Getting to the Bus Stop

September 2021

This report was prepared by Josephine Eady and Duane Burtt (Victoria Walks).

Victoria Walks Inc is a walking health promotion charity working to get more Victorians walking more every day. Our vision is people walk whenever and wherever possible, within strong and vibrant communities, with resulting health benefits. Victoria Walks is supported by VicHealth.

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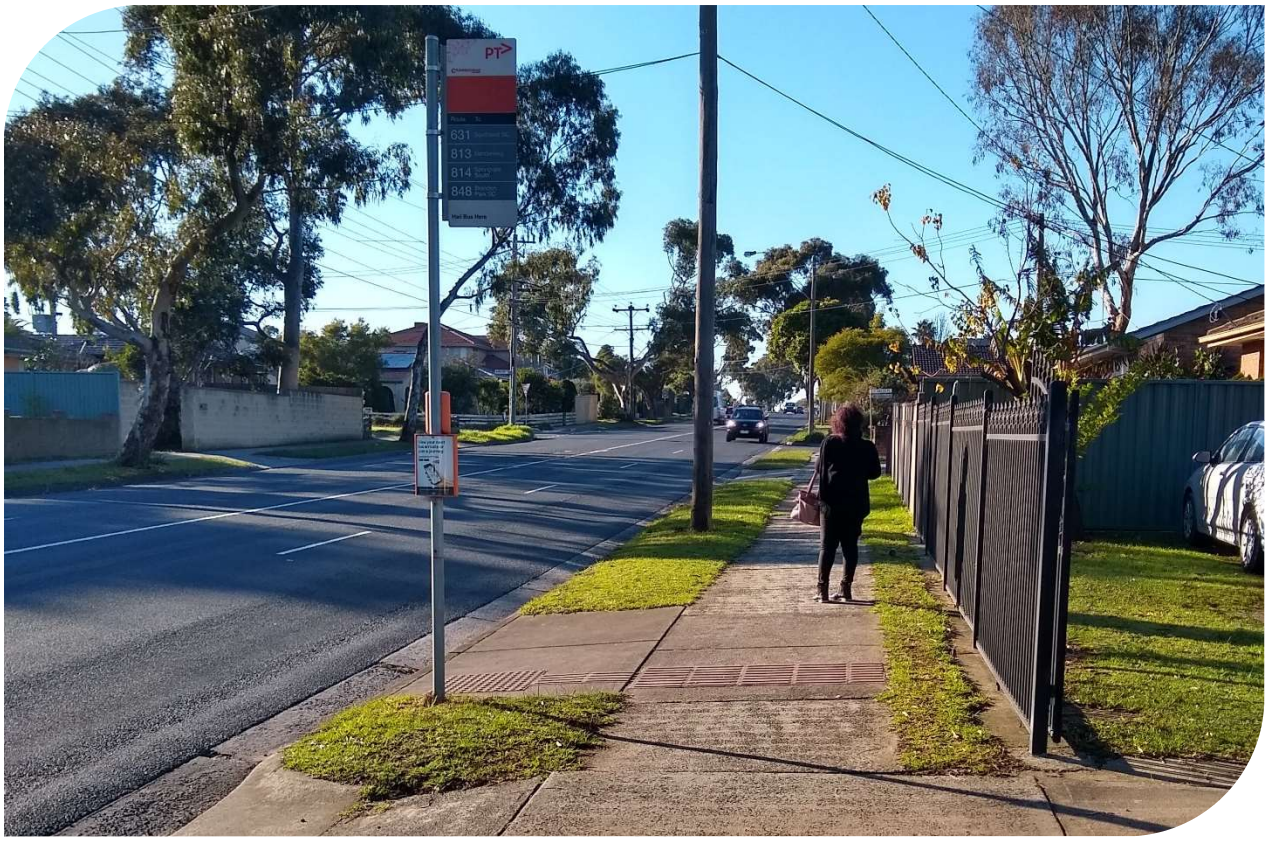
Table of Contents



Executive summary

This project looked at walking access to bus stops in Victoria and the accessibility, safety and amenity of the immediate area. Walking is the main way people access bus stops in Melbourne, with 94% of users walking all or part of the way.

This report investigates walking access to bus stops based on the findings of:

- A literature review
- Discussions with state transport agencies from Australia and New Zealand
- Analysis of Victorian Department of Transport data
- A survey of 436 Victorian bus users, and
- Audits of access to 70 bus stops in Melbourne and Victorian regional towns and cities.

Walking to the bus stop shares many of the characteristics of walkability generally. Places which are walkable are more pleasant and attractive for everyone, including women, children and older people. However, walkable areas are not evenly distributed and do not necessarily align with public transport provision. Inner city suburbs are more likely to have both good walkability and quality public transport services than other urban areas.

Bus users

Typical public bus users are slightly more likely to be female (52%) and considerably more likely to be younger than the general population, with a third aged 10-19 and another 22% aged in their twenties. They are more likely to be studying at secondary school, TAFE or university, or working casually, not have a full driver licence and have a personal income below $299/week ($15,548/year) or no income. They are also more likely to be travelling for education or work purposes.

Notwithstanding the dominance of young people, there is also a substantial bus patronage by older people, with 11% of bus users aged 60 or older. Both groups can be seen as particularly vulnerable, with young people sometimes having difficulty judging risk and older people highly susceptible to injury in the event of a crash.

Bus stops

Only a basic level of infrastructure is common to most bus stops in Victoria – 87% are identified by a sign on a pole and 84% have a concrete base. However, three quarters have no formal shelter. Shelters are more common in metropolitan Melbourne (29% of stops) than in regional and rural areas (16%).

The walk to the bus stop varies substantially between users but tends to be a relatively short journey, with half of trips walked 350 metres or less. A short distance is a key factor in using the bus in the first place and feeling pleasant and safe on the walk to the stop.

While not the focus of this study, the frequency and reliability of bus services is very important to users, in addition to the walk to the stop. Other research has previously found that although nearly 70% of homes in Melbourne are close to public transport services[1], only 35% are within 400 metres of a public transport service that operates at least every half hour between 7am and 7pm weekdays.

Crossing the road

Bus stops are typically located on main roads to facilitate bus operation, but this usually leaves customers to negotiate the crossing of a road with high traffic volume and speeds.

Bus stop access audits found that 60 km/h was the most common speed limit at the stop (42%) and a combined 60% of bus stops were located on roads with a limit of 60-80 km/h, above the 50 km/h default urban speed limit. The survey reported very similar results. The access audits also found that 95% of stops on roads with a speed limit of 60 km/h or more did not have a signalised crossing within 20m.

Two in five audited stops (41%) were located on roads where a person would have to cross at least four lanes of traffic and sometimes also parking lanes.

'Traffic' and 'road crossing' were the two factors most associated with feeling unsafe in the survey.

Despite these challenges, pedestrian crossings are not generally provided at bus stops. Of people surveyed, 55% used a bus stop with no crossing infrastructure. The bus stop access audits found 64% of stops had no formal crossing nearby. Signals were visible from 29% of bus stops but only 8% of those were very close to the stop, within about 5 metres. Zebra crossings, where people walking are given priority, and school crossings were much less common, being the only formal crossing within 50 metres at 3% of stops and 4% of stops respectively. Even where signals are visible, delays waiting for the signal to change, inconvenient locations and insufficient time to cross comfortably all discourage people from using the signals, or in some cases, using the bus at all.

"BUS STOPS ARE OFTEN LOCATED RIDICULOUSLY FAR FROM THE NEAREST INTERSECTION OR PEDESTRIAN CROSSING. THEY'RE LOCATED WHERE IT'S CONVENIENT FOR THE BUS TO STOP WITHOUT HOLDING UP TRAFFIC, WHICH IS OFTEN NOT AT ALL CONVENIENT FOR THE PASSENGER."

SURVEY RESPONDENT

People are unlikely to walk far out of their way to use an inconveniently located crossing. For 55% of people who used signals, they were located

[1] Defined as within 400 metres of a bus stop, 600 metres of a tram stop or 800 metres of a train station.

within 5 metres of their route. Only 23% of people who used a crossing said it was more than 50 metres out of their way. Expecting people who may be rushing to catch a bus to walk 100 or even 50 metres out of their way in order to use a crossing, rather than providing a crossing at the stop, is not realistic and does not provide safe access.

Medians can also be useful for crossing roads, although they can be an obstruction to wheeled devices if no kerb ramps are provided. The bus stop access audits found that only a third of roads had a raised median at the stop, but that this was not always wide enough to stand on.

In addition to crossing the road the stop is on, bus users may have to cross other roads on the way. The audits found that 56% of bus stops had intersecting roads within 50 metres. The vast majority of survey respondents (90%) reported having to cross at least one road on their way to the stop.

Other than roads, people may have to cross other vehicle paths to get to the bus stop including slip lanes, service roads and, most commonly, driveways to retail or industrial areas. Slightly more than one in three people reported feeling unsafe at these locations (36%), 27% felt safe and 37% reported feeling neither.

State government agencies in Australia indicated that they try to adopt a holistic view to bus stop access and recognised the desirability of providing crossing facilities, but reported being constrained by project scope and budget.

The way road crash data is collected and reported does not readily allow an analysis of actual crashes near or on the way to bus stops. The extent of people being injured walking to or from bus stops is not known. Discussions with state agencies suggested that the reactive approach to funding improvements at specific 'high risk' locations means that the relatively low number of people injured or killed at individual bus stops will never meet the threshold requirements to receive funding under current models.

"I HAVE TO CHOOSE BETWEEN CROSSING FIVE LANES OF TRAFFIC ON SYDNEY ROAD, WAITING FOR BREAKS IN THE TRAFFIC, OR WALK DOWN TO THE TRAFFIC LIGHTS WHERE THE CROSSING TIME IS SO SHORT THAT YOU HAVE TO RUN THE SECOND HALF OF THE CROSSING ANYWAY. IF YOU'RE ELDERLY, YOU HAVE TO WAIT FOR ANOTHER LIGHTS CHANGE."

SURVEY RESPONDENT

Crossing roads with lots of vehicles travelling at high speeds is inconvenient, unpleasant and often unsafe. Bus users are typically more vulnerable people – teenagers, young people and to a lesser extent older people – yet there is usually no convenient, direct pedestrian crossing to assist them. This is not a safe system response.

A pleasant walk?

Walking either for recreation or transport generally has positive associations, and survey respondents were more likely to rate the walk to the bus stop as pleasant (39%) than unpleasant (12%), although people were most commonly neutral (48%).

The natural environment, nice weather and large shade trees contribute to the walk to the bus stop being pleasant. The most enjoyable aspects reported in the survey were having parks or public space (79%) and shade trees (77%). The audits considered the number of trees large enough to stand

under on public land within 50 metres of the stop, and two-thirds of stops had at least one shade tree nearby. A third of stops (34%) had no shade trees, but some had small trees which had not yet grown to maturity.

Quiet, local streets and footpaths were other factors that contribute to a pleasant walk, along with places with shops and other people.

By comparison, travelling after dark and infrastructure deficits such as missing footpaths made the walk less enjoyable. Urban design aspects catering for driving such as car parks, crossing busy roads and walking along roads with speeds of 60 km/h or more all detracted from enjoyment. A lot of traffic travelling at high speeds is noisy and pollutes the air, contributing to an unpleasant walking environment.

European research suggests stimulating and pleasant walking environments can decrease the perceived walking distance to stops. This could possibly extend the reach of public transport services for people who find walking easy but probably not for those who are older or have disability.

Perceptions of safety

More than half of survey respondents felt safe on their walk to the bus stop (62%). Although nearly all (95%) travelled between 6am and 7pm – mostly daylight hours – walking at night or with insufficient light was raised by some as an issue, including by 13% of all people who replied to an open-ended question about 'other issues'. The bus access audits found that street lighting is the only lighting provided near most bus stops, and not necessarily at the stop itself.

In relation to perceptions of safety on the walk to the stop, there was a difference by gender, consistent with many studies of perceptions of public space. Females were less likely than males to report feeling safe (59% of women compared to 69% of males) and much more likely to feel unsafe (14% vs 6%).

Equality

Bus stops that comply with disability standards are not necessarily accessible, including for those using wheelchairs or mobility scooters. A compliant bus stop that has no footpath connection or one that has no ramps at crossing points limits the number of people who can safely and comfortably access a stop. Even when the system provides a way for a people to get to the bus stop and board a bus, there is no guarantee the infrastructure and support will be available for them to get off again at the other end.

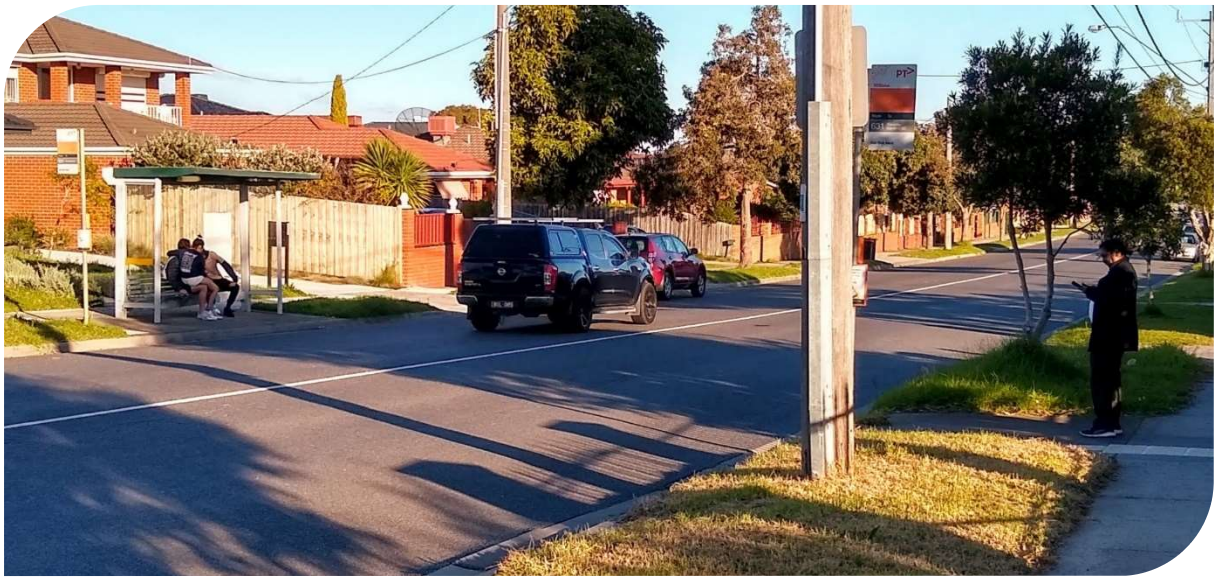
Ramps are essential for people using wheelchairs, mobility scooters and prams or with limited mobility to be able to cross the road. Kerbs were present in 94% of the access audits, but more than one third (36%) of these stops did not have any ramp access – kerb ramps or driveways – within 50 metres. Although not designed for pedestrian access, driveways can provide an opportunity to cross.

Footpaths are similarly important to people with limited mobility or travelling with wheeled devices. The bus stop access audits found about three quarters of stops were connected to footpaths in both directions, while 6% had a footpath connection only in one direction and 11% had no connecting path. In 2016, the RACV assessed bus stop footpath connections in Melbourne's growth areas and estimated that there were 1,485 stops in those areas without footpaths.

Victorian Department of Transport officers reported that for new or upgraded bus stops within about 50 metres of an existing footpath, they usually either connect it as part of the project (even though technically it is out of scope) or talk with the local council about sharing the cost.

State transport agencies reported that discussions around the introduction of Disability Standards suggested the federal government would provide funding to implement them. However, no federal funding has been forthcoming so upgrades have had to be funded through existing state and territory budgets. The current funding level of approximately $3 million per year for bus stops upgrades across Victoria is not sufficient to upgrade all stops to meet the Standards by the target date of December 2022, let alone provide crossings and footpath connections.

Everyone, regardless of ability, suburb, or gender, should be able to get to the bus safely and comfortably, but that is not currently the case.



Recommendations

The following recommendations are made for improving access to bus stops in Victoria based on the findings in this report. Some of these recommendations could be considered innovative given the status quo of designing roads for cars rather than people, however they all focus on making the experience of travelling to, from and waiting at bus stops more pleasant, convenient and safe.

Crossings

1. The Victorian Department of Transport should include road crossings in the scope of new and upgraded bus stops and be resourced accordingly.

2. The Victorian Department of Transport should develop design guidance on crossing facilities to be provided with bus stops, but in the interim:
   - Signalised crossings should generally be provided at stops on multi-lane roads with a speed limit of 60 km/h or higher and service frequency greater than 30 minutes during the day. Alternatively, consider reducing the speed limit, to reduce the need for signals and improve general safety. This may be a particularly useful option to consider on roads with a high density of bus stops or where bus stops are not paired (aligned on both sides of the road).
   - At other stops, the assistance to be provided should consider:
     - Providing formal crossings such as signals, or raised zebra crossings on streets with a speed limit of 50 km/h or less;
     - Simplifying the crossing by breaking it into two parts using a refuge or median with kerb ramps;
     - Reducing the crossing distance using kerb extensions or fewer traffic lanes.
   - At all stops, aligned kerb ramps should be provided on both sides of the road where there are no driveways (or where mountable kerbs have been continued across driveways) within 20 metres. Aligned kerb ramps or cut-throughs should also be provided to traverse any raised median.
   - Crossing assistance should be located as close as possible to the bus stop, within 20 metres.

3. The Victorian Government should create a fund for retrofitting pedestrian crossings, kerb ramps and 'missing link' footpath connections at bus stops, with priority given to stops:
   - Close to key destinations such as schools, universities, shops, community services and seniors accommodation.
   - On roads with a speed limit of 60 km/h or higher
   - With service frequency greater than 30 minutes during the day

4. The Victorian Department of Transport should consider the safety, amenity and mobility benefits of reducing speed limits on urban roads currently set at 60 km/h or more in sections with bus stops.

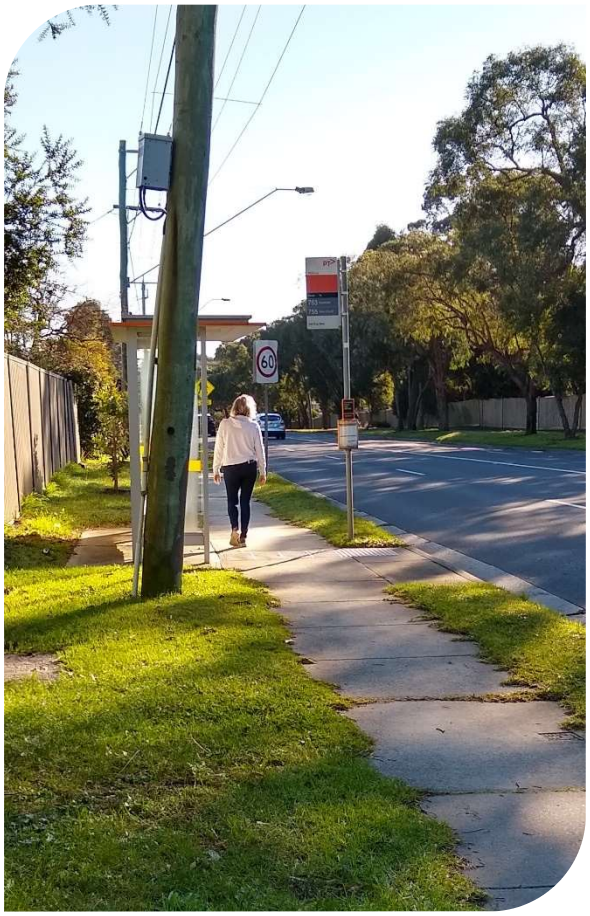
Signals

5. The Victorian Department of Transport should more broadly use existing technology that improves traffic signals for pedestrians, such as automatic green, at intersections outside of the CBD.

6. The Victorian Department of Transport should utilise the new technology available to operate signals in response to real time demand, to make crossing the road more responsive (reduce delays) for pedestrians and safer (sufficiently long crossing times).

7. The Victorian Department of Transport should not limit the walk (green) time at traffic signals to 8 seconds but instead continue it as long as the parallel vehicle phase allows.

8. The Victorian Department of Transport should review walking speed assumptions used in signal phasing to better reflect the actual range and allow sufficient time for older people and people with disability to cross at signals where the clearance time is static.



Footpaths

9. In constructing new or redeveloped bus stops, the Victorian state government should work with local government to develop and fund 'missing link' connections to existing footpaths within 150 metres of the stop.
10. Where there are no footpaths within 150 metres of stops being constructed or upgraded, the Victorian Department of Transport should work with local government to ensure connecting footpaths is included in future planning.
11. State and local government should build separate facilities for people walking and riding, rather than shared paths, on streets with bus stops and when new bus stops are installed or existing ones upgraded.
12. The Victorian Government should explore options to reduce cyclist speeds on shared paths within 50 metres of existing bus stops.

Accessibility

13. The Department of Transport should be resourced and mandated to ensure the co-ordination of accessibility improvements (including access for people with disability) across transport agencies, operators and local government.

14. The Australian Government should fund state and territory governments to upgrade existing bus stops to comply with Disability Standards, as intended when the standards were introduced.

15. The Australian Government should update the Disability Standards for Accessible Public Transport to encompass a broader definition of accessibility, including access to and from bus stops.

16. Until such time as disability standards have been reviewed to consider access to the stop, public transport agencies should prioritise improvements in accessibility outcomes. This

should include walking to stops, not only the extent of compliance with disability access standards in construction of the stop itself.

17. Future access improvements and bus stop upgrades should maximise the opportunities to create continuously accessible journey paths to the bus stop, at the stop and at subsequent stops on the route.

Bus stop

18. When locating new or relocating existing stops, consideration should be given to how convenient and pleasant it is for people to access them or how they fit into the broader public space, in addition to bus operations and general traffic.

19. The Victorian Department of Transport should investigate funding options in addition to bus stop advertising to increase the number of bus stops with shelters and seating.

Other

20. Local councils should continue with tree planting and urban greening programs, recognising not only the environmental benefits but also that improvements to walkability lead to better health, communities, equality and local economies. Walking paths near bus stops and other local destinations such as activity centres should be prioritised for tree planting.

21. The Victorian Government should co-locate new bus stops and shops and services where possible.

22. When considering the impact of traffic noise, the Victorian Department of Transport should consider the noise level for people walking along roads and waiting at bus stops, in addition to people in nearby buildings.

23. The Victorian Department of Transport should work with local councils to review the level and consistency of lighting within 50 metres walk of bus stops serviced by the Night Network and routes with high patronage that operate early in the morning and into the evening and night. The Victorian Government should provide funding to implement the necessary improvements.

24. The Victorian Department of Transport should consider ways to capture data about people injured or killed on their way to, from and at the bus stop.

25. The Victorian Department of Transport should investigate the potential to research the spatial correlation between pedestrian crashes and bus stops using existing data.

Introduction

This project centres on walking access to bus stops in Victoria and the accessibility, safety and amenity of the immediate area. It briefly considers the design of bus stops themselves, however access to the stop is the key focus of the study.

