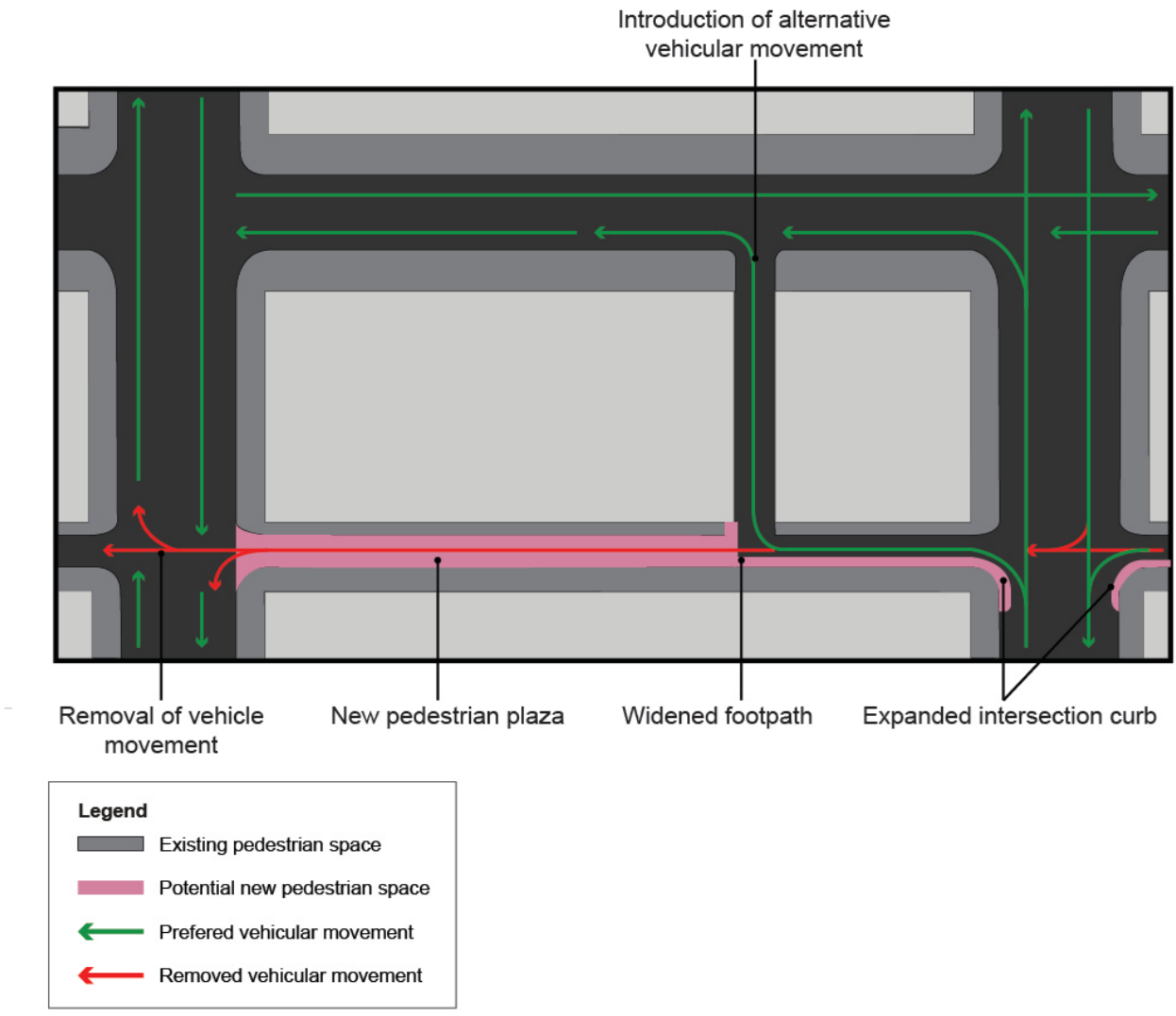
A clear central city traffic circulation plan is likely to be a prerequisite for any substantial reallocation of street space and intersection time to walking. A key challenge in establishing an effective plan that frees up space for more pedestrian-oriented streets will be in working with extensive vehicle access points to buildings across the central city street network. For example, access points to car parking buildings have deliberately been located (as a result of previous planning policies) across the 'little streets', making implementation of partial closures or vehicle filtering interventions on these streets more difficult.