This project included the following four key elements:

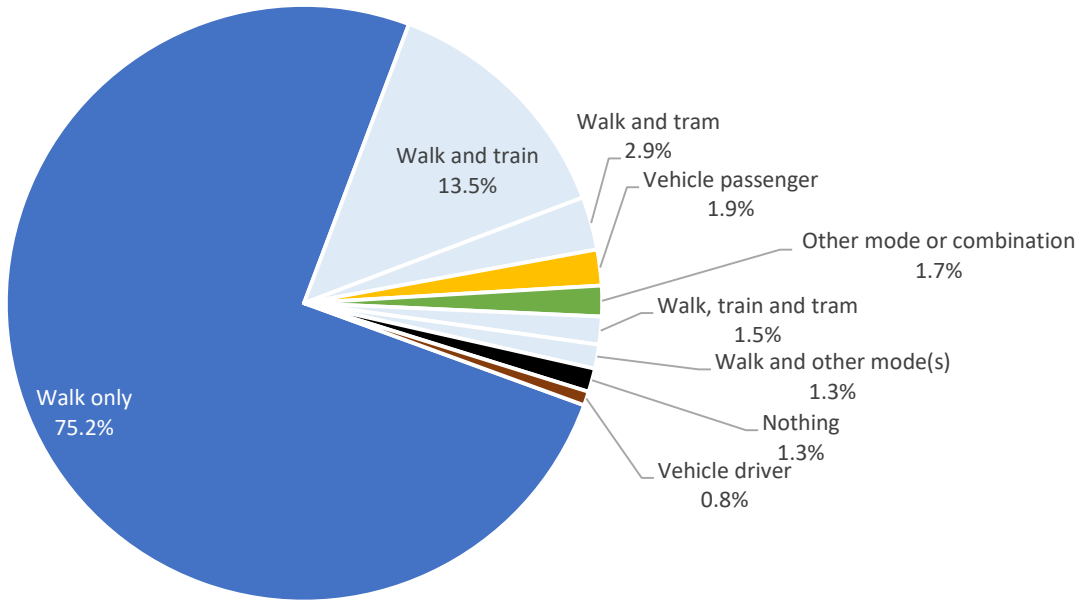
- Literature review and analysis of Victorian Department of Transport data.
- Speaking with state transport agencies and other relevant organisations from Australia and New Zealand.
- Survey of 436 Victorian bus users about bus stop access.
- Audits of access to 70 bus stops in Victoria. The stops were chosen to be broadly representative of stops state-wide.

The methodology and additional results of the survey and audits are detailed in Appendices A and B.

Walking and public transport

Walking and public transport are closely related. Nearly all (97%) public transport trips made in Melbourne include some walking, such as from home to the bus stop or from the train station to the office (Eady & Burtt, 2019). Data collected as part of the Victorian Integrated Survey of Travel and Activity (VISTA)[2] was analysed to understand how people travel specifically to bus stops. It found that walking is the key access mode, with 94% of trips to the bus stop walked at least part way. Figure 1 shows that three in four trips are walked all the way to the bus stop and another 18% are walked in combination with a train or tram (or both). This reflects the fact that many 'return' trips from a destination such as the city to a person's home involve walking to catch a train or tram and then changing to a bus before walking the final stage to home.

Figure 1 Ways in which people in Melbourne accessed public bus stops from all locations (analysis of VISTA data)



[2] People who live in Greater Melbourne and travelled on a public bus on a weekday between 1 July 2012 to 30 June 2018, n = 1,734. This period was prior to the impact of COVID lockdowns.

Of trips from home to the bus stop, 83% are walked in their entirety while walking in conjunction with train and/or tram are less important (9%) than from any origin.

Interestingly, 1% of people did not have to travel at all to access the stop because they were already there. This reflects people whose workplace or school has a bus stop immediately outside or who had picked up or dropped off someone at the bus stop prior to catching the bus.

Half of the walking journeys from home to a bus stop are less than 390 metres (the median distance). This is significantly less than to train stations (721 metres) but slightly more than to tram stops (360 metres) (Eady & Burtt, 2019).

The general principles of walkability can be applied to create pleasant walking journeys to bus stops. A recent US study by the National Academies of Sciences, Engineering, and Medicine (2021) reviewed literature on walkability and bus stops specifically. It reports that bus stops in areas with higher walkability and better pedestrian facilities are used more. Bus stops with obstructions and disconnected footpaths are harder for people with limited mobility to use and reduce their access to jobs by 86%. Making waiting at the stop more comfortable by, for example, providing a shelter, increases both the number of people using the bus and their satisfaction with the service.

Bus stops can contribute to walkable environments when they are well designed and become a welcome part of the environment, and public transport services themselves also contribute to a walkable environment. Bus stops which are not well maintained or attract unwanted activity can have a negative impact (Ayers-Johnston, Howard, Lauderdale, Polacek, & Schutt, 2018).

Walking and walkability

Many people walk every day, both for enjoyment/fitness (recreation) or to get places (transport). Of all physical activities in Australia, walking is by far the most popular. Recreational walking is particularly important for women, with 54% participating, although it is also the most popular physical activity for men (Australian Sports Commission, 2020). Across Melbourne, walking makes up 16% of transport trips according to 2012-16 data. An additional 8% of trips involve some walking, such as walking to the bus stop (Eady & Burtt, 2019).

Walking has many benefits, both for individuals as well as broader society (Badawi, Maclean, & Mason, 2018). Individual benefits include:

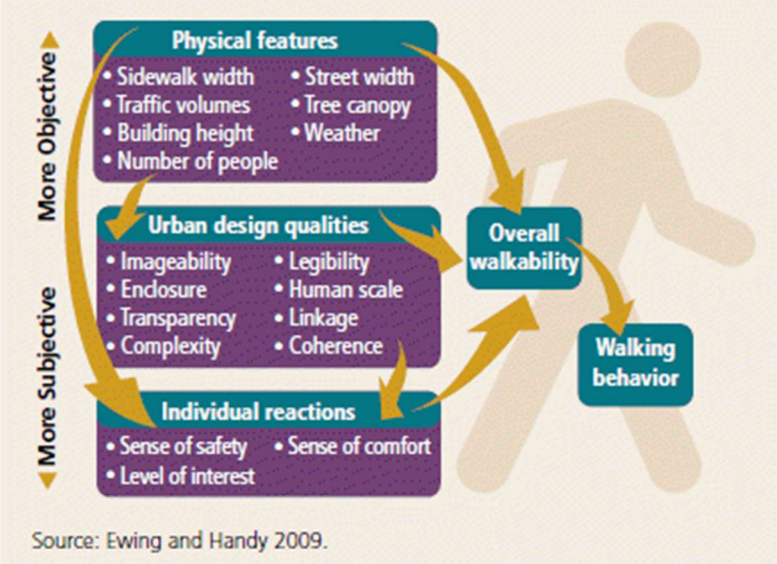
- **Better health** – physical, cognitive, mental and emotional.
- **Reduced costs** when used in place of other transport modes – purchase, operating and maintenance costs of a vehicle or fares for public transport.
- **Improved social connections** – meeting and chatting with neighbours and others.

Society also benefits from more walking, particularly when walking is done in place of driving:

- **Communities** – improving social cohesion and feelings of safety.
- **Local businesses** – increasing retail spend and revitalisation.
- **Equality** – encouraging everyone to use the street regardless of gender, age or ability.
- **Governments** – reducing both road and health costs.

Walkability refers to how easy and comfortable it is to walk around an area. It encompasses a range of physical, design and personal factors, shown in Figure 2.

Figure 2 Conceptual framework for walkability (Ewing & Bartholomew, 2013)



Walkability in general has been well studied. According to Ewing & Bartholomew (2013), Daniels & Mulley (2011) and Arundel, et al. (2017), features of walkable areas are:

- **High densities** and **mixed land use** mean lots of people to support and work at nearby shops, services and open space. People can conduct a wide range of activities in one local place.
- **Lots of walking route options (permeability)** are achieved by short blocks (about 120 – 240 metres) and walking connections away from roads through places like parks and strips of shops.
- **High quality pedestrian infrastructure** including continuous footpaths, lighting and crossings – both formal and informal – that are safe and convenient. Medians provide a pause point and simplify crossing of a two-way street to effectively two crossings of one-way streets. Kerb extensions elevate people waiting to cross as well as reduce the crossing distance.
- **Separation from traffic** using trees and parked cars make people feel more comfortable walking along a road.
- **Buildings that front the street** are interesting to look at and create both visual and physical connections between public areas like the footpath and private areas such as shops.
- **Nearby public transport services** which run frequently and operate when people want to use them.
- **Comfortable and safe places to wait**, which can affect people's decisions in whether to use public transport in the first place.

"IT IS HARD TO FIND A SIX-LANE ARTERIAL THAT IS EASY TO CROSS, PLEASANT TO WALK ALONG, OR COMFORTABLE TO WAIT NEXT TO WHEN USING TRANSIT"

(Ewing & Bartholomew, Pedestrian- and Transit-Oriented Design, 2013)

"DESPITE THE HEALTH AND ENVIRONMENTAL BENEFITS OF WALKABLE COMMUNITIES, AUSTRALIAN CITIES ARE STILL BEING DESIGNED FOR THE MOTOR VEHICLE"

(Arundel, et al., 2017)

In areas with a lot of high-speed traffic, people walk less and also experience negative outcomes for health, wellbeing and sense of community (Anciaes, Stockton, Ortegon, & Scholes, 2019). Importantly, it is not only actual traffic but perceived traffic that can have a negative impact. The cost of the 'barrier effect' due to busy roads on walking in the UK has been estimated at £1119/person/year, mainly due to reduced wellbeing (£420) and higher traffic volumes (£449) (Anciaes, Jones, Mindell, & Scholes, 2019).

A US study found that people who do walk and are familiar with an area are better at estimating walking times and distances. Conversely, in car-dependent locations, routes with lots of barriers and concerns about safety or getting lost lead people to overestimate walking times, reducing their likelihood to walk. Wayfinding information provides true walking times and reassurance, which may lead to improved perceptions of walking and more people walking (Ralph, Smart, Noland, Wang, & Cintron, 2020).

The attraction of walkable places is reflected in their economic value. Melbourne research found that an increase of five points in the Walk Score (a measure of walkability) of a suburb meant houses in that suburb commanded nearly $300 extra per square metre (Walker & Lock, 2013). Similar correlations have been observed in the US, with even larger increases for retail and office rents, including in suburban areas (Eady & Burtt, 2019). Conversely, in places with higher traffic volumes, higher speeds and more traffic lanes, people spend less overall at local businesses as the traffic creates a barrier to walking (Anciaes, Jones, Mindell, & Scholes, 2019).

Short block lengths, one of the features of a walkable area, also mean more intersections, creating more street frontage and corner blocks – both high value real estate (Ewing & Bartholomew, 2013).

"GOOD CITIES FOR WALKING ARE GOOD CITIES FOR LIVING"

(Hillnhütter, 2016)

Equality

Places which are walkable are more pleasant and attractive for everyone, including women, children and older people. As part of the Free to Be project, girls and women in Sydney frequently nominated good places as those busy with people and with good community environments. In contrast, bad places were commonly identified along roads including near public transport hubs (Plan International, 2018).

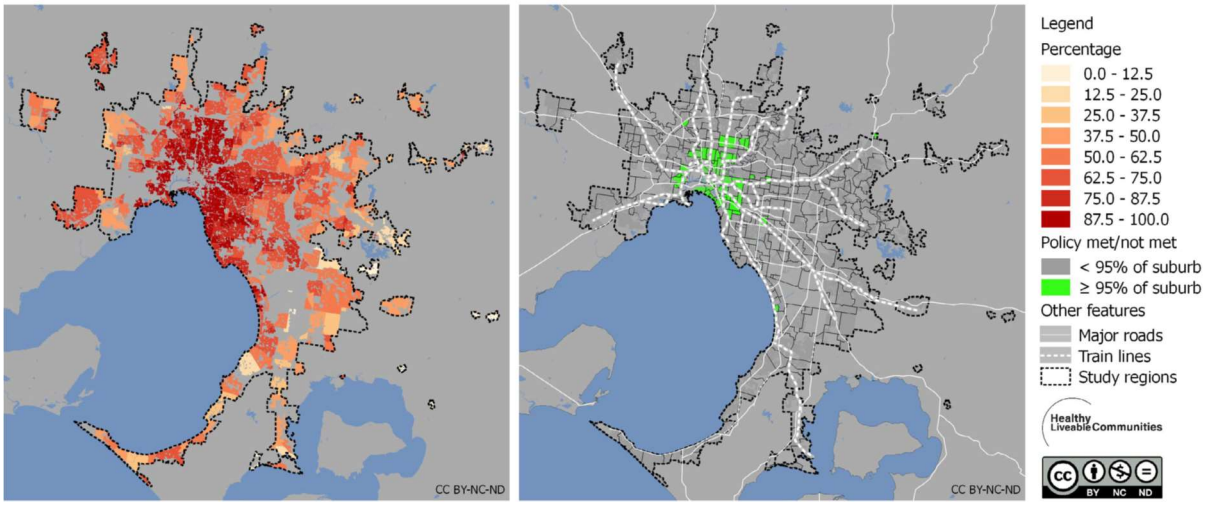
"ALL TRANSIT RIDERS—REGARDLESS OF PHYSICAL ABILITY, DISABILITY, INCOME LEVEL, RACE, ETHNICITY, OR NEIGHBORHOOD—SHOULD BE ABLE TO EASILY ACCESS THE PUBLIC TRANSIT SERVICES AVAILABLE IN THE CITY."

(National Academies of Sciences, Engineering, and Medicine, 2021)

Walkable areas are not evenly distributed, creating inequalities based on where a person lives. In Melbourne, walkable communities are generally concentrated in the inner suburbs, similar to most Australian cities (Giles-Corti & Arundel, 2018).

Inequality is also an issue for public transport service coverage and operation. Although nearly 70% of homes in Melbourne are close to public transport services[3], only 35% are within 400 metres of a service that operates at least every half hour between 7am and 7pm weekdays (Giles-Corti & Arundel, 2018). Melbourne's policy target is for 95% of homes to be close to public transport, but only 14% of suburbs meet this target, and they are mostly in the inner city (Arundel, et al., 2017).

Figure 3 Percentage of Melbourne residences (by suburb) within 400 m of a bus stop, 600 m of a tram stop or 800 m of a train station (left); suburbs that comply with the state policy (right) (Image source: Arundel, et al., 2017)



Responsible authority

Providing good access to bus stops is further complicated by varying responsibilities.

Typically, the Victorian government is responsible for the management of arterial roads and freeways, and local governments are responsible for the remaining roads and the roadside, with some exceptions (VicRoads, 2014a). State government authorisation is also required for major traffic control devices on council managed roads, including:

- Speed limit signs
- Traffic and pedestrian signals
- Pedestrian crossings (zebra crossings)
- Shared zones
- Some parking signs, particularly clearways.

In Victoria, the state government is responsible for the bus stop and service through the Department of Transport, but local councils generally manage the footpath. When constructing new bus stops or upgrading existing ones, the scope of the state's responsibility (and funding) extends only to the bus stop and associated stop infrastructure such as shelter and TGSIs. Victorian Department of Transport officers reported using a rule of thumb whereby if a new or upgraded bus stop is within about 50 metres of an existing footpath, they either connect it as part of the project or talk with the local council about sharing the cost. A similar division of responsibility between different levels of

[3] Defined as within 400 metres of a bus stop, 600 metres of a tram stop or 800 metres of a train station.

government exists in other Australian states, with other state agencies reporting similar discussions with local government.

Along with state and local government, there are multiple other agencies that provide services and infrastructure that can influence the accessibility of an area. For example, private businesses like shopping centre or airport owners have authority over how and where public transport services use their facilities, if at all, as well as control over the physical environment around the stop, including pedestrian access. Providers of public infrastructure such as electricity, telecommunications and postal services also use public space and have the authority to dig up footpaths or severely prune street trees. People sometimes create temporary obstacles by placing signs in access paths, blocking the path during building works or parking their car across the footpath (Victorian Council of Social Service, 2011).

"IN AN IDEAL FUNDING AND JURISDICTIONAL ENVIRONMENT, TRANSIT AGENCIES WOULD CONSTRUCT FULL AMENITIES AT BUS STOPS AND ALSO WOULD COMPLETE CONNECTED SIDEWALK NETWORKS TO REACH THE STOPS."

(National Academies of Sciences, Engineering, and Medicine, 2021)

Given this complexity of public space management, cooperation between the various agencies is particularly critical when it comes to improving the infrastructure immediately around a bus stop (National Academies of Sciences, Engineering, and Medicine, 2021). This means that governments and others working together is essential to providing safe and pleasant access to bus stops, something that the International Organization of Public Transport has been calling for since 2009 (Hillnhütter, 2016).

In Victoria, the various agencies, operators and contracts involved mean no single agency is responsible for the holistic view of accessibility. Each focus on their specific responsibilities, but often not in a coordinated way. "The core problem for users with this set of arrangements is that an accessible journey can only be created if it manages, *largely by chance*, to create a seamless path of access" (Victorian Council of Social Service, 2011). State governments in Australia reported generally try to adopt a holistic view to bus stop access but being constrained by project scope and budget.

Making public transport accessible to everyone

In 1992, the Australian Government introduced the Disability Discrimination Act ('*DDA*'), making it unlawful to discriminate against a person based on disability, including in providing access to buildings and services. In 2002, the Disability Standards for Accessible Public Transport ('*Standards*') were introduced under the Act to give providers (generally state governments who provide the infrastructure and vehicles) and operators (such as bus companies that run the services) guidance on how to make public transport accessible for people with disability. All new public transport infrastructure since is required to comply with the Standards, and 100% of bus stops must be compliant by the end of 2022.

Much progress has been made and Victoria's Accessible Public Transport in Victoria Action Plan 2020-24 states that 65% of metropolitan bus stops and 56% of regional bus stops are wheelchair accessible. Whether that means they comply with the Standards is not clear. However, at the current rate is it very unlikely that the 2022 compliance target will be met.

Improving public transport for people with disability generally also improves it for others. For example, providing unobstructed areas at bus stops improve access for people with a mobility disability but also those travelling with prams, shopping trolleys and luggage.

Some changes to comply with the Standards are relatively low cost, such as changes to parking signs, while others can be very expensive, particularly upgrading existing infrastructure.

"FULL COMPLIANCE WITH THE TRANSPORT STANDARDS AS THEY STAND WILL NOT NECESSARILY EQUATE TO ACCESSIBLE SERVICES"

(Victorian Equal Opportunity and Human Rights Commission, 2013)

State transport agencies reported that discussions with the federal government around the introduction of the Standards suggested that the states and territories would be responsible for implementing them and the federal government would provide funding to do so. However, since the Standards were introduced, no federal funding has been forthcoming and so upgrades have had to be funding through existing state and territory budgets. The current funding level of approximately $3 million per year for bus stops upgrades across Victoria is not sufficient to upgrade all stops to meet the Standards by the end of 2022. Many state agencies mentioned that lack of funding has been one of the biggest impediments to meeting the requirements of the Standards.

Understanding accessibility

In terms of bus stop design, accessibility is often used interchangeably with Standards compliance. But the two are not the same. Accessibility is about ensuring people can comfortably and safely get to the bus stop and then onto their destination. It involves access to the stop, waiting at the stop, getting onto the bus, being on the bus, getting off the bus again and getting to the destination. This project focuses on the first step – access to the stop – although all are important in providing an accessible journey.

Compliance often improves accessibility in the immediate area of the stop, with clear space for people to manoeuvre wheelchairs, mobility scooters and walking aids; and tactile indicators for those who are blind or have low vision. However simply because a stop is compliant does not make it accessible. In fact, the Standards explicitly state that "infrastructure does not include any area beyond immediate boarding points (for example, bus stops…)".

"PEOPLE DO NOT SIMPLY MATERIALISE AT BOARDING POINTS, AND EVAPORATE AFTER THEY DISEMBARK."

(Victorian Council of Social Service, 2011)

Compliance is important and a good goal, but not enough to provide a transport system which everyone can use regardless of ability. A compliant bus stop that has no footpath connection or that has a step (kerb) at crossing points rather than ramps limits the number of people who can safely access it. Even when the system provides a way for a person with disability to get to the bus stop and board a bus, there is no guarantee the infrastructure and support will be available for them to get off again where they need to. The Victorian Equal Opportunity and Human Rights Commission (2013) say "this means that the focus needs to shift from minimum compliance with the technical requirements set out in the Transport Standards, to creating a continuous accessible path of travel for people with disabilities." Likewise, the Victorian Council of Social Service

(2011) also recognises the distinction that compliance is about obligations of agencies to meet the Standards, whereas accessibility is about the outcome so that people can actually use the system.

Figure 4 A new bus stop in Riddells Creek which appears to comply with the Standards, but is not accessible to everyone as it has no connecting footpath

"COMPLIANCE INVOLVES REACHING THE STANDARD, WHEREAS ACCESSIBILITY INVOLVES REACHING THE DESTINATION."

(Victorian Council of Social Service, 2011)

Records of Standards compliance are kept but there are no records about whether the upgrades actually make journeys more accessible. Even with improved Standards compliance people continue to report frustrations and problems using the public transport system (Victorian Council of Social Service, 2011).

A complete journey

The 'Creating Accessible Journeys' report by the Victorian Council of Social Service (2011) is an excellent resource about accessible public transport systems. This was the only comprehensive Australian resource focussed on public transport access located during the literature review, apart from studies about access mode and distance.

The report notes that small changes can have a significant impact on how safe and accessible a bus stop is. Universal design principles require considering a stop and how it can be used by different people at different times for different purposes. It should feel safe, pleasant, comfortable, provide protection from sun, wind and rain, somewhere to sit and lighting. It needs to be able to be used by a diversity of people including those with disability, luggage or equipment.

"[CATCHING THE BUS] IS JUST SO HARD SOMETIMES AND ITS THE ONLY REAL TRANSPORT I HAVE APART FROM WALKING"

SURVEY RESPONDENT

For a person with disability to use public transport, they must be confident that every component of the journey will be accessible. "People will not necessarily know what type of vehicle will turn up next, or whether there will be the right level of access at their destination stop or station… Often these pieces of information are not available, or are very difficult to find, or may change

without notice. The uncertainty created means that trust in the public transport system is undermined" (Victorian Council of Social Service, 2011).

Putting the onus on people using public transport to research and understand the accessibility of each component of their journey creates a significant mental load. It also means if a person misses their stop, they may not be able to get off at the next stop and instead have to get off somewhere far away from where they wanted to, possibly having to go through the whole process again to get back. "Public transport users need to be confident they can complete their whole journey without becoming lost, stranded, frightened or mistreated. If the system cannot provide this reassurance, and if users find that they cannot trust the information they receive, then they will have to find an alternative transport option, or simply not make the journey at all" (Victorian Council of Social Service, 2011).

Victorian Council of Social Service (2011) argue that changing the current approach so that all stops along a route are accessible greatly improves the service for users rather than individual upgrades scattered across the network. It means people know ahead of time that they will be able to get on and off where they want, safely and easily. For a system to be truly accessible, it needs to provide:

- **Independent access** so that a person using the service does not have to rely on assistance from someone else.
- **Gapless access** so that there is no possibility of a person or any of their belongings falling or becoming stuck in a gap.
- **Equal access** for everyone using the service.

"FOR ME, HAVING AN ACCESSIBLE WALK TO THE BUS STOP [IS] JUST AS IMPORTANT, IF NOT MORE, THAN HAVING THE BUS STOP ITSELF ACCESSIBLE"

SURVEY RESPONDENT

Understanding people who catch the bus

A Sydney study by Daniels & Mulley (2013) compared bus users to train users and found that people who catch the bus are comparatively more likely to:

- be female,
- be younger (less than 19) or older (65+),
- travel for education/shopping,
- travel during the day (interpeak),
- travel on a concession fare,
- make short trips,
- be less likely to work full time,
- be less likely to have the option to drive (no license), and
- have low personal income.

Analysis of data collected as part of the Victorian Integrated Survey of Travel and Activity (VISTA) found some similar results for bus users in Melbourne. Figure 5 shows a breakdown of bus user demographics compared to the general population.

Public bus users are more likely than the general population to:

- Be female.
- Be older children and young adults. People aged 10-29 make up just over one quarter of the population but more than half of all public bus users.
- Be studying at secondary school, TAFE or uni, or in casual work.
- Have no car licence or only a learners permit.
- Have a low personal income (up to $299/week or $15,548/year) or no income.

Journeys starting in metropolitan Melbourne and involving at least one trip on a public bus (Figure 6) are more likely to be:

- for education and work purposes, and
- between 7 and 8am; and 3 and 4pm.

*Figure 5 Breakdown of Melbourne public bus user demographics compared to general population (analysis of VISTA data). Values **bolded and coloured** where percentage of public bus users greater than general population.*

Demographic details	Public bus users	General population
Sex		
- **Female**	**52.4%**	50.6%
- Male	47.6%	49.4%
Age group		
- 0-9	3.4%	12.8%
- **10-19**	**33.4%**	11.6%
- **20-29**	**21.7%**	16.5%
- 30-39	14.5%	15.8%
- 40-49	9.1%	13.5%
- 50-59	6.9%	11.6%
- 60-69	5.7%	8.9%
- 70-79	3.3%	5.9%
- 80+	1.9%	3.4%
Work status		
- **Casual Work**	**11.7%**	6.9%
- **Full-time TAFE/Uni**	**9.2%**	3.1%
- Full-time Work	26.0%	35.2%
- Keeping House	2.0%	3.7%
- Not Yet at School	1.6%	6.7%
- **Other**	**2.1%**	1.8%
- Other Education	0.00%	0.0%
- **Part-time TAFE/Uni**	**1.3%**	0.6%
- Part-time Work	9.6%	10.5%
- Primary School	3.4%	8.9%
- Retired	7.6%	13.1%
- **Secondary School**	**21.6%**	5.9%
- **Unemployed**	**3.8%**	3.6%
Licence status		
- Full Licence	32.5%	63.2%
- **Green Probationary Licence**	**5.5%**	4.0%
- **Learners Permit**	**19.0%**	4.1%
- **No Car Licence**	**41.0%**	27.4%

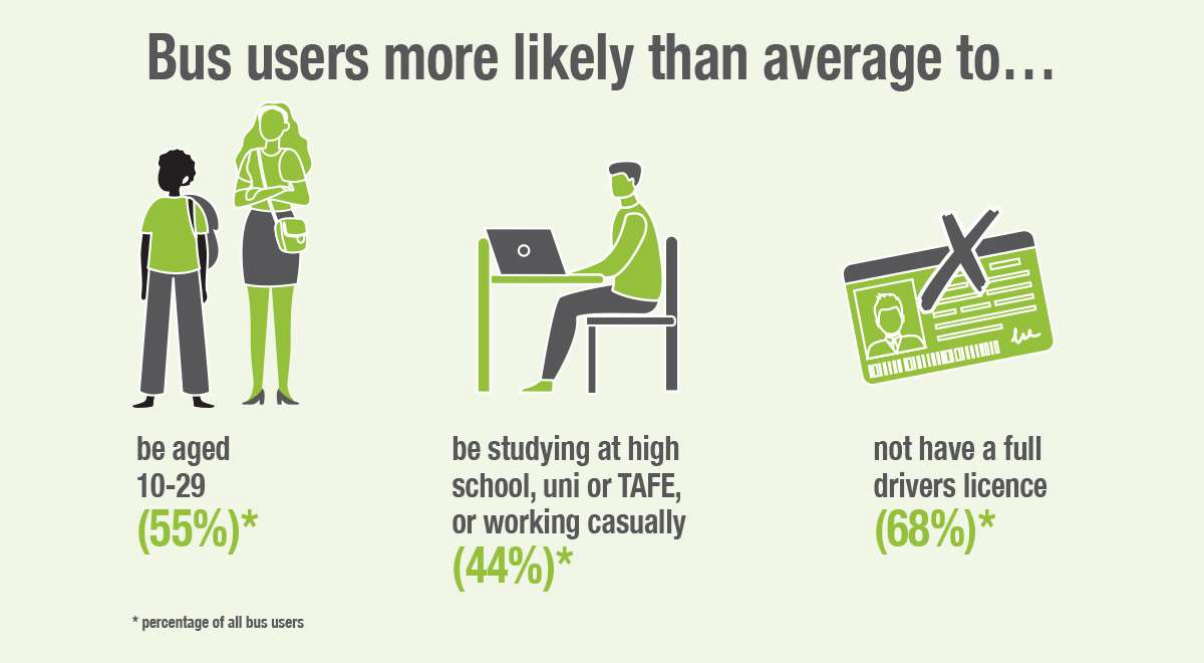
Demographic details	Public bus users	General population
- **Red Probationary Licence**	**2.0%**	1.3%
Personal income (per week)		
- **$1-199**	**11.7%**	5.9%
- **$200-299**	**7.0%**	5.6%
- $300-399	5.1%	6.1%
- **$400-599**	**9.5%**	9.4%
- $600-799	6.2%	7.7%
- $800-999	4.9%	8.0%
- $1000-1249	5.6%	7.6%
- $1250-1499	4.4%	6.1%
- $1500-1999	6.6%	8.0%
- $2000+	5.9%	8.4%
- **Negative Income**	**1.0%**	0.9%
- **Zero Income**	**32.0%**	26.4%

*Figure 6 Breakdown of trip purposes and start time for those involving a public bus compared to all trips originating in Melbourne (analysis of VISTA data). Values **bolded and coloured** where percentage of trips involving a public bus are greater than all trips.*

Trip details	Trips involving a public bus	All trips
Trip purpose		
- Accompany Someone	2.5%	6.6%
- At or Go Home	0.1%	0.1%
- Buy Something	13.0%	14.3%
- **Change Mode**	**0.4%**	0.1%
- **Education**	**34.5%**	9.9%
- Not Stated	0.0%	0.0%
- **Other Purpose**	**0.8%**	0.4%
- Personal Business	5.0%	7.7%
- Pick-up or Deliver Something	0.4%	2.0%
- Pick-up or Drop-off Someone	1.3%	12.6%
- Recreational	2.0%	8.2%
- Social	6.9%	12.2%
- **Unknown purpose (at start of day)**	**0.4%**	0.3%
- **Work Related**	**32.7%**	25.7%
Hour trip started		
- Before 6 am	0.6%	1.5%
- **6:00 AM**	**4.0%**	3.0%
- **7:00 AM**	**14.8%**	6.7%
- 8:00 AM	10.7%	13.3%
- 9:00 AM	5.5%	5.7%
- 10:00 AM	4.6%	5.3%
- 11:00 AM	5.0%	5.3%
- 12:00 PM	4.3%	5.4%
- 1:00 PM	4.3%	4.9%
- **2:00 PM**	**6.3%**	5.3%
- **3:00 PM**	**17.4%**	11.9%
- 4:00 PM	7.6%	8.0%
- **5:00 PM**	**9.0%**	8.9%

Trip details	Trips involving a public bus	All trips
- 6:00 PM	3.2%	5.9%
- 7:00 PM	1.3%	3.6%
- 8:00 PM	0.5%	2.2%
- After 9 PM (inc next day)	0.7%	3.1%

Taken together, these findings suggest that a typical Melbourne bus user is female, aged between 10 and 19 and travelling to/from high school. Teenagers and young people are physically capable of crossing roads but may struggle to make good judgements around risk, leading to risk-taking behaviour (Martin, Kauer, & Sanci, 2016). To that extent they can be considered more vulnerable than other adult pedestrians. While not more likely than others their age to use the bus, people 60 or older still represent 11% of all bus users. They generally have less physical capability to cross roads or walk long distances and are highly susceptible to injury in the event of a crash. Providing crossings that are not on desire lines is likely to be particularly unhelpful for either of these groups.



Appendix A has complete survey results, including a demographic breakdown of the bus users who responded to the online survey. There tended to be a similar split of genders to Melbourne bus users in general, but a more equal number of people in each age range.

Bus stop infrastructure

BusVic estimate there are approximately 36,000 bus stops used by public route buses across Victoria. The Department of Transport (DoT) audited 26,190 stops between Oct 2019 and August 2020. The database was analysed as part of this project to better understand existing infrastructure at Victorian bus stops. The information contained in the database includes:

- how the bus stop is identified,
- what type of stop it is,
- what type of ground it is on, and
- whether it has a shelter.

Identifying the bus stop

It is important for people to be able to identify where the bus stop is, especially for people and bus drivers unfamiliar with an area or bus route. Bus stops in Victoria are generally marked by signs on steel poles (called flags) or sometimes totems, both shown in Figure 7.

Figure 7 A bus stop in Northcote identified by a flag (left) and a bus stop in Box Hill identified by a totem (right)

Some bus stops have no identifying features to inform people that it is a bus stop, such as that in Figure 8. This could be because:

- the stop has never had a flag or totem,
- the flag is missing, for example knocked over by a driver or temporarily removed during roadworks, or
- the stop is not in use anymore.

Figure 8 This location in Castlemaine is identified on the PTV website as a bus stop, but has no identifier (Image source: Streetview, Google Maps, March 2010)

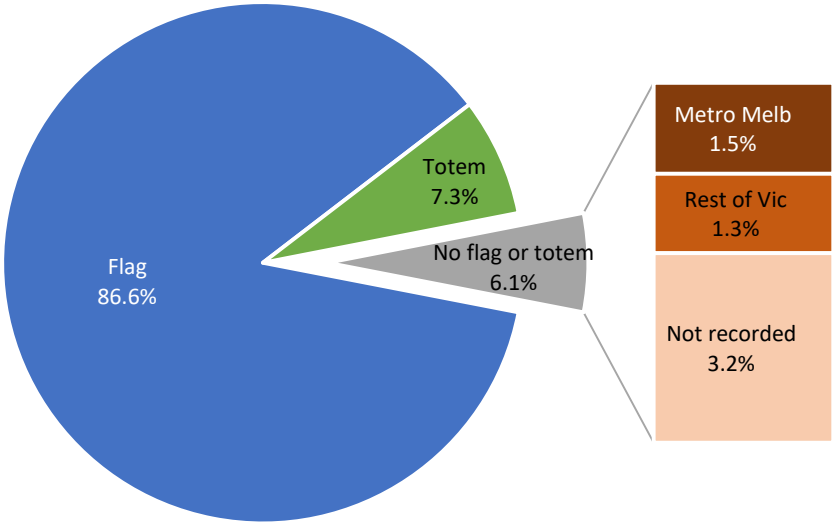
Bus stops might be identified by landmarks instead of signs, such as a petrol station or post office, especially in regional towns. The same also applies for bus stops located outside schools.

According to the DoT database, about 6% of Victorian bus stops have no flag nor totem (Figure 9). This is made up of 1.5% in metropolitan Melbourne, 1.3% elsewhere in the state and 3.2% where the

LGA is not recorded. It is likely that the actual figure for stops with no identification is less than 6%, as a quick review of several stops listed as having no identification do have flags in Streetview[4].

In the survey of Victorian bus users conducted as part of this project, some people mentioned that they had trouble finding the bus stop. As well as referring to a stop without a flag or totem, this could also refer to either finding the *right* bus stop at a location with multiple routes like a shopping centre or wayfinding information to get to the stop in the first place.

Figure 9 Identification of bus stops in Victoria (n=25,534, analysis of DoT database)



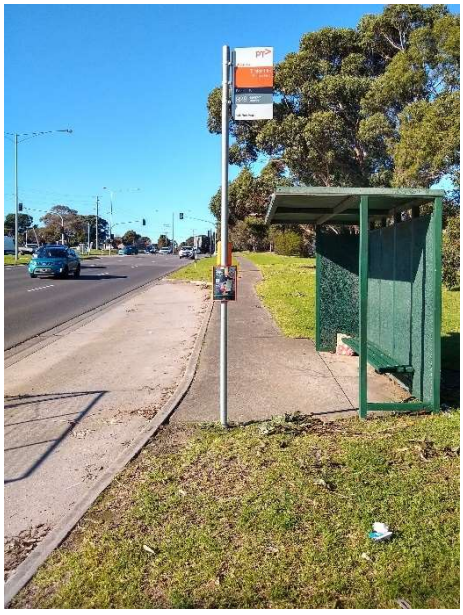
"SIGNAGE TO THE BUS STOP WAS POOR, HARD TO FIND THE ACTUAL STOP FOR THE BUS SERVICE I WANTED"

SURVEY RESPONDENT

Stop type

There are two main types of bus stop used in Victoria, kerbside and indented, shown in Figure 10. Kerbside stops generally require traffic to wait behind the bus, while indented stops mean the bus must pull out of the traffic and then back in.

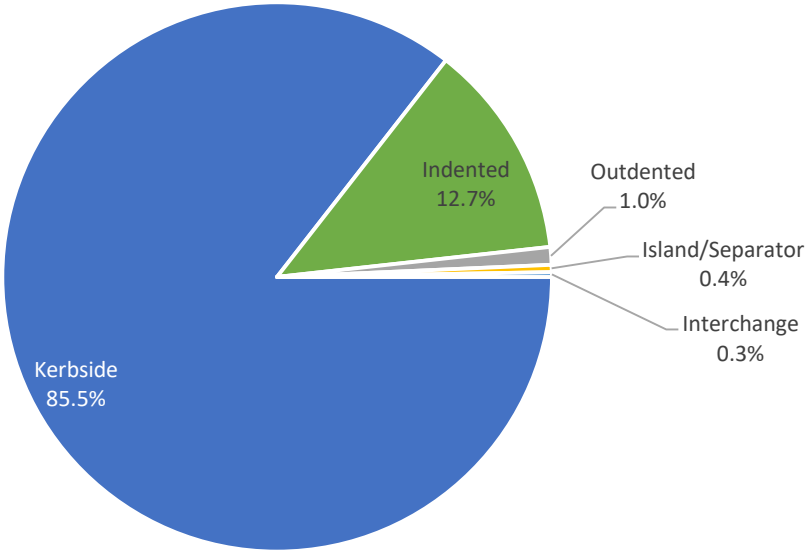
Figure 10 A kerbside bus stop in Warragul (left) and an indented bus stop in Narre Warren (right)



[4] Street level, panoramic photos taken by Google and available in Google Maps www.google.com.au/maps/

Figure 11 shows that kerbside stops are most common, representing more than four in five bus stops.

Figure 11 Bus stop types across Victoria (n=25,534, analysis of DoT database)



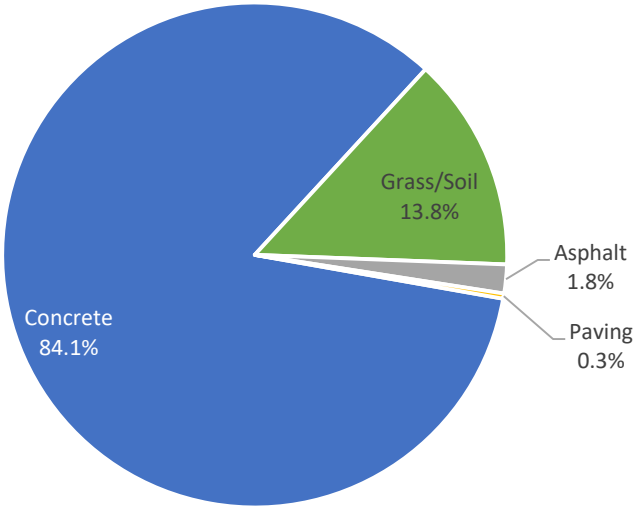
Ground type

A bus stop located on concrete generally provides an even, firm surface and tends to be less slippery and muddy than grass or soil when wet (Figure 12).

Figure 12 A bus stop with concrete surface in Hoppers Crossing (left) and one with a grass surface in Cheltenham (right)

Figure 13 shows that more than four in five bus stops in Victoria have concrete surfaces. The other main stop type is grass or soil, representing 23% of stops in regional/rural LGAs and 10% in metro LGAs.

Figure 13 Bus stop ground type state-wide (n=25,534, analysis of DoT database)



The proportion of concrete surfaces is higher in metro areas[5] (88%) than in regional and rural areas (74%). Interestingly, the two metropolitan LGAs with the highest proportion of grass/soil stops are Whitehorse (13.1% of all grass/soil stops in metropolitan Melbourne) and Monash (10.4%). These each take in middle ring suburbs and contain 4.5% and 4.6% respectively of all metropolitan bus stops. It could be that bus stops in middle suburbs existed before the Standards and so were not built with concrete bases. Yarra Ranges in the outer east of Melbourne is very similar to Monash, containing 4.6% of Melbourne's bus stops and 10.4% of all grass/soil stops.

Mildura has only 5.4% of all regional bus stops but tops the list of rural and regional LGAs with grass/soil bus stops at 16.0%.

"THE BUS STOP SIGN IS MOUNTED IN DIRT ON THE CURB AND THERE IS NO PAVEMENT TO STAND ON WITHOUT ENTERING A NEIGHBOURING DRIVEWAY. IN RAINY WINTERS IT GETS MUDDY, AND IN HOT SUMMERS THERE ARE ANTS CRAWLING ACROSS THE DIRT THAT GET INTO YOUR SHOES AND UP YOUR LEGS."

SURVEY RESPONDENT

[5] In the DoT database, 24,391 stops were allocated to a local government area (LGA) in Victoria (18,066 in metropolitan Melbourne and 6,325 elsewhere in the state); 1,799 were not allocated. Metropolitan Melbourne, also referred to as Greater Melbourne, is made up of 31 LGAs: Banyule, Bayside, Boroondara, Brimbank, Cardinia, Casey, Darebin, Frankston, Glen Eira, Greater Dandenong, Hobsons Bay, Hume, Kingston, Knox, Manningham, Maribyrnong, Maroondah, Melbourne, Melton, Monash, Moonee Valley, Moreland, Mornington Peninsula, Nillumbik, Port Phillip, Stonnington, Whitehorse, Whittlesea, Wyndham, Yarra and Yarra Ranges.

Shelter

The design of the bus stop itself was not the focus of this study but has been included because it is relevant to people's experience of the public space. A high quality, well-designed bus stop is attractive not only to bus users, but to everyone who uses the public space and residents and retailers whose premises are adjacent. Ayers-Johnston et al (2018) suggest that bus stops are usually designed and placed based on what is best for operators and traffic capacity rather than being considered from the view that they are assests for the broader community.

"BUS STOPS AND INTERCHANGES SHOULD BE DESIGNED TO MATCH THE STREETS THEY ARE LOCATED IN, MAKING A POSITIVE CONTRIBUTION TO ATTRACTIVE AND ACCESSIBLE TRANSPORT PRECINCTS"

(Department of Transport, 2021)

Formal shelters at bus stops can provide some protection from the wind, rain and sun and often include somewhere to sit. Shelters have been found to increase people's satisfaction with their bus journey, make them feel safer and even influence their decision to catch the bus in the first place (National Academies of Sciences, Engineering, and Medicine, 2021). Ewing & Bartholomew (2013) report that shelters were the most highly valued feature by people in choosing which bus stop to use, even if it meant a longer walk.

Analysis of the DoT database suggests that nearly one in four (24.9%) Victorian bus stops have a shelter. They are more common in metropolitan Melbourne (29.4% of stops) than in regional and rural areas (15.5%). Other nearby structures and trees can also provide shelter but are not recorded in the database.

The design of bus shelters has improved over time, with newer, transparent shelters allowing both the person sitting in the shelter to see an approaching bus and the bus driver to see and hence stop for the person waiting. They also provide better passive surveillance.

Figure 14 A transparent bus shelter in Pascoe Vale (left) and an older style, opaque shelter in Surf Beach, Philip Island (right)

An issue raised in discussions with stakeholders and by survey respondents was that formal shelters do not necessarily provide protection from the elements. When the wind, rain or sun is coming in at a particular angle, waiting in the shelter can be very uncomfortable.

The design of the bus stop itself, including the need for more shelter and seating, were among the most common themes people raised in open ended survey questions about general issues and possible improvements.

"IMPROVEMENTS [TO BUS STOPS] ARE OFTEN RELATIVELY CHEAP, ALTHOUGH, BEING SMALL CAPITAL PROJECTS THE FASHION FOR MEGA PROJECTS HAS DIVERTED ATTENTION FROM THEM."

(Parker, 2021)

One approach to funding the installation and maintenance of bus shelters is to sell advertising rights to part of the shelter. This is commonly done in Victoria, across Australia and internationally, such as in the USA (National Academies of Sciences, Engineering, and Medicine, 2021). This provides ongoing funding which the transport agency may otherwise not have to upkeep the shelter.

One disadvantage to this approach is that shelters tend to be concentrated at stops with high visibility and advertising potential rather than where they are most useful for bus passengers. Advertising can also detract from the amenity of the area, with both bus users and transport professionals preferring bus shelters that don't have advertising (Ewing & Bartholomew, 2013).

Cities internationally are finding innovative ways to better incorporate bus stop shelters into the public space. Utrecht, Netherlands and Leicester, UK have both installed green roofs on their bus stops with plants chosen specifically for their attractiveness to bees. As well as helping address declining bee numbers, they can also reduce the urban heat island effect, absorb rainwater, clean the air and beautify the city (Hirsh, 2019; designboom, 2021).

Figure 15 Bee friendly bus stops in Utrecht, Netherlands (Image source: Steffen, 2019)

Other bus stop shelters include a playful element, such as giant pieces of fruit in Konagai, Japan, a swing in London, UK and a soccer goal in Sao Paulo, Brazil (Toxel, 2009; Atlas Obscura, 2016; Fallon, 2008). Often these were created to promote specific, one-off events.

Figure 16 A bus stop in Sao Paulo, Brazil designed as a soccer goalto promote the World Cup (Image source: Toxel, 2009)

National Academies of Sciences, Engineering, and Medicine (2021) report on a case study of the Athens-Clarke County Transit Department in Georgia, who operate 18 bus routes in the city and 525 stops. They prioritise bus stop amenties such as shelters, seating and solar lighting based on number of people using each stop and existing facilities. Each stop is then allocated a level between 0 and 5 and there are targets in place to provide a corresponding level of amenities.

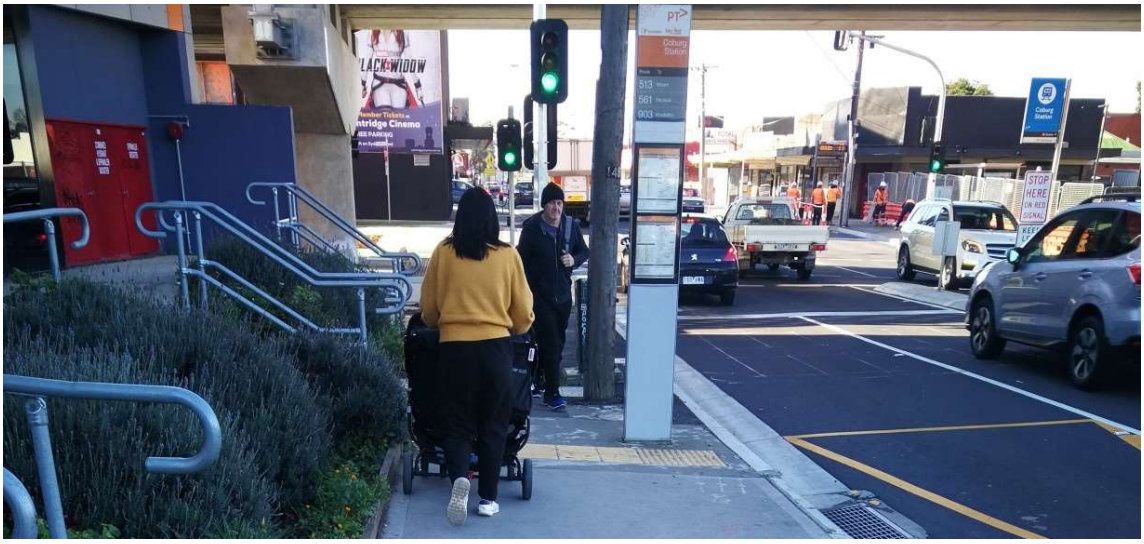
Athens-Clarke County also conduct an Art Shelter program where they run a competition for artists to submit shelter design and concepts. These shelters are not only practical, but double as public art in the public space, with one shown in Figure 17.

Figure 17 Pillbug art shelter in Athens-Clarke County, Georgia, USA (Image source: Athens-Clarke County, 2020)

Obstacles

The infrastructure provided at bus stops influences the broader walking environment, including how easy it is for people to get to, move around and walk past stops. Bus shelters, bins, trees and poles can create obstacles in the walking network and for accessing the bus, especially for people trying to manoeuvre wheelchairs, mobility scooters or prams. The majority of survey respondents (82%) reported that there was sufficient space for others to walk past the bus stop, although some pointed out that it depends on how many people are waiting and how many people are walking past.