The introduction of shared spaces may strike a balance between maintaining vehicle access and providing increased priority to pedestrians. Under this approach pedestrians are given greater priority while still allowing some vehicle traffic at low speeds. A number of shared zones already exist across the central city such as Manchester Lane which has been designed for shared use by pedestrians and vehicles to enable access to a carpark and a service lane. The City of Melbourne has identified numerous other opportunities for potential implementation of shared spaces, particularly on the 'little streets' of the Hoddle grid.

For shared spaces to function as intended, driver behavior must adjust to being in a shared space environment which can be assisted by designing shared spaces with visual and environmental cues which alert drivers to the shared zone and modify driver behavior. Even with shared space designs that provide favourable conditions for pedestrians, such spaces risk remaining de facto road spaces, dominated by traffic applied in locations with high volumes of traffic.

There are also challenges in ensuring that by concentrating traffic circulation on a more limited number of streets, such streets are not 'sacrificed' to traffic and remain high-amenity spaces with multi-modal functionality. Rationalising traffic circulation may result in lower overall traffic volumes in the central city by making driving a less attractive proposition.

Figure 23: Indicative concept for rationalisation of traffic circulation and reallocation of street space



4. Policy approaches for the City of Melbourne

The case studies of global best practice in the previous chapter illustrate innovative approaches to accelerating the shift toward more walkable cities. While the City of Melbourne has made substantial progress during the past 30 years, the range of tools presented by the case studies and in the summary of potential interventions in chapter 3 illustrate the possibilities for ongoing improvement to making a more inviting and safer place for walking.

The range of tools available is clear. The key decisions for the City of Melbourne to 2050 will be the level of ambition, the speed of implementation and the degree to which trade-offs with other street users are accepted while prioritising walkability. The cost of interventions is also an important consideration, with further analysis of range of interventions needed to assist prioritising actions and ensuring they result in net benefits for the community. There is a spectrum of strategic-level responses available, from incremental improvement to radical transformation. This chapter briefly outlines potential approaches to improving walkability:

- React – respond to acute problems, resulting in incremental improvements
- Anticipate – plan ahead and provide for forecast growth in walking, resulting in consistent improvements ahead of major problems occurring
- Transform – accelerate the transition to world-leading walkable city that makes the very best of the city's potential for human-centred places.

Table 4 summarises the underlying principles of each of these approaches, the key interventions that would accompany each and an indication of the potential positive and negative impacts.

Table 4: Comparison of three approaches to guiding walking policy

	React	**Anticipate**	**Transform**
Overall approach	Incrementally re-allocate road-space and intersection time to walking - but only where demand for walking is high and where safety, security, crowding or connectivity problems are obvious. Continue to accept poor walking environments where problems are not acute - and other transport modes are considered a higher priority.	Anticipate growth in walking demand – and plan and provide for it accordingly. Anticipate crowding, connectivity, security or safety problems – and proactively respond and design-in solutions ahead of time. Attempt to balance priority given to vehicle movement and walking, based on existing levels of demand.	Comprehensively transform the municipality's walking environment by creating widespread inviting public places for people. Ensure consistently high standards of walking, inviting future use in locations where current walking activity is low. Accept that negative impacts on vehicle movement are worthwhile trade-offs for a more walkable city.
Key interventions	Selective provision of wider footpaths and more intersection time for walking where walking demand is high. Selective safety improvements – where problems are obvious and impacts on other modes are not significant. Minimal public intervention for ensuring highly permeable walking networks in new development areas. Retain existing approach to traffic circulation.	Reallocation of street space and intersection time to walking in anticipation of growth in walking demand, particularly around public transport hubs. Selective application of 30km/h target speeds at safety blackspots. Proactive use of Council planning tools to improve the connectivity of the walking network alongside new development on private property. Minor changes to traffic circulation in selected locations to make space for walking. Attempt to minimise impacts of space reallocation on other modes. Integrate security measures alongside space reallocation interventions.	Extensive reallocation of street space to walking and public life to support a highly liveable and attractive place. Municipality-wide application of 30km/h target speeds. Extensive use of Council tools to partner with private property owners to improve provision of public space and walking connectivity with major new developments. Investment in high quality street design and street trees to support amenity and climate change adaptation goals. Comprehensively rationalise traffic circulation in the central city to free up space for walking and public life. Seamlessly integrate security measures into transformed public spaces.
Benefits	Some improvements to the functionality of the walking environment – in locations of major crowding. Some improvements to the safety of the walking – at	Improved walking network connectivity with benefits for economic performance and increased walking activity. Improved safety for people walking.	Transformational upgrade to the quality of public space in the central city, attracting business, vibrant public life and cultural activity with world-leading design and quality of public realm experience.