Figure 18 There is limited space for people walking past or waiting at this bus stop on Bell St, near Coburg station

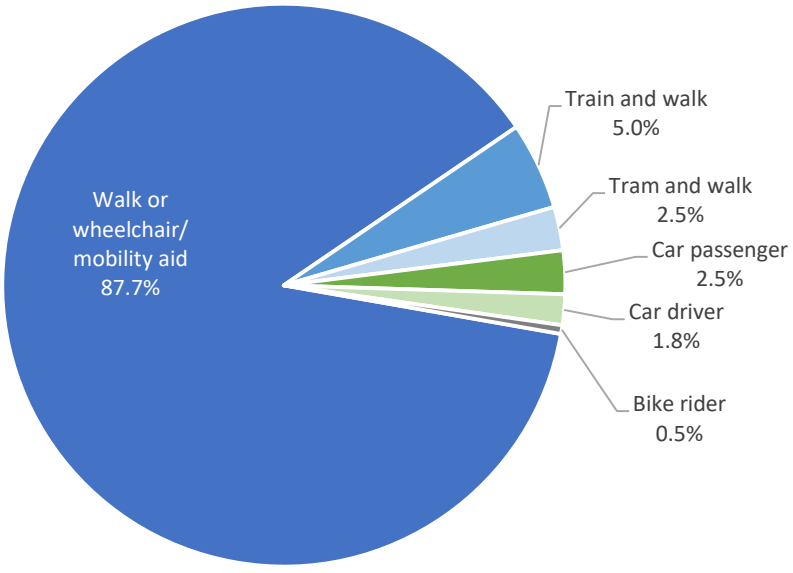


Walking to the bus stop

Although the walking environment is a key part of the journey, there is little research on travel to bus stops specifically, or any public transport. Most literature focuses on bus stop design or walkability in general. A review by Hillnhütter (2016) found only 24 texts about pedestrian access to public transport from between the late 1960s and 2015, some of which focused on peripheral aspects such as the health effects. Some are quite old, such as those by Fruin in the early 1970s who is well known for his work on pedestrian comfort and level of service.

As discussed previously, walking is the most common way people get to bus stops. This was also reflected in the survey of Victorian bus users as part of this project, shown in Figure 19. Those who walked the whole way plus others who walked from the train or tram made up 95% of all those who travelled to the bus stop.

Figure 19 Mode of travel to the bus stop (Survey of bus users; 399 responses)



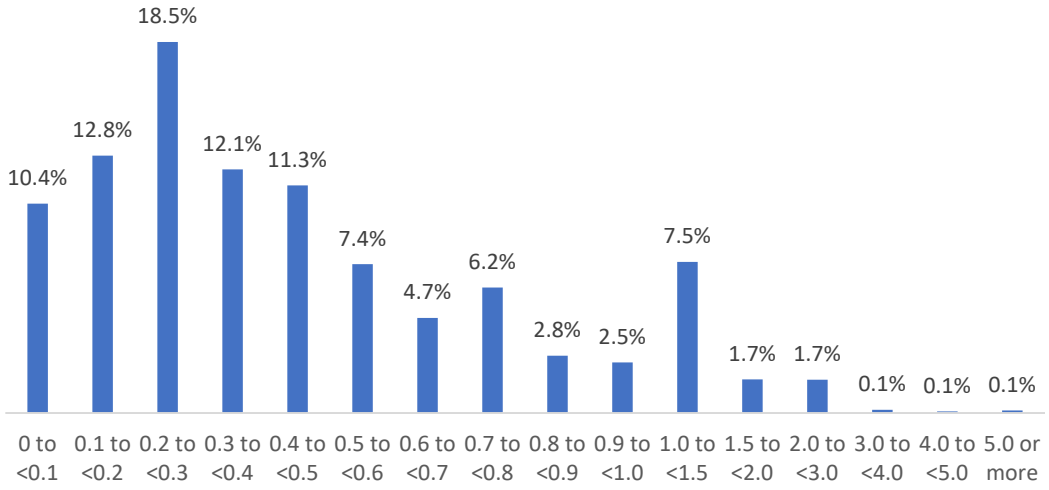
The main reason people gave for not walking to the bus stop was that it was too far/long to walk (mentioned by 11

respondents). Poor weather was a factor for three people, as were feelings of safety (2 people) and convenience (2 people).

Walking distance

The actual distances people walk to bus stops is generally short. Analysis of the VISTA data found that public bus passengers most commonly walked between 200 and 300 metres (Figure 20) to get to the stop, with half walking 350 metres or less. Only 2.0% of people walked more than 2 km.

Figure 20 Distance walked from origin to bus stop (analysis of VISTA data)



This is consistent with a Sydney study which found a median walking distance of 364 metres from home to the bus stop and suggests the 400-metre radius for a bus stop catchment often used in planning is reasonable.

The other factor in walking distances is that people do not like to backtrack to get to the bus stop. This means that people will sometimes use a bus stop which is slightly further away because they prefer to walk in the same direction as the bus. The bus arrives at the second stop slightly later than the first, so the extra walking time generally does not significantly change the time a person has to start walking (Hillnhütter, 2016).

Factors that influence walking to the bus stop

There are many factors than can influence decisions about whether to walk, and if so, which route to take.

"2 NEAREST BUS ROUTES CLOSED (30M AND 120M WALK) SO NOW I HAVE A 700M WALK TO THE NEAREST BUS STOP. FOR SHORT RIDES, I MIGHT AS WELL JUST KEEP WALKING."

SURVEY RESPONDENT

The distance to the stop is consistently found to be a key factor influencing walking rates. A US study found that public transport use falls by 0.14% for every 1% further people must walk to access it (Kittelson and Associates, 2003 cited in Ewing & Bartholomew, 2013). Daniels & Mulley (2011) cite research finding that the quality and amenity of the walking route to public transport is less important than minimising walking time. Factors like road safety and having trees tend to be secondary concerns to distance.

This was strongly borne out in the bus user survey. The key theme in what people enjoyed about their walk to the bus stop was that the stop was nearby, or it was a quick walk (Figure 23). This is reflected by the size of words like 'short' and 'close' in the word frequency diagram for responses to this question (Figure 24). A couple of people stated (unprompted) that they walked further than necessary because the longer option feels safer to them. However, many mentioned their frustration at bus stops that had been removed or relocated, requiring them to walk further to get to the bus, and in some cases, that they now avoid taking the bus as a result. 13% of people who replied to an open-ended question about general issues talked about the distance to the stop.

"WHEN NEARBY BUS ROUTES CLOSED, I WENT FROM 3 DAYS/WEEK RIDING THE BUSES TO 3 DAYS/YEAR. POINT TO POINT BUS RIDES ARE OFTEN SLOWER THAN WALKING, SO I WILL WALK OR DRIVE INSTEAD OF USING THE BUS."

SURVEY RESPONDENT

"I USED TO USE THE BUS MORE OFTEN BEFORE STOPS WERE REMOVED BUT HAVE TO GET A TAXI ON SHOPPING DAYS BECAUSE THE CLOSEST STOP IS TOO FAR FROM HOME NOW TO CARRY MY SHOPPING"

SURVEY RESPONDENT

Public transport factors

The Australian National Liveability Study found that the frequency of public transport in addition to access better predicted whether a person would walk to the stop or not (Arundel, et al., 2017). Basically, the more frequent the service is, the more likely people are to walk to access it.

People will also walk longer distances to avoid changing modes, especially as walking times are more consistent and reliable than public transport times. This means for example that people may walk home from the train station rather than catch a bus a short distance (Parker, 2006).

Daniels & Mulley (2011) looked at walking to bus stops and train stations in Sydney. They found that once a person decides to take public transport, the only considerable factor in how far they walk is whether they are going to catch the train (results in longer walks) or the bus (shorter walks). This is in part a reflection of the number and spacing of bus stops (lots of them, closer together) and train

stations (fewer, further apart). They found the following were statistically significant in explaining walking distances to bus stops from home:

- **Trip purpose**. Those travelling for shopping/personal business or education walk significantly shorter distances (mean = 414 metres for both) than those travelling for work (488 metres).
- **Fare type**. Those using a school pass walk shorter distances (403 metres) than those paying full fare (475 metres).

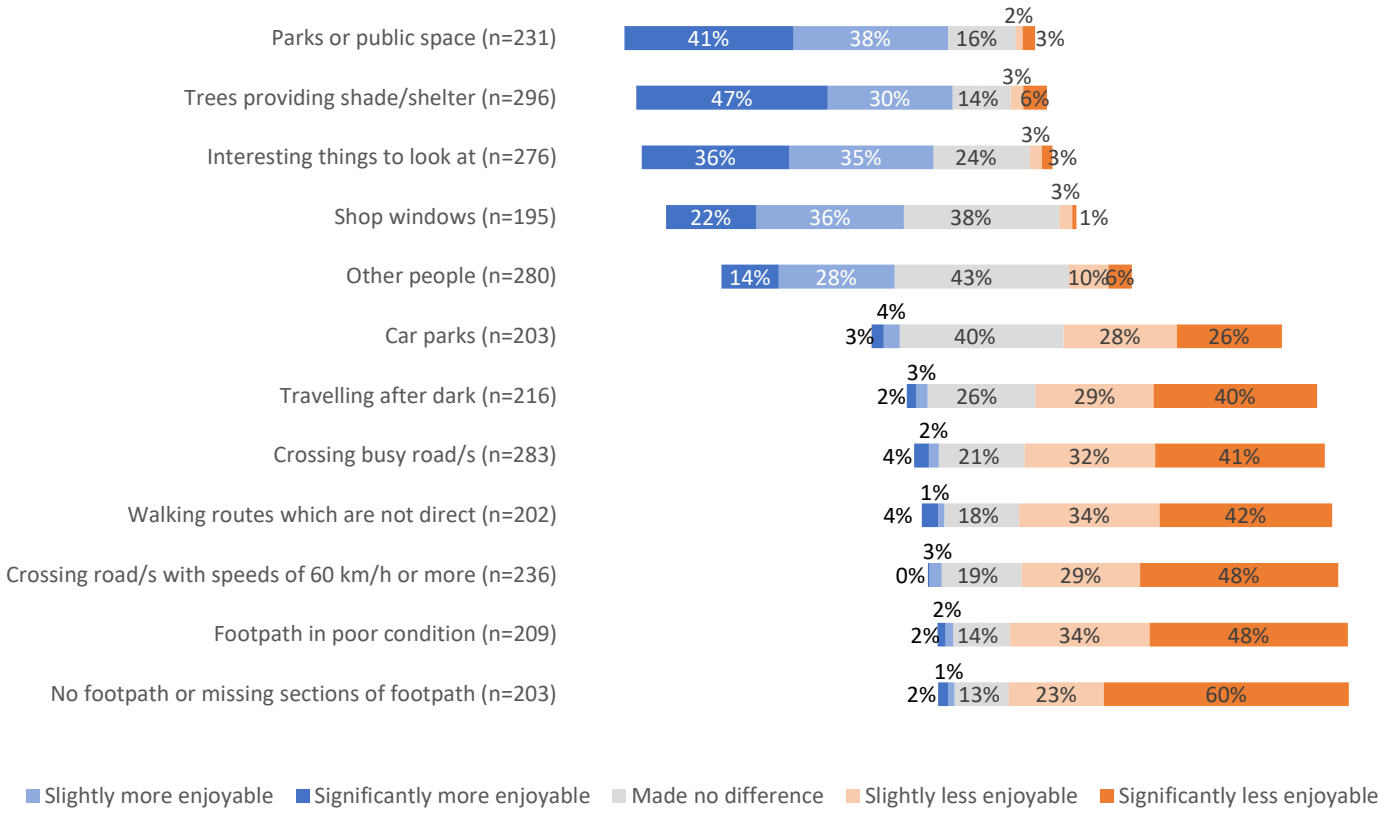
Other factors

The bus user survey asked both open-ended and specific questions about factors that influenced people's walk to the bus stop based on factors reported in the literature.

When asked how specific factors influenced their walk, factors related to the natural world had a strong, positive influence on people's walking experience, shown in Figure 21. The most enjoyable aspects reported were having parks or public space (79%) followed by shade trees (77%). Trees along the street on the walk to the bus stop were also highly valued in other studies (Ewing & Bartholomew, 2013). Places with shops and other people rounded out the positive factors.

By comparison, infrastructure deficits (such as missing footpaths) and travelling after dark made the walk less enjoyable. Urban design aspects catering for driving such as car parks, crossing busy roads and roads with speeds of 60 km/h or more all detracted from enjoyment of the walk to the bus.

Figure 21 Responses to specific question "Thinking about your recent bus trip, how did each of the following influence your walk?" ("NA" and "Don't know" not shown)

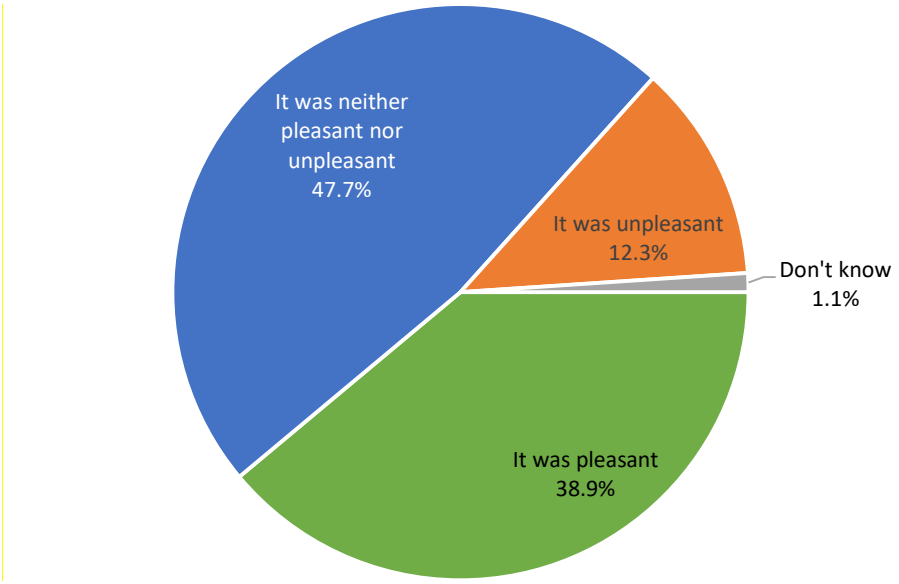


Interestingly the presence of other people was not obviously a positive or negative factor. This is likely a reflection on the type and number of other people. The literature generally considers a place busy with people as positive, but only up to a limit. A little bit of crowding adds interest, but this disappears once each person has less than about 9 – 14 square metres (Ewing & Bartholomew, 2013). A study of older people by Van Cauwenberg, et al. (2012) found that having others around supported walking unless there were large crowds or that people were behaving in antisocial ways. The negative responses to this survey question may reflect concerns about anti-social behaviour or personal safety, especially if travelling at night.

What makes a pleasant walk?

Half of survey respondents who walked to the bus stop reported that it was neither a pleasant nor unpleasant experience, while just over a third found it pleasant and fewer stated it was unpleasant (Figure 22).

Figure 22 "How was your walk to the bus stop?" (Survey of bus users; 375 responses)



People who replied that their walk was either pleasant or unpleasant were given the option to fill in an opened ended question about why this was the case. The responses, summarised in Figure 23 and Figure 24, could be grouped into four main categories:

- Distance/time of walk
- The natural world
- Infrastructure
- Experience and amenity of area

The distance/time factor was the key factor and has been discussed earlier. The other factors are discussed in the following sections.

Figure 23 Categorised themes in response to open ended survey question "What made your walk pleasant?" (Survey of bus users; 136 respondents; multiple responses permitted)

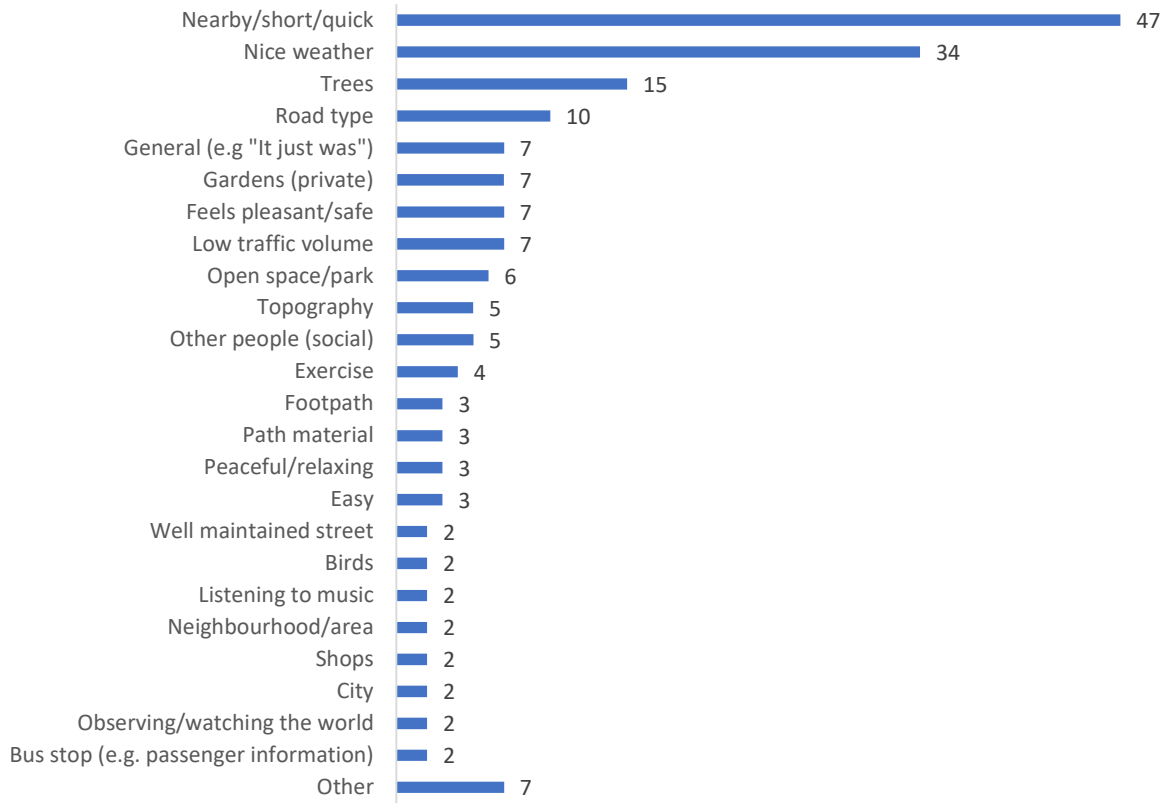


Figure 24 Frequency of words used in response to "What made your walk pleasant?" (Survey of bus users; 136 responses; 50 most common words excluding function words like 'the', 'and', 'a'; larger words used more often)

Street trees and nature

People walking like greenery in general because it contributes to the sense of an area being quiet, peaceful and healthy (Van Cauwenberg, et al., 2012). The natural world was commonly mentioned in the open-ended survey question about what they enjoyed regarding their walk to the bus stop; things like trees, parks and gardens. 'Weather' was the most common word used after 'bus' and

'stop' (Figure 24). Walking through mostly residential areas was enjoyable for some people as they were happy simply looking at other people's gardens.

Trees are a key component of walkability in general according to Ewing & Bartholomew (2013) and Steuteville (2012) as they:

- Make the street more pleasant to walk along.
- Provide shade, encouraging walking when it is hot and sunny.
- Contribute to a sense of enclosure and people sized definition of the street.
- Create a sense of safety when planted in the nature strip as they separate people from vehicles.

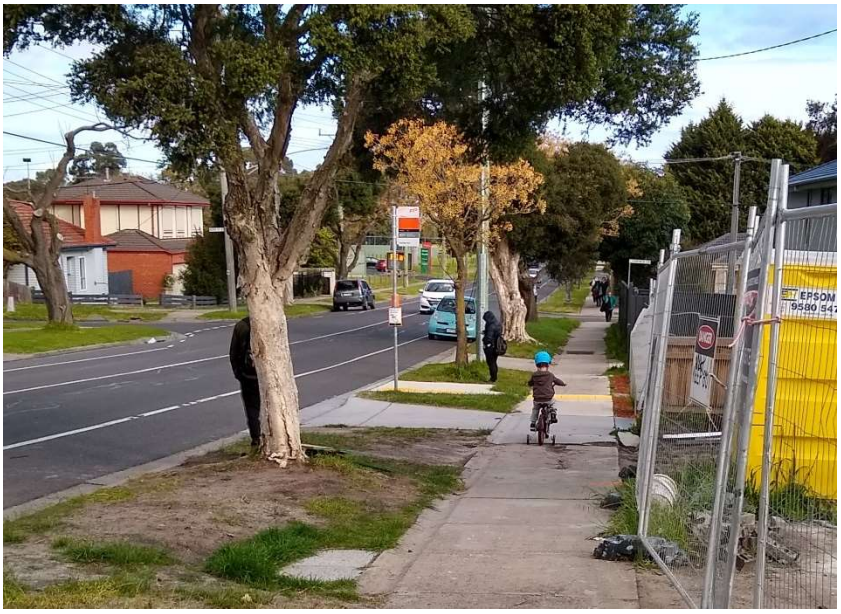
They also help mitigate the urban heat island effect which is becoming more of an issue because of global warming. Large trees that will reach a height of 15-21 metres and have a canopy 4.5 metres above the ground make the best street trees (Ewing & Bartholomew, 2013).

"IT IS A PERVERSE WORLD, INDEED, WHERE ERRANT VEHICLES ARE AFFORDED MORE PROTECTION FROM TREES THAN PEDESTRIANS ARE FROM ERRANT VEHICLES."

(Ewing & Bartholomew, 2013)

Shade trees along the street on the way to the bus stop was the second most valued factor (after a bus shelter) in a visual preference survey by Ewing (2000). 'Trees' was the eighth most common word people used in the survey to describe what made their walk to the bus stop pleasant (Figure 24). Large trees not only provide shade but shelter for people waiting at the bus stop with when it is raining, as in Figure 25.

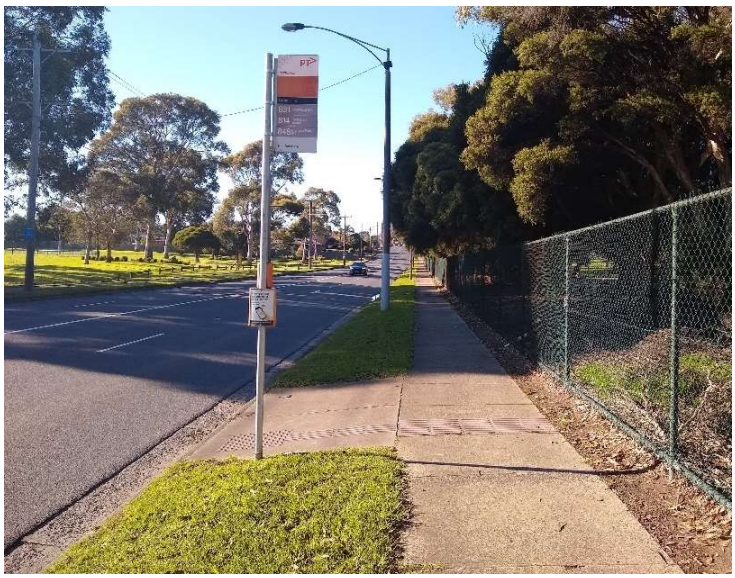
Figure 25 People waiting for the bus in Clarinda seek out nearby trees to stand under during a rain shower



The presence of trees is always positive for the walkability and amenity of an area, but not always enough to provide shade or shelter to nearby bus stops. It depends on the size, type and location of the trees as well as the time of day or year. Ideally trees would be planted to provide shade to the bus stop during most of the day in summer, particularly at stops with no bus shelter.

Bus stop access audits were conducted for 70 bus stops in Victoria, with the complete results in Appendix B – Bus stop access audits. These considered the number of shade trees, large enough to stand under, on public land[6] within 50 metres both sides of the bus stop. A third of stops (34%) had no shade trees, slightly fewer had up to 3 trees (29%) and the remaining had four trees or more (37%). Encouragingly, many of the stops with few or no shade trees did have trees nearby but were not included because they were significantly setback from the stop, in the median, on the opposite side of the road, or within private property (Figure 26).

Figure 26 There are no shade trees in the nature strip near this Springvale bus stop but trees in the adjacent private property and on the opposite side of the road provide some shade, depending on the time of day



Near multiple bus stops in varying parts of Melbourne, particularly newer developments in outer suburbs, councils had planted new saplings which hadn't yet grown to maturity and so didn't provide significant shade or shelter (Figure 27). Many councils have committed to increasing the number of trees in their area and planting species that will adapt to climate change. Hobsons Bay, Maribyrnong, Melton, Brimbank, Moonee Valley and Wyndham have committed to planting half a million trees in the western suburbs of Melbourne ("Move to make suburbs greener", 2021).

Figure 27 Trees along this street on the way to the bus stop in Doveton contribute to the walkability of the area but are not yet fully grown

[6] Only trees on public land were considered as those in private properties are often outside the control of authorities.

Infrastructure

The survey found the main infrastructure related theme that contributes towards a pleasant walk was the type of road. Often people referred to quiet, residential type streets with low traffic volumes, although three people listed busy or main roads, perhaps because drivers could help if need be or there were shops to look at. Other infrastructure related themes were the provision of a footpath and in one case, feeling that a walking path was nice because it was not made of concrete.

Footpaths

One seemingly clear factor in people's decision to walk and how pleasant they find it is whether there is a footpath. However, there is little quantitative evidence available on this relationship, possibly because the connection is too obvious (Ewing & Bartholomew, 2013).

"FOR SOME A FOOTPATH CAN MEAN THE DIFFERENCE BETWEEN GETTING OUT AND ABOUT OR HAVING TO RELY HEAVILY ON OTHERS FOR COMMUNITY ACCESS."

(RACV, 2016)

Like concrete bus stops, footpaths provide an even, firm surface to walk on and tend to be less slippery and muddy than grass or soil in the wet. This is particularly important for people who have limited mobility, affecting many people as they age, as well as those with mobility aids and other wheeled devices like prams. This was reflected by respondents to the online survey who reported that missing or poor-quality footpaths made their walk to the bus stop less enjoyable (Figure 21) or feel unsafe (Figure 51). 15% of people who reported general issues listed no footpath, or a footpath that was too narrow or obstructed, often due to vehicles parked across it or overgrown vegetation.

The number of people who reported using a walking aid was small, but these people were about three times more likely than others to find the walk unpleasant and unsafe.

"IT'S A VERY BUSY ROAD WITH AN UNEVEN UNMADE PATH THAT MEANS, IF YOU TRIP AND FALL, YOU'RE ON THE ROADWAY."

SURVEY RESPONDENT

The bus stop access audits found most stops (77%) were connected to footpaths in both directions, while 6% had a footpath connection only in one direction. The condition of the paths was generally good, with smooth, even surfaces, no obstacles and sufficient width to accommodate people present or a person using a pram or wheelchair. Of the stops with no connecting path (11%), some backed onto a train line or freeway, as in Figure 28; places where people would generally not have any reason to walk and would cross the road only to use the bus stop.

"THE STOP HAS A SHELTER BUT NO DEFINED FOOTPATH. I'M GOING TO BREAK A HIP IF NOT FIXED SOON."

SURVEY RESPONDENT

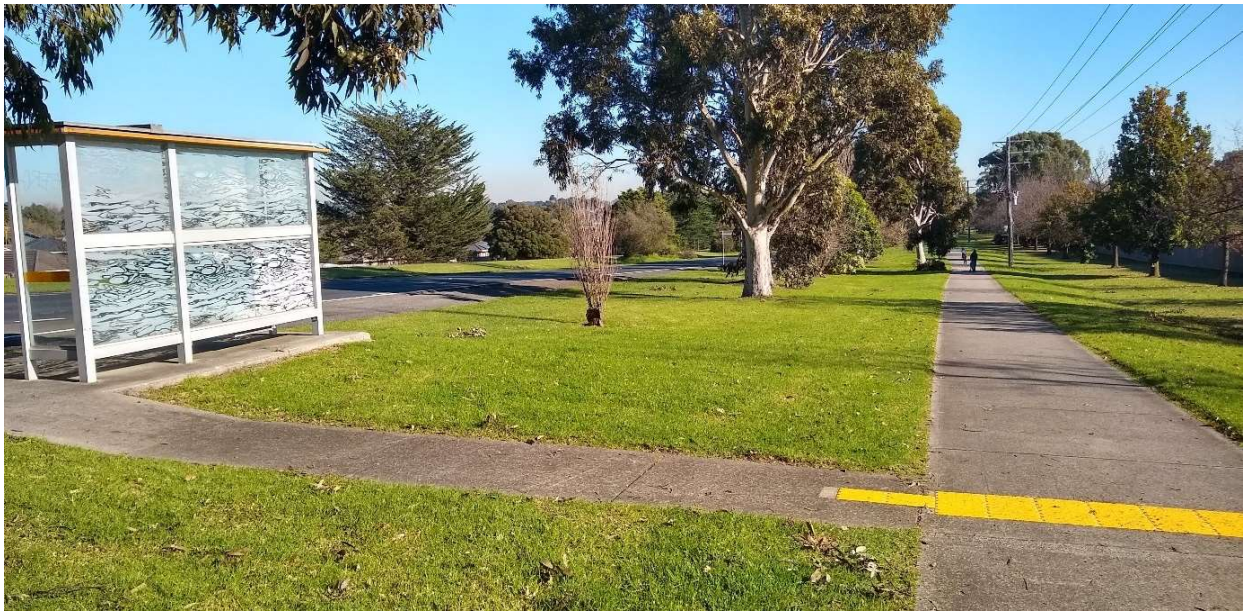
Figure 28 A bus stop adjacent to the train line in Oakleigh South without any footpath

In 2016, the RACV assessed bus stop footpath connections in Melbourne's outer growth suburbs. They estimated that there were 118 km of missing footpaths which, if completed, would connect 1485 bus stops. Of these, 111 are high-use stops and the cost to connect them was estimated at $2.3 million. They recommended the state government should fund the missing links to connect all bus stops in outer Melbourne to the footpath network.

Shared paths

A further 6% of audited stops were located on shared walking and cycling paths rather than dedicated footpaths. Shared paths were observed quite often in the outer suburbs; either behind the bus stop as in Figure 29, past the stop opposite that audited or simply in the vicinity of the bus stop.

Figure 29 A shared path runs behind a bus stop in Berwick



One bus stop was in the middle of the two directions of a shared path with very little space for people to stand while waiting for the bus (Figure 30). There were a further two audit locations where the path was not signed or marked as a shared path, but people were observed cycling on it.

Figure 30 This bus stop in Notting Hill near Monash University is in the middle of a shared path (Image source: Streetview, Google Maps, September 2019)

"BICYCLES RIDE ON THE PATH, OFTEN AT SPEED. THEY ALSO GO AROUND CORNERS AT SPEED, MAKING IT UNSAFE FOR PEDESTRIANS"

SURVEY RESPONDENT

Victoria Walks has significant reservations regarding shared paths, particularly for more vulnerable people such as those who are older or vision impaired. A study of people aged 60 and older found 39% identified cyclists on shared paths as a constraint to their walking (Garrard, 2013). Generally, slow moving recreational cyclists may be able to share paths with people walking, but commuter and sports cyclists typically travel at higher speed and are more likely to put people off walking or even injure them.

Unfortunately, cycling isn't limited to shared paths. Poor or non-existent on-road bicycle facilities mean that people sometimes choose to ride on the footpath instead. In the bus user survey, five respondents talking about feeling unsafe because of people riding on footpaths in an open-ended question about general issues.

Experience and amenity of walking

Research by Hillnhütter (2016) investigated the relationship between walking and public transport by interviewing and observing people walking to bus and tram stops. He focused on people's emotions and experiences of walking, believing people are aware of traffic and distance influences on their walking, but not environmental influences. As such, his findings were quite different from earlier studies; that perceptions of walking time are in fact influenced by the pleasantness and level of stimulation of the walking environment rather than simply distance, illustrated in Figure 31 and Figure 32.

Figure 31 Relationship between apparent distance to the stop (and apparent time needed to reach the stop) and accepted walking distance to stop (Image source: Hillnhütter, 2016)

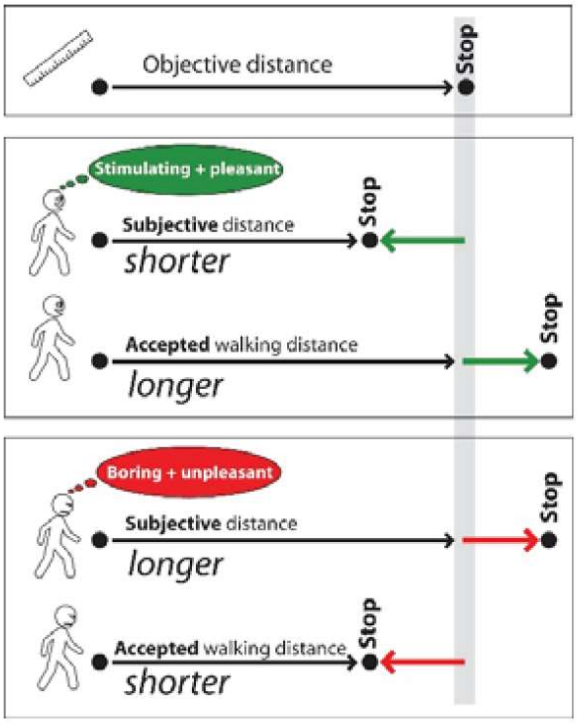
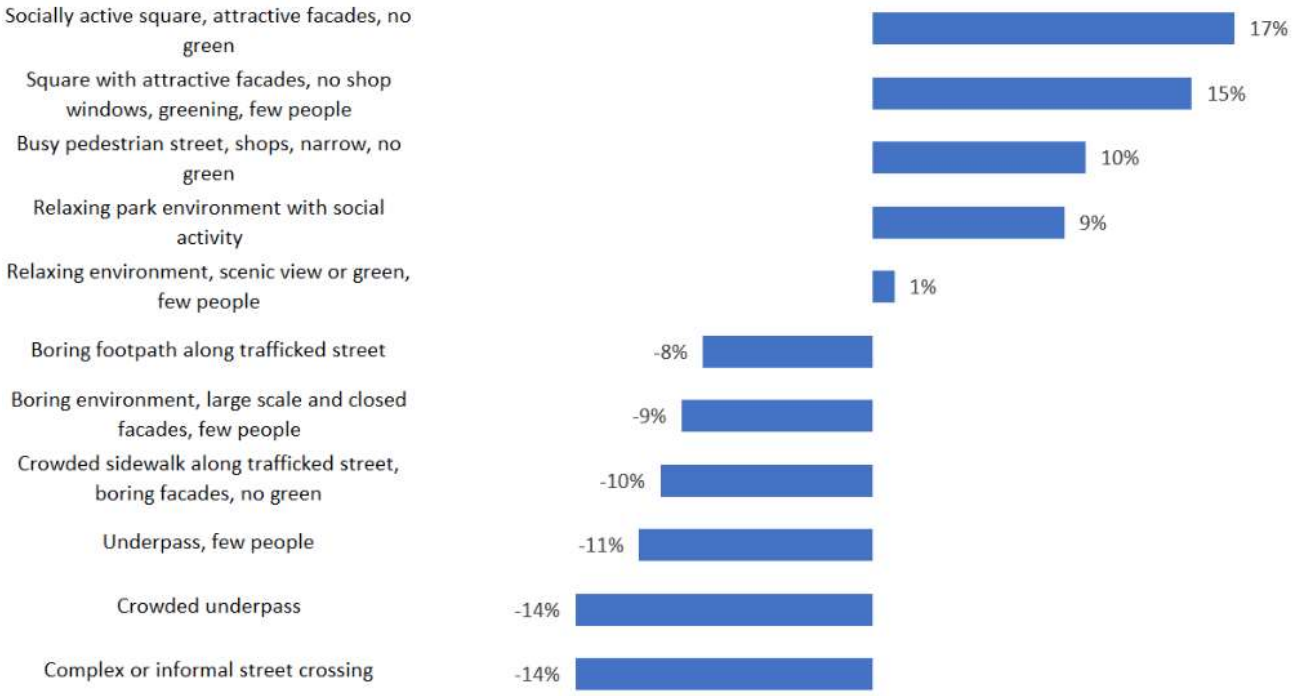


Figure 32 Variation of the accepted walking distance in different urban environments as a result of pedestrians' perception of walking distances (Data source: Hillnhütter, 2016)



Hillnhütter cites a German study by Peperna (1982) who found that people will accept 70% longer walking distances in pedestrian-oriented environments compared to car-dominated environments. He notes that this could theoretically triple the catchment size of a public transport stop. This assumes people walking are fit and healthy, capable of easily walking the additional distance. For

people who are older, have disability or simply trouble walking, any additional walking distance could be enough to stop them catching the bus altogether.

"A WATCH DOES NOT NECESSARILY REFLECT THE INDIVIDUAL IMPRESSION OF TIME"

(Hillnhütter, 2016)

Another interesting German study Hillnhütter cites is Brög (2014) which found that although people spend only 47% of their journey time walking to, from, and waiting at the stop, 73% of their comments refer to memories about walking to and waiting at the stop. Similar findings were replicated across cities in Europe, North America and Australia. So not only does a stimulating environment make time pass faster, but people are also much more likely to remember it than the bus component of their journey.

Hillnhütter (2016) concludes that acceptable walking distances are:

- Increased by up to 30% by stimulating and pleasant environments.
- Increased by 15-25% by additional destinations such as shops and services. Conveniently located shops are easy for public transport users to use as they have no car to park or bike to lock, they just walk in.

In communications with Hillnhütter, he notes that authorities in smaller Scandinavian cities often feel they can manage improving public transport by improving stop access, compared to big techonological changes, which feel far out of reach.

The bus user survey supports that pleasant and stimulating environments are enjoyable places to walk. Figure 21 (p. 33) shows that having interesting things to look at and shop windows both make a walk more enjoyable. Walks which feel safe, peaceful or relaxing, as well as the social aspect of seeing and talking with other people and the health benefits of walking were listed by participants in why their walk was pleasant (refer Figure 23 p. 35). Some people may choose to wait for the bus even if that's going to be slower than walking, if they can use the waiting time to shop (Parker, 2006). Simply providing information about the walking distance to the next bus stop could encourage people to make use of their waiting time by walking part of the way.

"ADDING WALKING DISTANCE TO THE NEXT BUS STOP WOULD BE GREAT, THE BUS ONLY CAME EVERY HALF AN HOUR SO I COULD HAVE GOT SOME EXERCISE BY WALKING TO THE NEXT STOP BUT I DIDN'T WANT TO MISS THE BUS."

SURVEY RESPONDENT

What makes an unpleasant walk?

In contrast, the absence of the factors that make a walk pleasant such as trees and nice weather are not necessarily what made a walk unpleasant. The key unpleasant theme raised by respondents to the survey was vehicular traffic (Figure 33), with the words "busy", "road" and "traffic" featuring heavily in people's responses (Figure 34). Physical infrastructure was another key, related theme, with common mentions of road crossings – either insufficient design or operation, or no crossing at all – and missing sections of footpath, particularly near the bus stop. Indirect routes, poor surfaces and poor or no lighting were other infrastructure related issues. Footpaths were discussed earlier in 'Footpaths' p. 38; the other factors are discussed here.

Figure 33 Categorised themes in response to open ended question "What made your walk unpleasant?" (Survey of bus users; 45 respondents; multiple responses permitted)

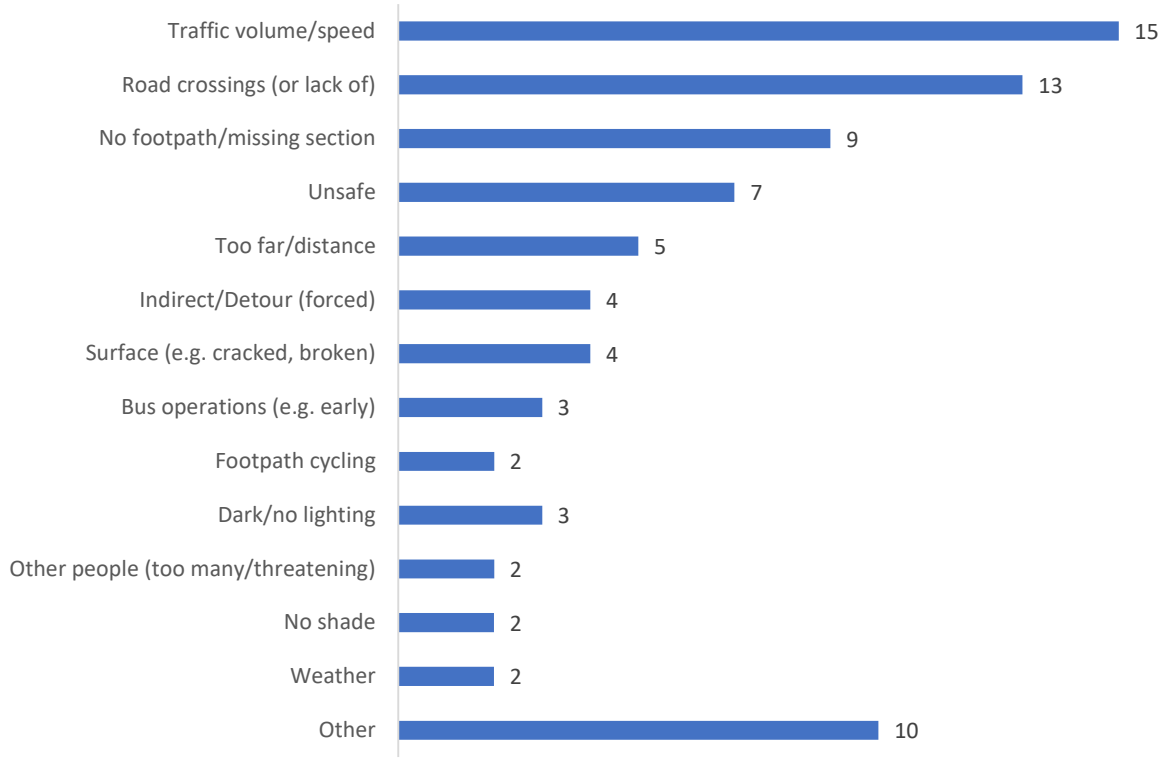


Figure 34 Frequency of words used in response to "What made your walk unpleasant?" (Survey of bus users; 45 responses; 50 most common words excluding function words like 'the', 'and', 'a'; larger words were used more often)

Traffic

Traffic volume and speed is related to an unpleasant walking experience because of the close link it has to noise and air pollution.

Traffic noise

Noisy environments are not pleasant for walking, particularly for people walking together and trying to talk to one another. There are many factors that influence traffic noise, but the key ones are the speed and volume of traffic.

At speeds of up to 30 - 40 km/h, the vehicle engine is the dominant noise heard. Above that the noise of the tyres on the road (rolling noise) is the main thing heard (ECMT/OECD, 2006). The effects

of acceleration and deceleration are also greatest under 50 km/h (ECMT/OECD, 2006). It is expected that as petrol engines are replaced with electric engines the noise associated with vehicle engines will fall, however given speed is a more important factor, this will apply only in low-speed areas.

"IN URBAN AREAS WITH SPEEDS OF BETWEEN 30 AND 60 KPH PER HOUR, REDUCING SPEEDS BY 10 KPH PER HOUR WOULD CUT NOISE LEVELS BY UP TO 40%."

(Mitchell, 2009)

A doubling of traffic volume increases noise by 3 dB(A)[7] (VicRoads, 2013). "However, even here speed reduction is crucial. Traffic noise will not fall automatically with a drop in vehicle numbers if it simply allows the remaining traffic to speed up" (Mitchell, 2009).

Vehicle noise in relation to acceleration and braking is regulated by the Australian Government's Australian Design Rules and Victorian Government's Environmental Protection (Vehicle Emissions) Regulations (VicRoads, 2013). However, increasing controls on vehicle noise emission limits have not led to reduced road traffic noise levels. This is due to many factors but includes that the engine noise is less important at speeds most vehicles travel at, the replacement rate of vehicles and that newer vehicles tend to be larger and more powerful (Brown, 2004).

Many of the studies on traffic noise focus on how it affects people living nearby. No literature was found on how it affects people walking along the road; those most exposed to the impacts. The Victorian government measure traffic noise for residential buildings and sensitive buildings, like schools, but not for people walking along the road. One Danish study reports that those living next to noisy roads are at higher risk of blood clots, diabetes, high blood pressure, stroke and that traffic noise even leads to premature death (Finne & Petersen, undated).

"ROAD NOISE IS THE ABSOLUTE BIGGEST SOURCE OF NOISE NUISANCE."

(Hillnhütter, 2016)

Measures to reduce traffic noise in Australia have traditionally been dominated by engineering solutions (Brown, 2004). The focus has been on mitigating noise impacts through engineering treatments (VicRoads, 2013) such as noise barriers, which do not improve the walking environment, and the use of low noise road pavement, which do improve the walking environment but are generally used in freeways where people aren't walking anyway.

The other related issue that was raised in relation to bus stops was the noise and fumes of a bus idling at a stop, contributing to an unpleasant experience while waiting at or walking past the stop.

Traffic pollution

The effects of traffic on air pollution have been well studied in recent years. Approximately 2600 Australians die from air pollution each year and traffic pollution has been linked with increased rates of asthma (Loo, 2020). In urban areas, the main contributor to air pollution is

"DON'T WANT TO STAND NEAR IDLING CARS AND TRUCKS BREATHING IN THEIR EXHAUST POLLUTION."

SURVEY RESPONDENT

[7] Noise is not measured using a linear scale. An increase of 10 dB(A) sounds twice as loud (VicRoads, 2013).

traffic. Forehead and collegues (2020) measured pollution levels next to the road close to the height of an adult in Sydney. They found levels at busy intersections were ten times higher than background levels measured by nearby official monitoring stations. Children are most at risk from traffic pollution because their bodies are more sensitive to air pollution (Loo, 2020) and they are shorter, so closer to the tailpipe where emissions are released. In 2020, possibly for the first time anywhere in the world, air pollution was included as a contributing factor in the death of 9 year-old Ella Adoo-Kissi-Debrah in London (Marshall, 2020).

Crossing roads

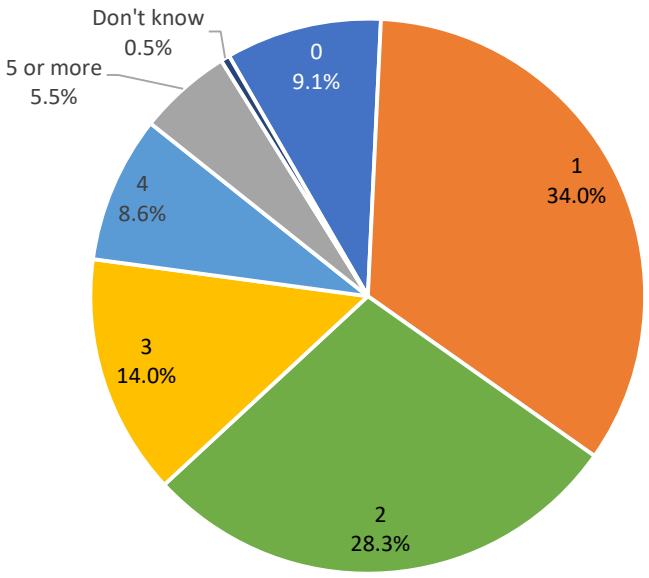
Road crossings (or the lack of) was a key factor that people listed in the survey as making the walk to the bus stop unpleasant. Crossing roads was cited as making the journey unpleasant by a greater number of respondents than any other factor except for the related traffic volume and speed. It was also the area most listed for potential improvement in an open-ended question about walking to the bus stop. Crossing roads is an unavoidable part of using the bus. A person who catches a bus to their destination and then back again will have to cross, at the least, the road the stops are on as part of their journey. Or in the case of one person who responded to the survey, not even catching the bus for the return journey because crossing the road is inconvenient and unsafe.

"I REGULARLY USE THE BUS FROM HOME TO DESTINATION BUT MAKE OTHER ARRANGEMENTS RETURNING BECAUSE OF A LACK OF SAFE/CONVENIENT MAIN ROAD CROSSINGS."

SURVEY RESPONDENT

The bus stop access audits found that 56% of the roads on which bus stops were located had intersecting roads within 50 metres of the stop. Nine in ten (90%) survey respondents reported having to cross at least one road on a recent walk to the bus stop, with 56% having to cross two or more roads (Figure 35). Even for the 17 people who got to the bus stop in a vehicle, 10 still had to cross a road between getting out of the vehicle and getting to the bus stop.