	major crash blackspots. Minor financial cost implications for Council and community and relatively easy implementation due to low level of infrastructural intervention.	Improvements to public realm quality in selected locations.	Transformational impacts on the safety and connectivity of the walking environment.
Challenges	Problems of crowding and connectivity are left to become acute, impacting on business location choices and residential and visitor growth. Deterioration of walkability means Melbourne falls behind international competitor cities. Public transport investment (eg Metro) is not supported by adequate pedestrian infrastructure. The benefits of continuing central city concentration such as agglomeration economies are foregone.	Focusing on functional problems of crowding and safety neglects potential for more transformational changes to street space that provide additional benefits for the public realm. Attempts to balance vehicle and walking needs based on existing levels of demand fails to realise the potential for mode shifts with more transformational change.	Comprehensive change to traffic circulation risks unacceptably negative impacts on vehicle movement efficiency with problems for deliveries and site access. Potential for substantial financial cost implications for Council and community from infrastructural works.

5. Recommendations

The City of Melbourne's 2014 Walking Plan provides a solid platform for improving walkability. It identifies a comprehensive range of actions, most of which have yet to be fully implemented and remain relevant going forward. The strategic directions possible for the City of Melbourne as it looks to 2050, range from targeted responses to obvious deficiencies through to transformational and comprehensive shifts to central city traffic circulation and road space allocation that clearly place walking first.

In refreshing the transport strategy and considering the role or walking, the following ideas should be considered:

1. **Take a bolder and faster approach to re-allocating space for walking.** The City of Melbourne needs to manage profound growth in walking activity in the central city with forecasts for walking volumes to increase by two and half times today's levels by 2030. Incremental responses such as minor footpath widening will be insufficient to address problems and more transformational approaches to redesigning the street are required. While the existing Walking Plan identifies a comprehensive range of locations for more pedestrian-oriented environments, the pace of implementing such changes has been slow. There are good opportunities to integrate the re-allocation of space to walking with strengthened security for crowded locations. This will be most effective when security concerns are considered early in the design process for transformed streets.
2. **Provide space not only for a functional walking environment, but also the public life of the street.** There are risks that the forecast growth in walking activity crowds out the public life of the central city's pedestrianised areas and footpaths. In planning for walking, there needs to be a focus not only on maintaining the movement function of footpaths but also on ensuring high-quality spaces for public life.
3. **Take seriously the challenge of significant increases in walking activity accompanying growing public transport use and new Metro stations.** Public transport patronage to and from the municipality continues to grow and pedestrian crowding is identified as highest around rail stations. Crowding around tram stops is also a major problem. The completion of the Melbourne Metro will see further increases in walking activity around stations. Transformational changes to walking infrastructure and allocation of road space around the municipality's rail stations and busy tram stops will be necessary to accommodate this public transport growth.
4. **Reduce traffic speeds to 30km/h or less in all areas of the city with high levels of walking activity.** The numbers of injury and fatality road crashes involving pedestrians in the municipality remains unacceptably high. There is clear evidence that reduced traffic speeds can reduce the risk of injury and fatality crashes for people on foot. While the central city has a relatively low 40km/h speed limit, further reduction to 30km/h of less in all locations with high levels of walking activity is warranted. In some locations such as shared spaces and laneways even lower speeds are desirable. Changes to speed limits will need to be accompanied by infrastructure and enforcement to ensure lower traffic speeds.
5. **Provide more space for walking and an enhanced public realm by rationalising traffic circulation in the central city.** Freeing up the required space to effectively accommodate substantial growth in walking activity in Melbourne's central city will likely only be possible by making changes to the amount of space allocated to vehicle movement and parking. An effective way of doing this could involve a city-wide rationalisation of traffic circulation patterns, reducing the complexity of intersections and concentrating traffic on a more limited number of routes.
6. **Review decision-making tools for re-allocating space and time among various street users.** Current approaches to making decisions on allocation of signal time and road space between walking