Figure 35 Number of roads people crossed on walk to the bus stop (Survey of bus users; 385 responses)



"THE BUSES ARE NOT THAT REGULAR. IF YOU MISS THE BUS, YOU MISS YOUR APPOINTMENT. YOU HAVE TO ALLOW A LOT OF EXTRA TIME TO GET TO THE BUS STOP TO CROSS THE ROAD AND TO MAKE SURE YOU ARE THERE WELL BEFORE THE BUS IS EXPECTED."

SURVEY RESPONDENT

Research by Hillnhütter (2016) found that people walking like to cross busy roads to the same side of the bus stop as early as possible. This is due to unpredictable waiting times and so minimising the risk of delays in crossing later. Most people (81%) walking to the bus stop are under time pressure (they want to get there before the bus) compared to only 31% who have alighted the bus and are walking away from the stop. Unpredictable crossing times can make crossing the road stressful and even result in missing the bus.

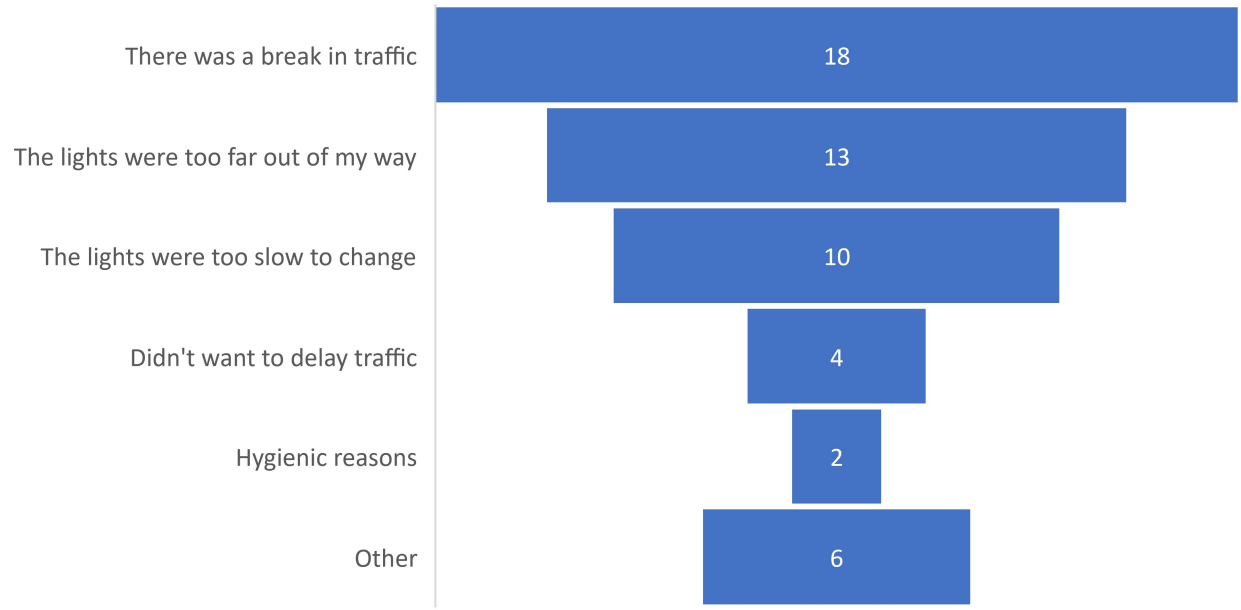
Signals

Signal operation

Hillnhütter (2016) quanitifed the effects of waiting at signals in walking to the bus or tram stop, finding that a short walk (about 300 metres) is increased by 10-15% due to one set of signals when crossing a busy road. Delays due to signals are particularly relevant on the way to the bus stop because people are feeling rushed and worrying about getting to the stop before the bus.

Signals were an option to cross the road for less than half (45%) of survey respondents. Most (76%) who had the option to cross using a green signal used it. Reasons given for not using a green signal included that a break in the traffic provided an opportunity to cross or that the lights were too slow to change (Figure 36), both related to minimising waiting delay. People who arrive at the signals after the parallel vehicle phase has started have to wait a complete cycle before they are given a green signal to cross, often in excess of one and half minutes.

Figure 36 Reasons for not using the green pedestrian light to cross the road
(Survey of bus users; 39 respondents; multiple responses permitted)



"THE CROSSING TAKES 2 SETS OF LIGHT CYCLE AND PEDESTRIAN CROSSING ON A SLIP LANE WITH HIGH SPEED TRAFFIC TO DO SO [GET ACROSS THE ROAD]"

SURVEY RESPONDENT

Multiple respondents commented in the open-ended questions that the signals did not provide enough time for them to cross comfortably or where they had to stop in the middle of the road and wait for the next green signal to complete their crossing. This is a concern commonly heard by Victoria Walks and raised by multiple bus users in the survey. At signalised intersections, pedestrian provision almost always fits around vehicular requirements. Signal operation is usually designed to maximise vehicle throughput and minimise vehicle delay, then a limited time for pedestrians is provided (in a way that does not delay vehicles) on condition that they trigger the signals before the phase begins. This approach typically results in a very poor level of service for pedestrians, with pedestrians' time being valued much less than vehicle occupants.

Signalised intersections are operated assuming the people crossing are fit, healthy adults. In Victoria, a walking speed of 1.2 m/s is assumed in calculating the length of green time to give people crossing (walk time) and a higher speed of 1.5 m/s is assumed during the flashing red (clearance) phase. The 1.2 m/s value is based on observations of the 15th percentile speed of only about 300 midblock crossings[8] nearly 20 years ago (Austroads, 2016, Figure G6). These values do not reflect the wide range in walking speeds, especially as walking speed decreases with age (Cronkleton, 2019). A study of older people in Spain found that 42.6% of people aged 65 or over walk at a speed of less than 0.8 m/s (Castell, et al., 2013). Given the ageing population, it would be appropriate to look at this once again.

"I FELT PRESSURED TO JAY WALK OR IGNORE PEDESTRIAN CROSSINGS AS THE BUS WAS APPROACHING THE STOP AND I KNEW THERE WOULDN'T BE ANOTHER FOR QUITE SOME TIME."

SURVEY RESPONDENT

Currently the VicRoads Traffic Engineering Manual (2014b) sets a maximum walk (green) time of 8 seconds for all roads except divided carriageways able to store people in the median, irrespective of the green time for the parallel vehicle phase. Providing automatic and longer green time for people crossing increases the chance of being able to cross upon arriving at the signal, reducing delay.

"TRAFFIC LIGHT CYCLES JUST AREN'T SETUP FOR PEDESTRIANS. IT WOULD BE GOOD IF THEY ALL AUTOMATICALLY TURNED GREEN AND STAYED GREEN FOR AS LONG AS IT IS SAFE TO CROSS - LIKE THEY DO IN THE CBD."

SURVEY RESPONDENT

Existing technology exists to improve crossing conditions by, for example, providing people walking with an automatic green signal without having to press the button (as done for vehicles). Most of the signals in the Melbourne CBD operate like

[8] Observations were made of one pedestrian each cycle for about 50 cycles at 3 sites over two time periods.

this. However, in separate discussions with the Department of Transport, it is understood that this technique will not be expanded to other signals outside of the CBD. At midblock pedestrian signals (not at an intersection), the technology exists and is used to detect people who need longer to cross. However the equivalent technology for intersections is only in it's infancy (the camera has to be able to tell the difference between a person and a vehicle).

"CHANGE TRAFFIC LIGHT SEQUENCE TO GIVE EQUAL PRIORITY TO PEOPLE WALKING"

SURVEY RESPONDENT

Further improvements in technology mean that signals can be adjusted in real time to provide people crossing with the time they need. The state government have installed cameras at signals across south east Melbourne and have trialled cameras which recognise people waiting to cross at a few locations. It is unclear whether these new technologies have been used to improve crossing operations for people walking or simply to optimise signals for traffic.

Signal location

"ROAD CROSSINGS SHOULD BE PLACED CLOSER TO THE BUS STOPS"

SURVEY RESPONDENT

Assistance in crossing high-speed and high-volume roads on the way to the bus stops is important, but equally important is that crossings are direct. Inconveniently located street crossings and staged crossings, along with other detours in the street scape, can add 20-25% trip time to the walk to the bus stop (Hillnhütter, 2016). Given that half of trips walked to bus stops are 350 metres or less in Melbourne, walking 200 or 300 metres to a set of signals and then back again can more than double the walking distance compared to crossing at the bus stop.

People commonly reported that they don't use signals because they are too far out of the way (refer Figure 36 p. 46). The bus stop access audits found signals were visible from 29% of stops, but only 8% of those were very close to the stop, within about 5 metres. Of the 40 stops on roads with a speed limit of 60 km/h or more, 95% did not have a signalised crossing within 20 metres. Interestingly, the majority of people (54%) who reported having the option to cross using signals said that the signals were very close, less than 5 metres away. This difference could suggest that people only consider signals as an option if they are nearby, or that people cross at signals which are on their way to the bus stop but not necessarily near the bus stop.

Simply having signals is not sufficient, with users reporting that the crossing was not safe, was too far away or was confusing to use. Many people were observed crossing a road at the bus stop rather than walking to signals, such as the person in Figure 37. This was not only young, fit people either. Plenty of people were observed during the audits crossing roads away from signals, even when the signals were nearby. During one audit, four people crossed a 50 km/h road in the 50 metres between the bus stop and signals, including one using a walker. In one case, an older couple chose to cross a four-lane, 60 km/h undivided arterial to access the bus stop rather than walking to the signals 180 metres down the road. Ironically, people may cross away from the signals because having signals nearby slows drivers down and creates gaps in the traffic. Although qualitative rather than quantitative, these observations support the assertion that people will not go far out of their way to use signals in crossing a road.

Figure 37 A person waits to cross an arterial road in Box Hill to access the bus stop on the opposite side rather than walking 200 metres to the signals and back

The location of signals can also affect which stop people use. A person who wants to use the signals in crossing a road might be better off using the bus stop closest to the signals, rather than closest to where they are coming from.

Signal location is also relevant in decisions about bus stop locations and arose in discussions with multiple state agencies. A bus stop located after the bus has passed a signalised intersection is considered better from a bus operations point of view (the bus doesn't miss a green light while at the bus stop), but worse from a pedestrian safety point of view as people do not want to have to backtrack to get to the signals and so may cross in front of the bus or at the stop after the bus has left (Ewing & Bartholomew, 2013). The bus stop access audits found that of stops which a formal crossing[9] was visible, 60% were located after the crossing, indicating that bus operation is being prioritised over safe pedestrian access.

Pedestrian (zebra) crossings

Pedestrian crossings (also referred to as zebra crossings) provide people walking with the best level of service as there is no delay in waiting to cross the road and people can take as long as they need to cross. They can also minimise delays to vehicles compared with signals as drivers only have to stop for the time there is a person present (VicRoads, 2015a). Signals may be more convenient for

[9] Includes zebra crossings and school crossings as well as intersection and pedestrian signals.

the small number of people who require more regulated crossings, such as those who are blind or have low vision.

Unfortunately, zebra crossings are not as common as signals. Only 3% of stops in the access audits had a zebra crossing within 50 metres and 10% of people in the survey who did not have the option to use lights had the option to use a zebra crossing on their walk to the bus stop. According to Austroads (2017), “zebra crossings are not favoured on arterial roads where traffic speeds and volumes are relatively high.”

Raised crossings

Raised crossings (also referred to as raised safety platforms) have been installed at limited locations in Victoria, both at midblock zebra crossings and signalised intersections on arterial roads. They have primarily been installed to slow drivers, improving safety for everyone (Blewden, Mackie, & Thorne, 2020). In addition, they make walking easier as they provide a flush path of travel. Some have been trialled at intersections where the approach roads have speed limits of 60 km/h, such as Dalton Rd in Thomastown (Figure 38) and Plenty Rd in Whittlesea.

Figure 38 Raised safety platforms on Dalton Road, Thomastown (Image source: Blewden, Mackie, & Thorne, 2020)

Medians

Medians can be useful for crossing roads as they break the crossing up into two crossings, each with only one direction of traffic. The bus stop access audits found that most roads do not have medians (60%) at the bus stop. One third had a raised median (although not always wide enough to stand on) and the remaining 7% had some sort of flush, painted median, including hatched areas on approach to a turning lane. All five roads audited with a speed limit of 80 km/h had raised medians, but most common on roads with other limits (40 – 70 km/h) if crossing at the bus stop was no place to stand in the middle of the road.

Of bus users surveyed who did not have the option to use lights on their walk to the bus stop, 20% reported having space to stand in the middle of the road on at least one road – leaving 80% who did not.

No crossing assistance

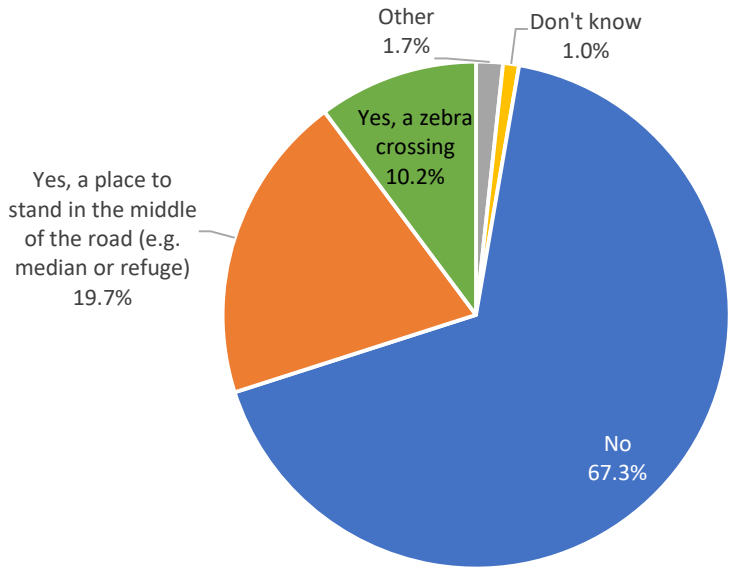
The most common situation for people crossing roads is that they simply have to wait for a suitable gap in traffic to cross. In the survey of bus users, 55% of 391 people who responded said there was no crossing infrastructure at the bus stop they used. One respondent wrote of a campaign to have signals installed near the bus stop they used.

"WITH A SMALL CHILD IN TOW, I HAD TO CROSS A BUSY INTERSECTION (COMPLETE WITH A ROUNDABOUT) TO GET TO THE NEAREST BUS STOP. IT WAS UNSAFE ESPECIALLY AS THERE ARE NO PEDESTRIAN CROSSINGS NEAR THE BUS STOP."

SURVEY RESPONDENT

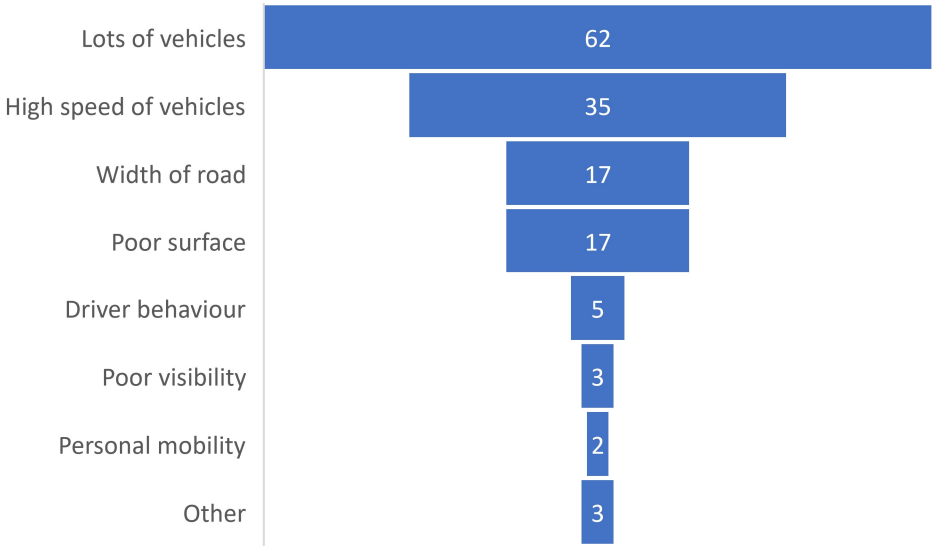
The survey also found that 54% of 346 respondents did not have the option to use signals at all on their walk to the bus stop, and another 34% who crossed at least two roads had the option of signals at only one road. Two thirds of crossings without lights did not have any other crossing assistance (Figure 39). This is comparable to the bus stop access audits, which found there was no formal crossing visible from two-thirds (64%) of stops. Even then, the crossings were not conveniently located with nearly half (48%) more than 50 metres away. At one quarter of stops (24%), people had to cross at least one side road to get between the bus stop and crossing.

Figure 39 Responses to "At locations where there were no lights, was there any other infrastructure nearby to assist you in crossing?" (Survey of bus users; 294 responses)



That said, crossing assistance is not necessary on all roads. On a local residential street with low traffic volumes, there would be plenty of opportunities for people of all ages and abilities to cross with very little delay. This was reflected in the survey, with 45% of 195 people happy even though they did not have any assistance to cross the road. A similar amount would have liked crossing assistance (44%) and interestingly the remaining 11% were unsure. People would have liked assistance primarily due to the high volume and speed of vehicles and the width and surface of the road (Figure 40).

Figure 40 Reasons why people would have liked crossing assistance
(Survey of bus users; 84 respondents; multiple responses permitted)



VicRoads Traffic Engineering Manual (2015b) notes that pedestrian refuges are "perhaps the best treatment that can be provided to help pedestrians get across undivided roads with moderate to heavy traffic, because they simplify the task of crossing the road: a gap in only one direction of traffic needs to be found at any one time." However, the guidance prioritises vehicle capacity over people's safety, stating that refuges are not appropriate where the number of traffic lanes would be reduced as a result.

Other innovative changes to make it safer to cross the road include narrowing the road so that vehicles wait behind the bus (as done at kerb extension tram stops in Melbourne) and raised platforms at signals (Corben, 2020). Permitting only buses to use the road at certain locations reduces the number of vehicles, making it safer and easier for people to cross the road.

"RECOVERING FROM SURGERY SO NOT THE BEST AT DASHING IF MOTORIST WAS SPEEDING/ NOT LOOKING"

SURVEY RESPONDENT

Kerb ramps

Roads are often built at a lower level than the footpath, creating a 'step' between the two. In these instances, crossing the road is only possible for everyone when there is some sort of ramp to provide a smooth transition between the level of the bus stop and the road, as in Figure 41. A kerb and channel is often constructed the edge of the roadway in urban areas for water drainage. Kerbs can also help bus drivers pull into the stop accurately. Kerbs were present in 94% of the access audits, but more than one third (36%) of stops did not have any ramp access – either kerb ramps or driveways – within 50 metres. This was particularly an issue where the bus stop was located adjacent to a train line (but not at a station) or the adjacent property was large and had no or few driveways (Figure 42).

Figure 41 Kerb ramps and a median cut through have been constructed specifically to assist people in crossing the road near this bus stop in Blackburn North

Figure 42 This bus stop in Springvale is adjacent to the Crematorium and there are no kerb ramps or driveways to help people using wheeled devices or with limited mobility to cross the road

At 23% of stops there were no kerb ramps but there were driveways which people using wheeled devices or with limited mobility would have to use to cross the road. Crossing at driveways is not often direct, as they are built for property access rather than to assist people crossing the road. In some new developments in the outer suburbs, the continuation of mountable kerbs at driveways means not everyone can use them to cross the road. There is also the issue of footpaths which change grade at driveways to provide vehicle access, as in Figure 43.

Figure 43 This footpath next to a bus stop in Airport West changes grade at the driveway

Few bus stops audited had kerb ramps very close to the stop specifically installed for people crossing. The 36% of stops where kerb ramps were recorded were usually at formal crossings or ramps to cross side roads. Crossing the main road (where the bus stop is located) at a side street complicates the crossing because people not only have to navigate the main road, but they also must avoid traffic turning in and out of the side road.

State and territory transport agencies suggested in discussions that kerb ramps should be included as a minimum if there are no other crossing facilities (kerb ramps or driveways) nearby. However, there were few bus stop access audits where kerb ramps were specifically provided for bus users to cross the road.

An alternative to kerb ramps is to raise the level of the road to be the same as the footpath, called raised thresholds or continuous footpaths. There were only two examples of this in the bus stop

access audits; one in the CBD across a very low trafficked laneway and the one shown in Figure 44 where a shared path continues across the side street at path level (although with no additional obligations on drivers to give way to path users).

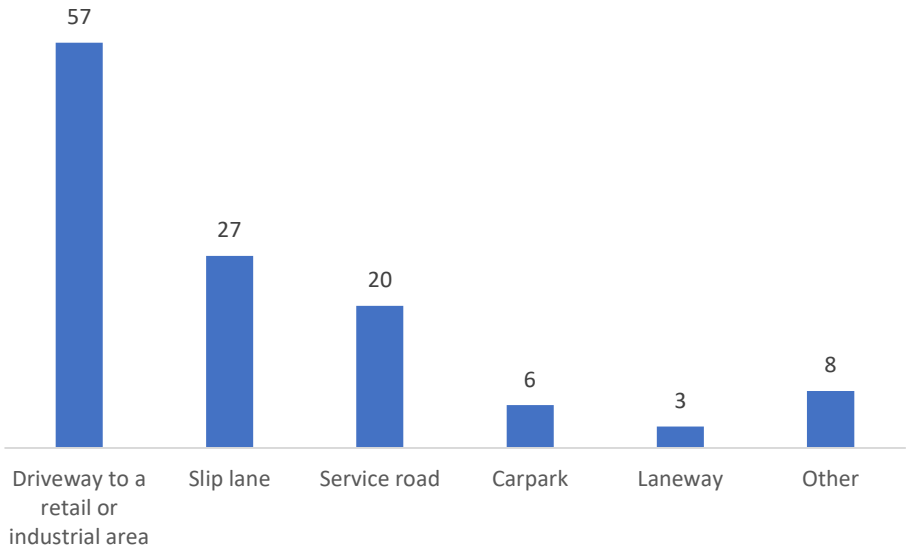
Figure 44 This shared path in Avondale Heights remains at a constant level across the side street (Image source: Streetview, Google Maps, March 2021)

Raised thresholds were mentioned by a few survey respondents in open ended questions. Existing raised thresholds were well regarded with calls for more across side roads.

Other significant crossings

In addition to roads, people may have to cross other vehicle paths to get to the bus stop include residential driveways, driveways to retail or industrial areas, slip lanes and service roads. The survey did not ask about residential driveways as they are so prevalent. Figure 45 shows that driveways to retail or industrial areas were the most common form of crossing after road crossings. Six people walked through a car park on their way to the bus stop. Slightly more than one in three people reported feeling unsafe at these locations (36%), 27% felt safe and 37% reported feeling neither.

Figure 45 Other significant crossings (Survey of bus users; 121 responses)



The bus stop access audits similarly found major driveways within 50 metres of bus stops; 11% had a driveway to an industrial, retail or aged care facilities, and 9% had entrances to car parks.

Indirect routes

The walking network always includes some detours as there are buildings and private property that can't be walked through. Barriers such as train lines with limited crossing points, crossings arterial roads and large buildings with no walk throughs (such as strip shops or industrial areas) can create significant detours. Hillnhütter (2016) found that that average detour factor for pedestrians using public transport stops in European cities was 1.16; this means the walking distance was 16% longer than the straight-line distance ("as the crow flies"). He also observed that an increasing number of road crossings leads to increasing detours. Research suggests walking detours become unacceptable when they exceed about 40%, as do detours when the bus stop is in sight (Schmitz (1991b) cited in (Hillnhütter, 2016)).

As such, although the catchment area of a bus stop might be a 400 metres straight-line distance, the majority of people within a 400-metre radius of the stop will have to walk further than 400 metres to access the stop.

This means that shorter blocks, or larger blocks with walk throughs, and a grid type road network are important features in providing direct walking routes, including to bus stops (Ewing & Bartholomew, 2013).

Some walking routes are difficult for certain groups to use, creating significant walking detours. Bollards and fencing can have the unintentional consequence of stopping people using prams, wheelchairs and mobility scooters from accessing the path at that point.

While walking 'shortcuts' through parks or dedicated pedestrian accessways are valuable, they often have limited passive surveillance. This can deter walking at specific times and by particular groups who may be concerned for their personal safety, such as women walking at night.

Safety

There is much literature on both road safety and personal safety in relation to walking.

There are however no official statistics on the safety of walking to or from a bus stop. In Victoria, Transport Safety Victoria require bus operators to report certain incidents. The statistics are slow to be released – the latest data is from 2017 – and they only include crashes if a bus is directly involved. Examples of the types of injuries recorded in this data set are people:

- on the bus who are injured when the driver brakes heavily to avoid a crash,
- who slip or trip on the bus, or
- who fall as they are stepping between the bus and the kerb.

A study by Laughlin & Berecki-Gisolf (2017) looked at hospital admissions data for Victorian hospitals as a result of bus related injuries over a 10 year period. It found little additional information in the hospital data, with the the circumstances of the crash not recorded in 38.7% of cases and the role of the individual not recorded in 40.4%. For injuries where there was data, the largest category was 'no collision occurred prior to injury' (82.6%) with majority of people injured being bus passengers (41.7%) or boarding/alighting the bus at the time of injury (31.1%).

People walking to or from a bus stop who are (seriously) injured or killed in a crash are captured in the road crash databases maintained by Victoria Police, Department of Transport and the TAC. However, these people are recorded as pedestrians with no further information about their purpose, such as the person was walking to or from a bus stop at the time.

This lack of data means the extent of people being injured walking to or from bus stops is simply not known. There are however media reports of people killed while waiting at or getting to the bus stop, particularly as deaths are investigated by the coroner and so more information is known about the circumstances, such as:

- In February 2019, Antoine and Leila Alam were crossing Thompsons Rd in Geelong to get to the bus stop; a four lane, 60 km/h arterial. Leila made it to the bus stop but Antoine was hit by a car before he could and died in hospital later the same day. He was 78 years old (Tippet, 2021).
- In February 2016, a 65-year-old woman died waiting at a bus stop in Deer Park when a driver lost control, mounting the kerb and crashing into her (Butt, 2016).

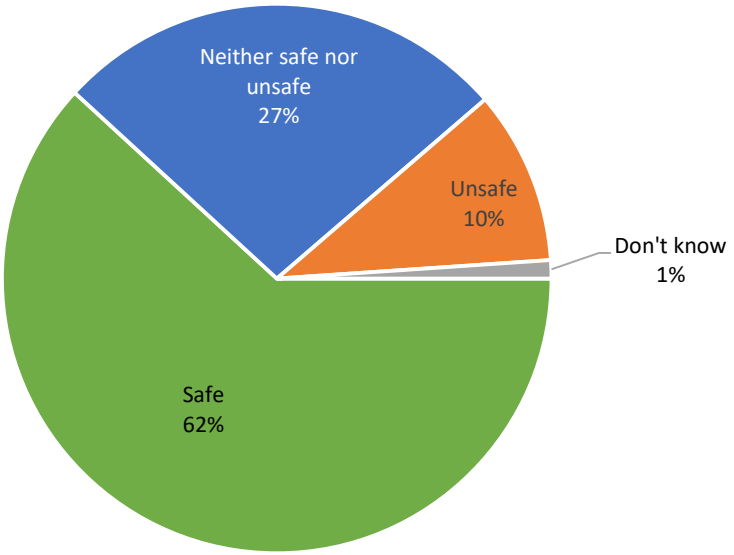
Traffic and pedestrian signals as well as pedestrian crossings (zebra crossings) are not part of the scope of bus stop design and construction, meaning they are considered under general road management. There is a presumption that facilities for pedestrians are not provided unless certain minimum prerequisites are met, which often set the bar very high and tend to be reactive (such as the number of people killed, injured or observed crossing) rather than proactive.

Discussions with state agencies suggested that the reactive approach to funding improvements at specific 'high risk' locations means that the relatively low number of people injured or killed at individual bus stops will never meet the threshold requirements to receive funding. As a result of this approach as well as the lack of data, walking to or from bus stops is not a high priority for agencies in charge of road safety.

What makes a walk feel safe?

The bus user survey asked people how they felt while walking to the bus stop. Nearly two thirds reported feeling safe and one in ten felt unsafe (Figure 46). The initial question intentionally left open the idea of safety to include both road safety and personal safety. Survey respondents who reported the walk as feeling either safe or unsafe were given the option to answer an opened ended question about what factors influenced their feelings. These results generally related to feelings of personal safety or road safety.

Figure 46 "How did you feel on your walk to the bus stop?" (Bus user survey, 372 responses)



There was a difference by gender, with females less likely than males to report feeling safe (59% of women compared to 69% of males) and more likely to feel unsafe (14%; 6%). People who identified as non-binary were even less likely to feel safe (33%), although there were only a small number in the sample. This is supported by consistent findings that women are more likely to feel unsafe walking alone than men, particularly after dark (Hall, 2019). In Australia, the gap between the sexes is greater than any other OECD country, with 50% of women feeling unsafe walking at night compared to 20% of men (Liddy, 2018).

People who generally use a mobility aid were also less likely than others to feel safe (38% felt safe compared to 64% of those without an aid), but again there were only a small number.

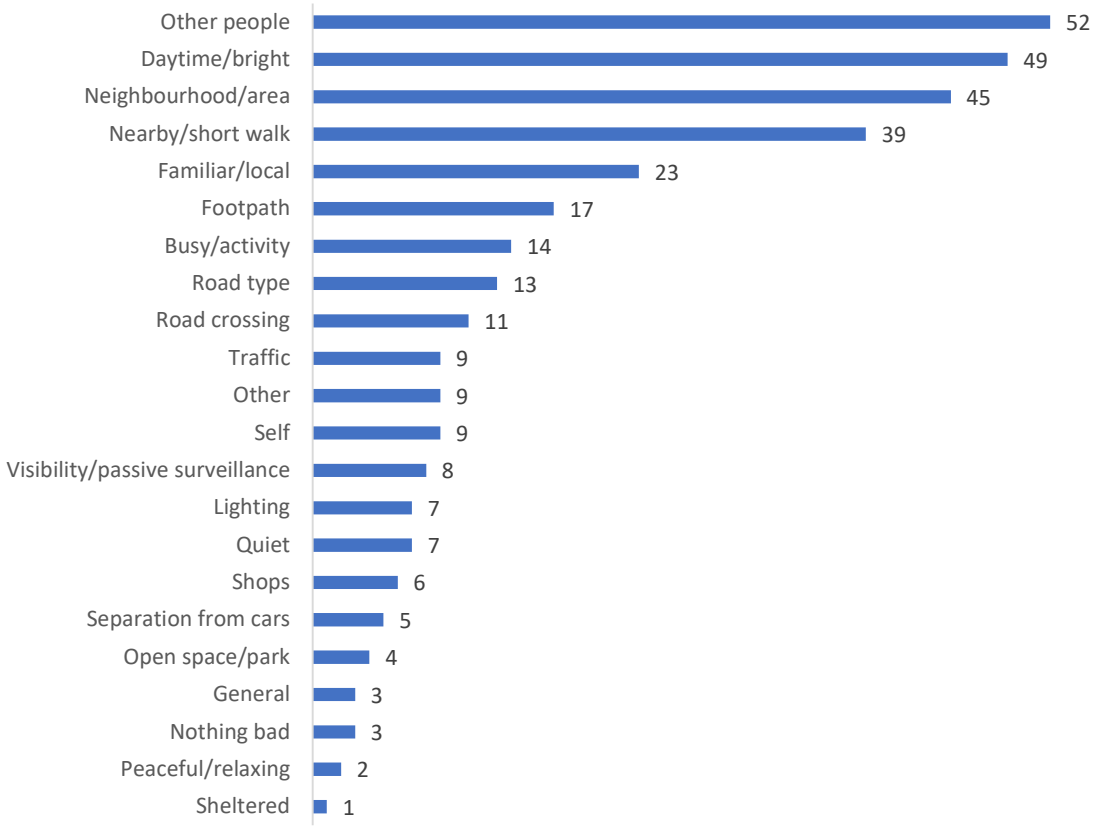
Daytime

Walking to the bus stop during the day was an important factor in people's feelings of safety. This is related to both being able to see other people and their intentions, as well as feel seen should you require assistance. Walking during daytime also means physical infrastructure such as steps, kerbs and objects in the path are easier to see and negotiate.

Other people and passive surveillance

The factors that contributed to people's general feeling of safety were overwhelmingly related to personal safety rather than road safety, with a key factor being other people (Figure 47). For most respondents, this meant having other people around. Some people mentioned walking with others while a few noted officials such as crossing supervisors and police officers. Having others to provide passive surveillance appears to be very important, whether from people walking, driving, in their homes or shops.

Figure 47 Categorised themes in response to open ended question "What made your walk feel safe?" (Survey of bus users; 210 respondents; multiple responses permitted)



"HARDLY ANYONE AROUND, THOSE I MEET LOOK FRIENDLY"

SURVEY RESPONDENT

Interestingly some respondents mentioned the lack of other people made them feel safe and others felt unsafe because others present appeared threatening. These findings suggest that it's not enough to simply have other people around to feel safe, but that they feel like people who are looking out for you.

During the bus stop access audits, other people were observed walking around near most stops (72%). At 21% of stops, there were 5 or more people observed. The small number of people who reported traffic helps them feel safe may relate to having drivers nearby provides a level of passive surveillance.

Neighbourhood

People regularly attributed feeling safe to the area or neighbourhood in which they were walking and also that they were familiar with it. This was reflected in comments about "my" neighbourhood and it being a "safe area". This links with the desire to have other people around from a social aspect.

"FAMILIAR AREA, QUIET SUBURB"

"I GENERALLY FEEL SAFE IN MY AREA."

SURVEY RESPONDENTS

Visibility

A factor that was mentioned by some in the survey but strongly emerged from the bus stop access audits was the visibility of the built environment around the bus stop. Visibility is important for both personal safety as well as road safety. At a bus stop it is crucial so that the approaching bus driver can see if they will have to stop, and people waiting can see when the bus is approaching, and if multiple routes service the stop, whether it is the right bus.

Figure 48 Stops with good visibility – (left) transparent bus stop shelter in Collingwood provides excellent visibility for people waiting as well as walking past; (right) bus stop in Tarneit with excellent visibility for people walking and waiting as there are no power poles and low front fences

"THE BUS SHELTER AND BUS STOP WERE POSITIONED BADLY, SO THAT THE BUS COULD NOT BE SEEN APPROACHING. IT WAS NOT CONVENIENT TO USE THE BUS SHELTER IN CASE THE BUS WENT PAST WITHOUT SEEING ME AND WITHOUT STOPPING."

SURVEY RESPONDENT

Two thirds (67%) of bus access audits found good visibility of an approaching bus; both the person waiting at the stop and need to be able to see each other. Factors influencing visibility both while waiting at the stop and on the walk there include:

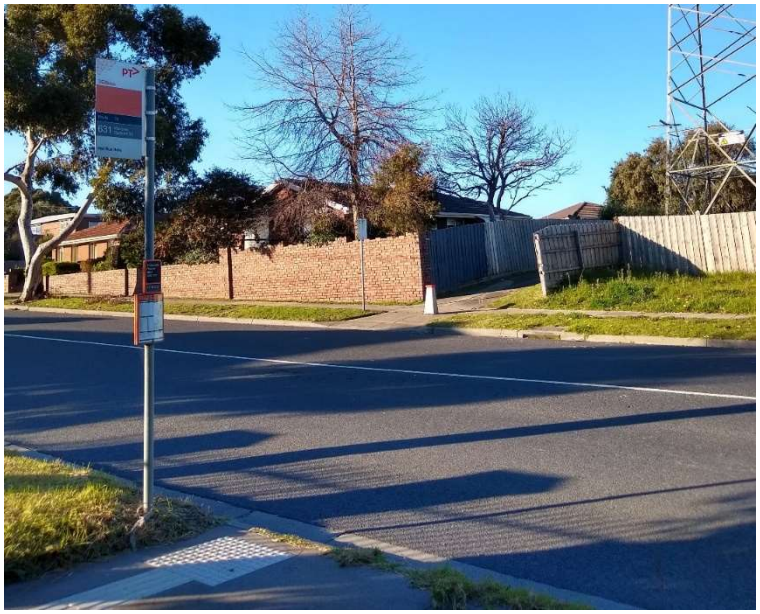
- Vehicles parked along the road can reduce crossing visibility, but they do create a buffer from traffic when walking along the road.
- High, opaque property fences or walls, as in Figure 49.
- Vegetation. Overgrown bushes and large trees in the nature strip can limit visibility along the footpath and when crossing the road.
- Electricity poles.
- The bus itself or other buses at high use stops or interchanges. When people alight a bus and then attempt to cross in front of it, the bus obstructs the view of approaching traffic.

"THE BUS STOP CLOSEST TO ME HAS A BUS SHELTER FROM WHICH IT IS IMPOSSIBLE TO SEE THE BUS COMING"

SURVEY RESPONDENT

- Newer bus stop shelters tend to be clear with good visibility (Figure 48), although marbling, advertising and condensation on shelters were all observed during the access audits. Older styles which cannot be seen through are particularly limiting for visibility. In some cases, people would choose not to use the bus shelter because they can't see through it.

Figure 49 High, opaque fences and high-speed traffic at this bus stop in Clarinda limit passive surveillance



Large trees are important to provide shade and shelter while walking but need to be managed and positioned in relation to bus stops and crossing points so that trunks and foliage at eye level do not obstruct people's visibility while waiting at stops and crossing roads.

"TREES/PLANT GROWTH IN LINE OF SIGHT BETWEEN THE STOP AND BUS CAN BE QUITE ANNOYING - REQUIRING THE (POTENTIAL) PASSENGER TO STAND VERY CLOSE TO TRAFFIC"

SURVEY RESPONDENT

Bus stops in newer estates in the outer suburbs tended to have excellent visibility, with no or low property fences, few large trees and no power poles. As well as providing good passive surveillance, it also meant people walking to the bus stop could easily see drivers reversing out of driveways and when crossing the road.

Other

The fact that it was only a short walk to the bus stop was mentioned by nearly one in five people in why they felt safe.

Interestingly, some people mentioned that they felt confident in themselves, either their physical or mental state, and so they weren't fearful of being assaulted. Seven of the nine people who mentioned this factor were male.

"FEELING SAFE IS MY DEFAULT AND THE FACT THAT BEING ATTACKED IS HIGHLY IMPROBABLE"

"I'M A BIG, FAT & UGLY BLOKE"

SURVEY RESPONDENTS

Road safety related factors were not so commonly mentioned in feeling safe on the walk to the bus stop. Positive comments included having space to walk separate from traffic and ease of crossing the road, or not even having to.

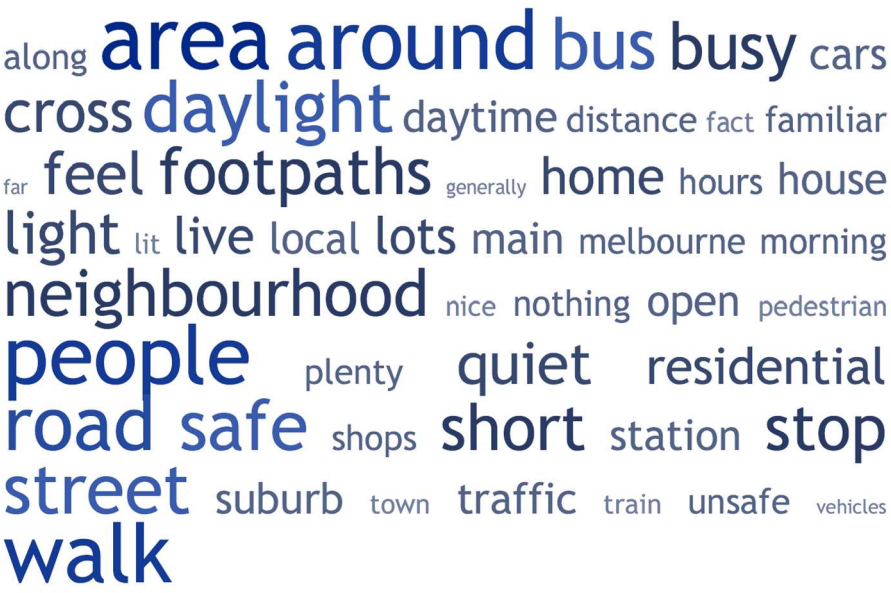
"IT IS MY NEIGHBOURHOOD. I FEEL SAFE"

SURVEY RESPONDENT

Sometimes responses were difficult to classify because it was not always clear whether they related to personal safety or road safety. The terms 'neighbourhood/area' and 'traffic' could refer to there being friendly people around, possibly providing passive surveillance (personal safety) or it could mean few, low speed vehicles (road safety).

It was interesting to note that both the terms 'busy' and 'quiet' were used by people in explaining what made them feel safe (Figure 50). These terms can be opposites; however they are both positive in this context. "Busy" was often used to mean others around walking or driving and so providing passive surveillance (personal safety related) and "quiet street/area" referred to few others (personal safety related) or few vehicles (road safety related).

Figure 50 Frequency of words used in response to "What made your walk feel safe?" (Survey of bus users; 210 responses; 50 most common words excluding function words like 'the', 'and', 'a'; larger words were used more often)



What makes a walk feel unsafe?

Like the findings for what makes a walk unpleasant, it is not simply the absence of 'safe' factors which contribute to feeling unsafe. Reasons given in the bus user survey were much more likely to relate to road safety than personal safety (Figure 51). Footpaths and other people have been discussed previously (refer p. 38 and p. 58 respectively); the other factors are discussed here.

Figure 51 Categorised themes in response to open ended question "What made your walk feel unsafe?" (Survey of bus users; 40 respondents; multiple responses permitted)

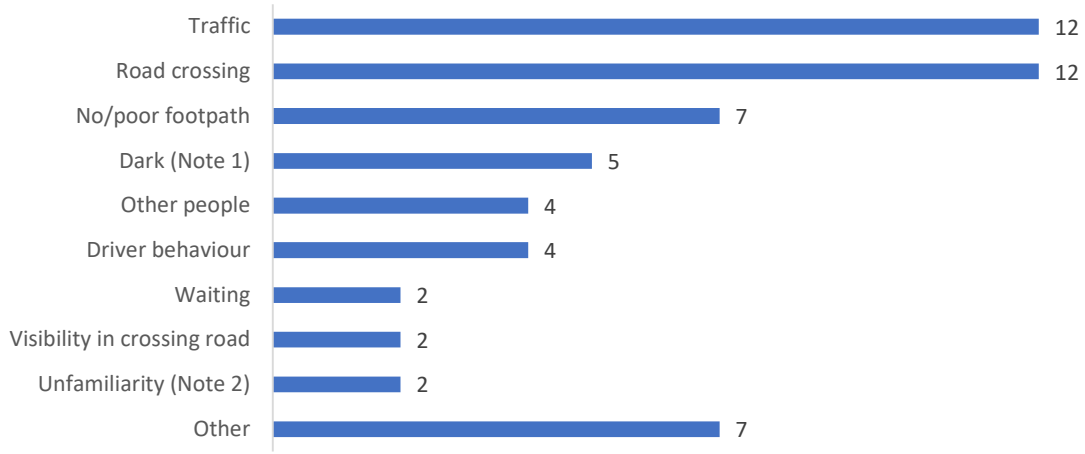


Figure notes:

1. This includes three people who reported feeling safe on their walk but commented they feel less safe walking at night.
2. This includes one person who reported feeling safe on their walk but commented they feel less safe in unfamiliar areas.

"STANDING AT A BUS STOP IS NOT A SAFE THING TO DO- THERE ARE OFTEN UNDESIRABLE PEOPLE STANDING NEARBY AND IT'S DIFFICULT TO TIME WHEN TO ARRIVE, AS A BUS CAN BE A FEW MINUTES EARLY, OR UP TO 10 MINUTES LATE."

SURVEY RESPONDENT

Traffic and road crossings

Traffic, in the form of "busy roads" and "fast cars", and road crossings received equal mentions as safety concerns. "Road" and "cross" were the words most used by respondents in describing why they felt unsafe (Figure 52). Road crossings felt unsafe either because there was no crossing, or existing crossings were inadequate. Drivers failing to give way at pedestrian crossings was mentioned by multiple respondents in open ended questions.

Figure 52 Frequency of words used in response to "What made your walk feel unsafe?" (Survey of bus users; 36 responses; 50 most common words excluding function words like 'the', 'and', 'a'; larger words were used more often)

Busy roads create a barrier to walking that is both physical and psychological (Anciaes, Jones, Mindell, & Scholes, 2019). They are associated with less walking, reduced health and wellbeing, fewer people knowing their neighbours and reduced expenditure at local businesses (Anciaes, Stockton, Ortegon, & Scholes, 2019). Many bus stops in urban areas of Victoria are located on arterial roads as they provide direct routes for buses, minimising both onboard travel times and the number of buses required to operate a route. This means arterial roads are preferred from a bus operations point of view. In residential areas, bus stops on arterial roads often have larger catchments than local roads simply because there are more intersecting side roads and therefore people within walking distance.

"LOTS OF FAST TRAFFIC ON BIG ROADS AND NOWHERE TO CROSS SAFELY"

SURVEY RESPONDENT

"MAKING 99% OF A JOURNEY SAFE AND CONVENIENT BY FOOT OR BIKE IS FUTILE IF THE REMAINING 1% CONTAINS A DANGEROUS ROAD CROSSING"

ROD TOLLEY, QUOTED IN EWING & BARTHOLOMEW (2013)

However, locating bus stops on arterial roads can lead to longer walking distances because of limited places to cross the road, make crossing the road difficult or dangerous and create an unpleasant walking environment. One middle aged male without disability related that having to cross an arterial road is sometimes enough to stop him catching the bus at all. In another example, residents of Federation Retirement Village are so scared to cross Ballarat Road in Ardeer and Albion – an 80

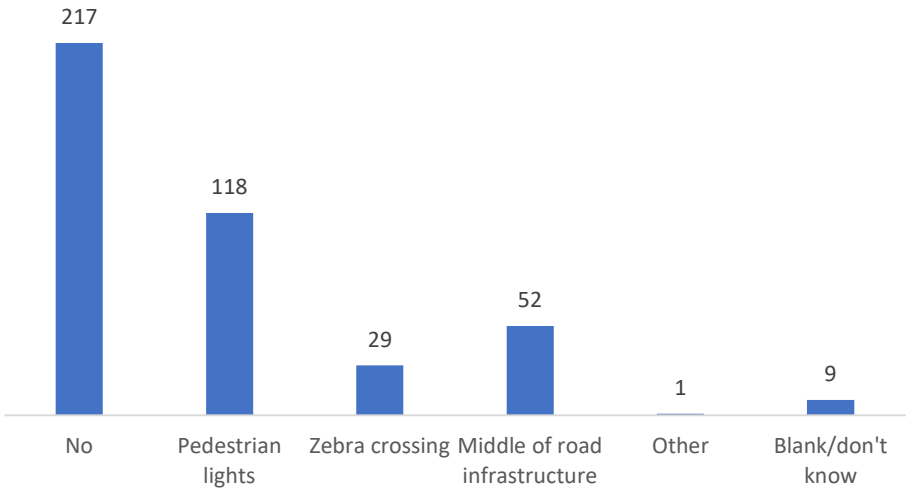
km/h, five-lane arterial with turning lanes and service roads – that they catch a bus 1 km west to the nearest pedestrian crossing and another back again, simply to get across the road (Simpson, 2019).

Figure 53 A person waits for bus on Ballarat Rd, Ardeer. Wire rope barriers in the median and guardrail on the opposite side of the road, in addition to the high speed and volume of traffic, make crossing directly to or from the bus stop extremely difficult and dangerous (Image source: Streetview, Google Maps, February 2020)

Hillnhütter (2016) observed people in European cities and found most who cross the road after getting off a bus or tram do so right at the stop, often in front of the stopped vehicle. Crossing is easier because the vehicle blocks one lane of traffic, reducing the number of lanes a person must cross. It is unknown whether the same applies in Victoria, especially given most arterials have four or more lanes of high-speed traffic.

Despite the importance of crossings at the bus stop, more than half of survey respondents said there was no infrastructure at the bus stop they used to help them cross the road (Figure 54).