and other modes may be unduly prioritising traffic functions and frequently involve minimal attention to measuring benefits and costs for walking. New tools to measure pedestrian delay and use these findings to guide decision making are needed. The current Walking Plan emphasises the use of VicRoad's Smart Roads framework for decision-making on space allocation between modes. Currently all major streets in the Hoddle grid are designated as pedestrian priority routes under this framework. While pedestrians are likely to be priority users throughout the central city, the framework does not appear to provide a sufficiently nuanced prioritisation between modes to usefully guide decision-making on the allocation of space and time among traffic and walking. Within the central city, a more detailed identification of the relative priority of streets for walking may be more effective in helping to make trade-offs between modes. In addition, new tools that more precisely measure levels of delay for walking will assist with decision-making.

7. **Address gaps in walking connectivity including missing pedestrian crossing links.** There are several locations in the municipality where formal opportunities for crossing busy and wide roads are insufficient due to long distances between crossings and long block lengths. Addressing these deficiencies in the basic connectivity of the walking network can stitch places together more tightly and provide a more inviting walking environment.
8. **Recognise the critical role that walking plays in micro-scale connectivity between businesses and supporting commercial and public life. Use this insight to guide decisions on the allocation of street space among multiple users.** Walking is used for 66% of internal trips within the City of Melbourne and the connectivity of the walking environment is fundamental to supporting the growing business service and innovation sectors that cluster in the central city. Prioritising walking can support both high-value business activity and the quality of everyday experience in the city for residents, workers and visitors.
9. **Optimise allocation of time at signalised intersections to maximise benefits for all street users.** Without changes to signal management, increased numbers of people walking and using public transport in Melbourne's central city will be accompanied by increased crowding and delay at signalised intersections. There are opportunities to improve signal management including reviewing total cycle times and allocation of signal time to better reflect the relative volume of various road users. Complementary measures such as rationalising traffic turning movements and simplifying intersections can also improve signal operation for walking.

References

ABS 2017a Census of Population and Housing

ABS 2017b, ABS Australian Demographic Statistics March 2017, http://www.abs.gov.au/ausstats/abs@.nsf/mf/3101.0

Adams, R. 2005, Melbourne Back from the Edge, City Edge: Case Studies in Contemporary Urbanism, Oxford, United Kingdom

Aecom, 2011, Economic evaluation of pedestrian improvements. Sydney, in Walking Plan Technical Report – Pedestrian Delay Overcrowding Block Length and Through Block Links, 2014).

AJM Joint Venture, 2016, Melbourne Metro Rail Project - Transport Impact Assessment, Melbourne Metro Rail Authority

Ajuntament de Barcelona, 2017a, Presentation | Supercil, http://ajuntament.barcelona.cat/superilles/ca/presentacio

Ajuntament de Barcelona 2017b, Urban Mobility Plan of Barcelona PMU 2013-2018

Ajuntament de Barcelona 2017c, Avantprojecte de Reurbanització dels carrers Borrell i Tamarit

Auckland Council 2017b, Measuring Pedestrian Delay Final Report, http://knowledgeauckland.org.nz/assets/publications/Measuring-pedestrian-delay-Auckland-MRCagney-2017.pdf

BCN Ecologia, 2017a, Superblocks, http://www.bcnecologia.net/en/conceptual-model/superblocks

City of Dublin 2017a, Dublin City Special Speed Limits Bylaws 2011 Map, 7c Appendix Map 2011

City of Dublin, 2017b, Phase 2 Expansion of 30km/h Slow Zones in Dublin, Website

City of Dublin 2017c, Speed Limits in Your Area

City of Dublin 2017d, Speed Review – Frequently Asked Questions

City of Melbourne 2009, The effects of pedestrian delay and overcrowding on our streets, Council report agenda item 6.2 31 March 2009 pp.13 http://www.melbourne.vic.gov.au/aboutmelbourne/projectsandinitiatives/majorprojects/swanstonstreet/documents/attachment1swanstonstreetasnapshot.pdf

City of Melbourne 2012, Transport Strategy 2012 Planning for Future Growth

City of Melbourne 2014a, Walking Plan 2014-17

City of Melbourne 2014b, Melbourne for All People strategy 2014-17

City of Melbourne 2017a, City of Melbourne Open Data, pedestrian volume October 31, 2016 to October 31, 2017, Accessed Online: https://data.melbourne.vic.gov.au/Transport-Movement/Pedestrian-volume-updated-monthly-/b2ak-trbp

City of Melbourne 2017b, City of Melbourne Economic Profile, Accessed Online: http://melbourne.geografia.com.au/

City of Melbourne 2017c, Daily Population Estimates and Forecasts – 2017 Update

City of Melbourne 2017d, Pedestrian Comfort Level in Melbourne

City of Melbourne 2017e, Southbank Boulevard and Dodds Street Draft Concept Plan https://participate.melbourne.vic.gov.au/southbankboulevard?_ga=2.129624648.574780076.1512006718-1395745975.1508364837#/features

City of Melbourne 2017f, City Speed Limits, Accessed Online: http://www.melbourne.vic.gov.au/parking-and-transport/roads/road-safety/Pages/city-speed-limits.aspx

Commonwealth of Australia 2017, Australia's Strategy for Protecting Corded Places from Terrorism https://www.nationalsecurity.gov.au/Media-and-publications/Publications/Documents/Australias-Strategy-Protecting-Crowded-Places-Terrorism.pdf

Designing Out Crime Research Centre 2014, Safe Places Vehicle Management, http://designingoutcrime.com/wp-content/uploads/2014/11/SafePlaces_Vehicle-Management.pdf

Duranton, G., & Puga, D. 2004. Chapter 48 Micro-foundations of urban agglomeration economies. In J. V. Henderson & T. Jacques-François (Eds.), Handbook of Regional and Urban Economics (Vol. Volume 4, pp. 2063-2117): Elsevier.

Fishermans Bend Framework 2017, Draft Fishermans Bend Framework, Victorian Government, Melbourne

Gravitas, 2011, Drivers of Business Location in the Auckland CBD http://knowledgeauckland.org.nz/assets/publications/Drivers-of-business-location-in-the-Auckland-CBD-Gravitas-2011.pdf

Heart of the City, 2017, Real Time Pedestrian Counts https://www.hotcity.co.nz/pedestrians-in-the-city

Department of Health, 2017, Australia's Physical Activity & Sedentary Behaviour Guidelines for Adults (18-64 years) http://www.health.gov.au/internet/main/Publishing.nsf/Content/health-pubhlth-strateg-phys-act-guidelines#apaadult

Heart Foundation, 2004, Healthy by Design a planners; guide to environments for active living National Heart Foundation of Australia (Victorian Division) http://www.healthyplaces.org.au/userfiles/file/Healthy_by_Design.pdf

Heart Foundation, 2017, Why Walk? | Heart Foundation, https://walking.heartfoundation.org.au/why-walk/

JLL, 2017, Melbourne Retail Market Overview Q3 2016 http://www.jllapsites.com/research/melbourne-cbd-retail-vacancy-remains-tight/).

Kelly, O. 2017 Christmas crackdown on motorists breaking 30km/h limits, The Irish Times.

Marshall, A. 1890. Principles of economics. London ; New York: Macmillan and Co.

McKibbin, D, 2014, Impact of 20mph speed limits, Research and information service research paper, Northern Ireland Assembly

MRCagney 2017a – Estimating Internal Walking Trips Final Report

MRCagney, 2017b, Business Case for Walking Investigating the Economic Value of Walking in Auckland City Centre

Plan International 2016, A Right to the Night, Australian girls on their safety in public places

Ramidus Consulting, 2016, Clusters and Connectivity: The City as a Place for SMEs, City of London Corporation and the City Property Association

SGS 2014, Pedestrian Analysis Technical Report for the City of Melbourne

Siksna, A. 1996, The effects of block size and form in North American and Australian city centres, Urban Morphology, Brisbane, Australia, pp.19-33

Smart Growth America, (2015), Core Values: Why American Companied are Moving Downtown, Accessed Online: https://smartgrowthamerica.org/resources/core-values-why-american-companies-are-moving-downtown/

Traffinity, 2014, Review of Signal Operations for Pedestrians in the City of Melbourne Report on the Action Stream of Draft Walking Plan 2014-17

Tivendale Transport Consulting, 2012, CBD Shared Zones Melbourne

Turner S, Vallyon, C, Biner, S, Hodgson, S, 2018, Reducing Pedestrian Delay at Traffic Signals, http://www.transportationgroup.nz/papers/2008/FullPapers/Vallyon,%20Chris%202.pdf

VicRoads 2012, SmartRoads, Road User Heirachy, City of Melbourne https://www.planning.vic.gov.au/__data/assets/pdf_file/0029/27956/Appendix-E-SmartRoads-Road-Use-Hierarchy-Maps.pdf

VicRoads 2016, Crashes Last Five Years, https://www.data.vic.gov.au/data/dataset/crashes-last-five-years)

VicRoads 2017, Traffic Volumes for Freeways and Arterial Roads, Accessed Online: https://vicroadsopendata-vicroadsmaps.opendata.arcgis.com/datasets/traffic-volume

VicHealth 2016a, Increasing Participation in physical activity and reducing sedentary behavior https://www.vichealth.vic.gov.au/media-and-resources/publications/vichealth-indicators-action-guides-2015

VicHealth 2016b, Explore your data, City of Melbourne, Accessed Online: http://www.exploreyourdata.com.au/

VicHealth 2016c, VicHealth Health Indicators Survey: Selected Findings 2015, https://www.vichealth.vic.gov.au/media-and-resources/publications/vichealth-indicators-report-2015

Victorian Department of Health and Human Services, 2017, Victorian Population Health Survey 2015: Selected Survey Findings, State of Victoria, Melbourne. https://www2.health.vic.gov.au/public-health/population-health-systems/health-status-of-victorians/survey-data-and-reports/victorian-population-health-survey/victorian-population-health-survey-2015

Victorian State Government 2013, Victorian Transport Atlas 2013

Victorian State Government 2016, Victorian Integrated Study of Travel and Activity (VISTA) 2016

Victorian Government 2016, Towards Zero 2016-20, Victoria's Road Safety Strategy and Action Plan https://www.towardszero.vic.gov.au/__data/assets/pdf_file/0010/183556/STU_0206_RS_STRATEGY_2016_web.pdf

Victoria State Government 2017, Plan Melbourne 2017-2050

Victoria Walks, 2016, Safer Road Design for Older Pedestrians

Victoria Walks 2017, Fall-Related Injuries While Walking in Victoria

Yarra 2017, Yarra to Introduce 30km Speed Trial https://www.yarracity.vic.gov.au/news/2017/09/05/yarra-to-introduce-30kmh-speed-trial

Woods, E, 2017, How slow can you go? Council gears down for 30km/h limit in center of Footscray http://www.theage.com.au/victoria/how-slow-can-you-go-council-gears-down-for-30kmh-limit-in-centre-of-footscray-20170519-gw8xw9.html

World Resources Institute 2017, Bigger isn't always better: Narrow Traffic Lanes Make Cities Safer, http://www.wri.org/blog/2016/12/bigger-isnt-always-better-narrow-traffic-lanes-make-cities-safer