Figure 54 "At the bus stop you used, was there any infrastructure to help people cross the road?" (Survey of bus users; 400 respondents; multiple responses permitted)



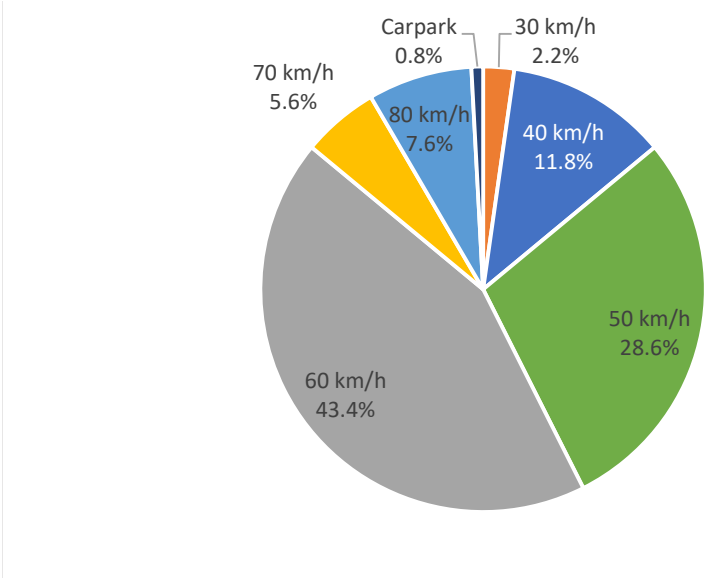
Speed

Arterial roads are dangerous places to walk. There is strong evidence that higher speeds result in more crashes and greater injuries, but the relationship is not linear. The risk of death for a young adult hit at 50 km/h is between three and ten times the risk compared to 30 km/h (Victoria Walks, 2021). The risk is greater again for children and older people. In Victoria, 40% of crashes involving

people walking occur on roads with a speed limit of 60 km/h or more (Oxley, Stephan, & O'Hern, 2020) but crash data shows that these roads account for 77% of all pedestrian deaths (Victoria Walks, 2021). Despite the road safety risks, the vast majority of bus stops are on roads with a speed limit higher than the 30-40 km/h recommended for pedestrian safety and activity.

The majority (57%) of bus stops audited were on roads with a speed limit of 60, 70 or 80 km/h. Two roads were reduced from 60 km/h or 70 km/h to 40 km/h at the time of auditing for roadworks, meaning 60% of bus stops were located on high-speed roads. The bus user survey also found that 57% of bus stops that people used were located on high-speed roads (Figure 55).

Figure 55 Speed limit of the road the bus stop was on (Survey of bus users; 357 responses)



In addition to improved safety, lower traffic speeds contribute to more walking (Garrard, Safe speed: promoting safe walking and cycling by reducing traffic speed, 2008) and general use of the streets, resulting in physical and mental health benefits (Badawi, Maclean, & Mason, 2018) as well as improved social cohesion, personal safety and equality.

Traffic lanes

Along with the speed of traffic on a road, another factor in feeling unsafe is the width of the road. Multiple studies have found that increasing numbers of traffic lanes result in roads which are less safe for people to cross (Zegeer, 2013). A Melbourne study of people crossing roads at signalised intersections found that shorter crossing distances resulted in people feeling more comfortable and safer when crossing (Hutchinson, 2011).

The bus stop access audits measured the number of traffic, bike and parking lanes directly in front of each stop. Nearly half (41%) of stops were located on roads where a person would have to cross at least four lanes of traffic (and generally also parking lanes), compared to only 19% of sites where there were two traffic lanes and no parking lanes. 10% of sites also had bicycle lanes. Crossing distances could be even more once medians and service roads are considered.

Walking at night

Walking after dark can make people feel unsafe, especially young women. A survey of Victorians aged between 15 and 20 found 88% of females felt safe walking during the day, but only 15% felt safe at night, compared with 54% of young men (Garrard, 2017). As a result of feeling unsafe,

women change their behaviour, with women avoiding certain locations or walking only with other people (Paul, 2021).

Although 95% of survey respondents travelled between 6am and 7pm – mostly daylight hours – walking at night or with insufficient light was raised as an issue by people both who felt unsafe while walking (Figure 51) and by 13% of all people who replied to an open-ended question about 'other issues'. Three people reported feeling safe (rather than unsafe) on their walk but were concerned enough about walking at night to mention it as part of their response to what makes them feel safe. Some people stated that they would like to be dropped off closer to home due to fear of walking, especially in the dark.

"I AM ALWAYS MINDFUL WHEN IT IS DARK WALKING HOME FROM STOP"

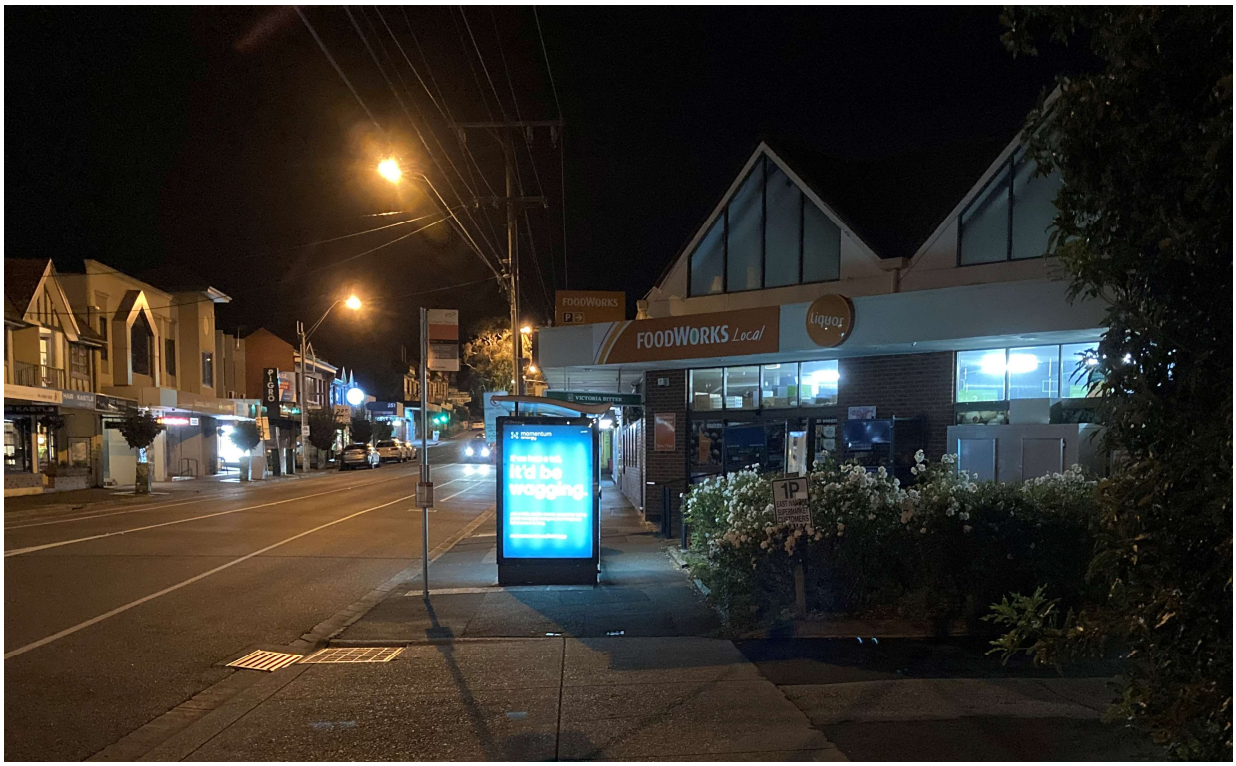
SURVEY RESPONDENT

The Urban Design Guidelines for Victoria recognise that lighting is "critical to creating a public realm that is safe and inviting for users" and state that public transport stops should be lit to the same level as surrounding areas and approach paths (Department of Environment, Land, Water and Planning, 2017). Uniform lighting is particularly important to avoid creating areas of darkness where people could hide, but also to avoid people feeling uncomfortable and like they are under a spotlight. Good lighting:

- means people can clearly see where they're walking and identify and avoid obstacles or tripping hazards.
- helps people identify other people and whether they may be friendly, indifferent or threatening.
- Supports women, older people and those with limited vision to be and feel safe.

Figure 56 shows advertising at a bus stop which is uncomfortably bright compared to the surrounds. There is no other bus stop specific lighting to assist people using the stop, only street lights.

Figure 56 A bus stop in East Ivanhoe at night where the advertising is brighter than the surrounding environment



Most street lighting is designed for drivers, while people walking have to make do with whatever light reaches them from distant fixtures through the tree canopy. The bus access audits found that street lighting is the only lighting provided at most bus stops, and not necessarily at the stop. The audits were conducted during the day, so it is not known how sufficient the lighting was, but other work Victoria Walks have done auditing local shopping centres found that it is relatively common for streetlights not to be operating at night.

Lighting is particularly relevant where the bus service operates in the early morning or into the evening and night. This affects people leaving or arriving home during shorter days in winter, those who work shifts and evening activities such as dining out. As part of changes to the Night Network bus services, there will be more routes operating 24 hours a day on weekends (Public Transport Victoria, 2021).

Conclusions

Nearly every bus trip involves some walking. Bus stops which are accessible, well connected and have safe and convenient crossing options provide equal access to everyone who may want to catch the bus. Meeting legal requirements in relation to stop layout is a respectable goal, but unless broader accessibility is considered and provided, many people will be discouraged or excluded from going to the bus stop in the first place.

Bus stops have traditionally been located based on what is least inconvenient for general traffic and bus operations. Comparatively little attention has been given to how convenient and pleasant it is for people to access them or how they fit into the broader public space. The benefit of running services along high-speed roads to minimise (on-board) travel time has come at the cost of bus stop environments which are unpleasant and unsafe to walk.

Ensuring bus stops are within easy walking distance is so important. A short walk to the bus stop not only is convenient, but it also contributes to people perceiving the walk as pleasant. People do not like walking long distances to a bus stop and will sometimes make other travel arrangements to avoid doing so.

Provision of shade trees, footpaths and things to look at, such as shop fronts, on the walk to the bus stop create a more pleasant walk and can make it feel shorter than it is. Bus stops which are nice places and even destinations in their own right become part of the community and are more likely to be seen as assets, including by those who own adjacent properties. Knowing there are other people around makes people feel safer on their way to the bus stop, be they neighbours, others walking past or even people driving in their cars. However, it's not enough to simply have other people around; generally other people are conducive to walking so long as they are not perceived as a potential source of anti-social behaviour. Walking to the bus stop during the day makes a walk feel much safer than at night, even when lighting is provided. To make people feel safer about using the bus at night, uniform, consistent lighting along the way and at the stop is crucial.

Crossing roads with lots of vehicles travelling at high speeds is inconvenient, unpleasant and often unsafe. Bus stops are necessarily located on main roads to facilitate bus operation, but this typically leaves customers to negotiate the crossing of a road with high traffic volume and speeds. Those customers are typically more vulnerable pedestrians, teenagers, young people and to a lesser extent elderly people. Yet there is usually no convenient, direct pedestrian crossing to assist them. That is not a safe system response.

Even when signals are provided, they are often far from the bus stop, slow to change and don't provide sufficient time to cross comfortably. A formal crossing 200 metres away can more than double the shortest walking distance to the bus stop and is not a realistic crossing option. Bus users, like other people walking, are influenced by the location and operation of traffic lights in their decisions about whether to use and obey signals. Road crossings that are properly located on pedestrian desire lines not only improve bus stop access but increase the catchment area and potential number of bus users, as well as enhancing the walkability of the area for everyone. Providing pedestrian crossings at bus stops should be standard practice – the rule rather than the exception. State agencies recognised the need to provide some form of crossing assistance, within the constraints of budget and traffic operations.

The vast majority of bus stops are on roads with a speed limit higher than the 30 km/h recommended for safety and pleasant walking conditions, and more than half are on higher speed 60-80 km/h roads. Changes to the road system have traditionally been assessed subject to minimising vehicle delay, even at the expense of safety. It is time broader goals such as Vision Zero, making public places nice to walk and be in – and hence making public transport more attractive – were better considered in assessing physical and operational changes to public roads. Vehicle speed is key. Lower speeds, ideally of 30 and 40 km/h, are not only safer for everyone but also reduce traffic noise, make it easier to cross the road and make the area more pleasant in general.

So many people who catch the bus simply want the basics:

- unobstructed footpaths connecting to the bus stop,
- safe road crossings,
- feel safe walking, including at night, and
- shelter and seating at the stop.

Making improvements to the walking network makes catching the bus more attractive and can be cheaper than making changes to bus operations. We have to start by getting the basics right if we want a world class bus system that people will want to use, rather than being forced to endure.

References

Anciaes, P., Jones, P., Mindell, J., & Scholes, S. (2019, September). Busy Roads Reduce Walking and Affect Individuals and Communities: What is the Value of Those Impacts in Great Britain? *Journal of Transport & Health, Vol 14*.

Anciaes, P., Stockton, J., Ortegon, A., & Scholes, S. (2019). Perceptions of road traffic conditions along with their reported impacts on walking are associated with wellbeing. *Travel Behaviour and Society, Vol 15*(April 2019), pp. 88-101.

Arundel, J., Lowe, M., Hooper, P., Roberts, R., Rozek, J., Higgs, C., & Giles-Corti, B. (2017). *Creating liveable cities in Australia.* Melbourne: Centre for Urban Research (CUR) RMIT University.

Athens-Clarke County. (2020). *Art Shelters*. Retrieved July 2021, from Athens-Clarke County: https://www.accgov.com/9591/Art-Shelters

Atlas Obscura. (2016, May 24). *Konagai, Japan's Fruit Shaped Bus Stops*. Retrieved November 2020, from Atlas Obscura: https://www.atlasobscura.com/places/konagai-japan-fruit-shaped-bus-stops

Australian Sports Commission. (2020). *AusPlay results*. Retrieved March 2021, from Clearinghouse for Sport: https://www.clearinghouseforsport.gov.au/research/ausplay/results

Austroads. (2016). *Guide to Traffic Management Part 9: Traffic Operations.* Sydney: Austroads.

Austroads. (2017). *Guide to Road Deign Part 4: Intersections and Crossings - General.* Sydney: Austroads.

Ayers-Johnston, J., Howard, K., Lauderdale, C., Polacek, J., & Schutt, J. (2018). *Bus Stops as Community Assets.* University of Minnesota.

Badawi, Y., Maclean, F., & Mason, B. (2018). *The economic case for investment in walking.* Melbourne: prepared for Victoria Walks.

Blewden, M., Mackie, H., & Thorne, R. (2020). *Effectiveness and Implementation of Raised Safety Platforms.* Sydney: Austroads.

Brown, A. L. (2004). Road traffic noise: Losing the fight? *Acoustics 2004* (pp. pp. 31 - 40). Gold Coast: Australian Acoustical Society.

Butt, C. (2016, February 12). Woman struck and killed by car at bus stop. *The Age*.

Castell, M.-V., Sánchez, M., Julián, R., Queipo, R., Martín, S., & Otero, Á. (2013, June 19). Frailty prevalence and slow walking speed in persons age 65 and older: implications for primary care. *BMC family practice, Vol 14*, p. 86.

Corben, B. (2020). *Integrating Safe System with Movement and Place for Vulnerable Road Users.* Sydney: Austroads.

Cronkleton, E. (2019, March 14). What Is the Average Walking Speed of an Adult? *healthline*. Retrieved from https://www.healthline.com/health/exercise-fitness/average-walking-speed

Daniels, R., & Mulley, C. (2011). Explaining walking distance to public transport: the dominance of public transport supply. *v 6*.

Daniels, R., & Mulley, C. (2013). Explaining walking distance to public transport: the dominance of public transport supply. *The Journal of Transport and Land Use, Vol. 6 No. 2*, pp. 5-20.

Department of Environment, Land, Water and Planning. (2017). *Urban Design Guidelines for Victoria.* State of Victoria. Retrieved from www.planning.vic.gov.au

Department of Transport. (2020). *Accessible Public Transport in Victoria Action Plan 2020-2024.* Melbourne: Victorian Government.

Department of Transport. (2021). *Victoria's Bus Plan.* Melbourne: Victorian State Government.

designboom. (2021, July 2). *leicester transforms thirty bus stops into green-roofed 'bee stops'*. Retrieved July 2021, from designboom: https://www.designboom.com/design/leicester-bus-stops-green-roofed-bee-stops-07-02-2021/

Eady, J., & Burtt, D. (2019). *Walking and transport in Melbourne suburbs.* Melbourne: Victoria Walks.

ECMT/OECD. (2006). *Speed Management.* Paris: European Conference of Ministers of Transport.

Ewing, R. (2000, January 1). Asking Transit Users About Transit-Oriented Design. *Transportation Research Record: Journal of the Transportation Research Board, Vol 1735*(Iss 1), pp. 19-24.

Ewing, R., & Bartholomew, K. (2013). *Pedestrian- and Transit-Oriented Design.* Washington D.C: Urban Land Institute and American Planning Association.

Fallon, S. (2008, August 19). *Bus Stop Swing Set: A Public Transportation Playground*. Retrieved July 2021, from Gizmodo: https://gizmodo.com/bus-stop-swing-set-a-public-transportation-playground-5039030

Finne, P., & Petersen, T. H. (undated). *Traffic noise is dangerous to our health – but what do we do about it?* Retrieved July 2021, from FORCE Technology: https://forcetechnology.com/en/articles/traffic-noise-dangerous-health-what-to-do-about-it

Forehead, H. (2020, April 30). *Air quality near busy Australian roads up to 10 times worse than official figures*. Retrieved July 2021, from The Conversation: https://theconversation.com/air-quality-near-busy-australian-roads-up-to-10-times-worse-than-official-figures-137227

Garrard, J. (2008). *Safe speed: promoting safe walking and cycling by reducing traffic speed.* Melbourne: The Heart Foundation, City of Port Phillip and City of Yarra.

Garrard, J. (2013). *Senior Victorians and walking: obstacles and opportunities.* Melbourne: prepared for Victoria Walks.

Garrard, J. (2017). *Young people and walking.* Melbourne: prepared for Victoria Walks.

Giles-Corti, B., & Arundel, J. (2018, April 10). Too many cars, too few supermarkets: how Australia's cities really stack up. *The Guardian*.

Hall, S. F. (2019). *Gender gaps: Findings from the Youth Survey 2018.* Sydney: Mission Australia.

Hillnhütter, H. (2016). *Pedestrian Access to Public Transport.* Stavanger, Norway: University of Stavanger.

Hirsh, S. (2019, July 12). *Bees Can Take Refuge on These Bus Stop "Green Roofs"*. Retrieved November 2020, from Green Matters: https://www.greenmatters.com/p/bus-stops-for-bees

Hutchinson, N. (2011). Improving Pedestrian Access across Arterial Roads. *2011 State of Australian Cities National Conference*, *29 November - 2 December.* Melbourne.

Laughlin, A., & Berecki-Gisolf, J. (2017). *Bus Related Injury Statistics Victoria 2005/06 to 2014/15.* Melbourne: Accident Research Centre.

Liddy, M. (2018, June). Do you feel safe walking home at night? Men and women have very different answers. *ABC News*. Retrieved July 2021, from https://www.abc.net.au/news/2018-06-19/chart-of-the-day-do-you-feel-safe-walking-alone-at-night/9880408

Loo, K. (2020). *Air pollution*. Retrieved July 2021, from AMA NSW: https://www.amansw.com.au/air-pollution/

Marshall, C. (2020, December 17). *Air pollution death ruling: What comes next?* Retrieved July 2021, from BBC: https://www.bbc.com/news/science-environment-55352247

Martin, J., Kauer, S. D., & Sanci, L. (2016, September). Road safety risks in young people attending general practice: A cross-sectional study of road risks and associated health risks. *Australian Family Physician, Vol. 45*(No. 9), p. 666-672.

Mitchell, P. (2009). *Speed and Road Traffic Noise.* London: UK Noise Association.

Move to make suburbs greener - and cooler. (2021, August 7). *The Age*, p. Business p. 18.

National Academies of Sciences, Engineering, and Medicine. (2021). *Transit Agency Relationships and Initiatives to Improve Bus Stops and Pedestrian Access.* Washington DC: The National Academies Press.

Oxley, J., Stephan, K., & O'Hern, S. (2020). *Understanding Pedestrian Crashes in Victoria: UNPUBLISHED DRAFT REPORT.* Melbourne: Monash University Accident Research Centre.

Parker, P. (2006, October 16). *Driver boosts patronage by 700%*. Retrieved November 2020, from Melbourne on Transit: https://melbourneontransit.blogspot.com/2006/10

Parker, P. (2021, March 26). *Building Melbourne's Useful Network Part 87: The hunt for Melbourne's six sorriest bus stops*. Retrieved November 2020, from Melbourne on Transit: https://melbourneontransit.blogspot.com/2021/03/building-melbournes-useful-network-part_26.html

Paul, M. (2021, May 8). *The challenge of making public spaces safer for women*. Retrieved from ABC News: https://www.abc.net.au/news/2021-05-08/the-challenge-of-making-public-spaces-safer-for-women/100125422?utm_medium=content_shared&utm_source=abc_news_amp&utm_campaign=abc_news_amp&utm_content=mail

Plan International. (2018). *Free to Be: Sydney.* Plan International.

Public Transport Victoria. (2021). *Changes to Night Network bus services*. Retrieved July 2021, from Public Transport Victoria: https://www.ptv.vic.gov.au/more/travelling-on-the-network/changes-to-night-network-bus-services/

RACV. (2016). *Footpath Connect: Outer Melbourne footpaths.* Melbourne.

Ralph, K., Smart, M., Noland, R., Wang, S., & Cintron, L. (2020). Is it really too far? Overestimating walk time and distance reduces walking. *Transportation Research Part F: Traffic Psychology and Behaviour, Vol 74*, pp. 522-535.

Simpson, S. (2019, June 20). 'There will be more fatals': Residents demand safe crossings on notorious road. *The Age*.

Steffen, L. (2019, August 1). *The Netherlands Turns Hundreds Of Bus Stops Into Bee Sanctuaries*. Retrieved November 2020, from Intelligent Living: https://www.intelligentliving.co/netherlands-bus-stops-bee-sanctuaries/

Steuteville, R. (2012, April 4). Ten steps to creating complete streets. *Public Square*. Retrieved July 2021, from https://www.cnu.org/publicsquare/ten-steps-creating-complete-streets

Tippet, H. (2021, July 21). Shocking rise in Geelong pedestrian deaths shattering families' lives. *Geelong Advertiser*.

Toxel. (2009, May 1). *15 Unusual and Creative Bus Stops*. Retrieved November 2020, from Toxel: https://www.toxel.com/inspiration/2009/05/01/15-unusual-and-creative-bus-stops/

Van Cauwenberg, J., Van Holle, V., Simons, D., Deridder, R., Clarys, P., Goubert, L., . . . Deforche, B. (2012). Environmental factors influencing older adults' walking for transportation: a study using walk-along interviews. *International Journal of Behavioral Nutrition and Physical Activity, Vol 9*(Article number 85).

VicRoads. (2013). *Traffic noise.* Melbourne: VicRoads.

VicRoads. (2014a, August). *VicRoads roadside management strategy*. Retrieved July 2021, from VicRoads: https://www.vicroads.vic.gov.au/about-vicroads/our-strategy/vicroads-roadside-management-strategy

VicRoads. (2014b). *Supplement to Austroads Guide to Traffic Management Part 9: Traffic Operations.* Melbourne: VicRoads.

VicRoads. (2015a). *Supplement to AS 1742.10:2009 –.* Melbourne: VicRoads.

VicRoads. (2015b). *Supplement to Austroads Guide to Traffic Management Part 6: Intersections, Interchanges and Crossings (2013).* Melbourne: VicRoads.

Victoria Walks. (2021). *Safer Urban Speed Limits.* Melbourne: Victoria Walks.

Victorian Council of Social Service. (2011). *Creating Accessible Journeys.* Melbourne: Victorian Council of Social Service.

Victorian Equal Opportunity and Human Rights Commission. (2013). *Who's on board? Public transport for people with disabilities in Victoria.* Melbourne: State of Victoria.

Walker, J., & Lock, O. (2013). *Wonderful Walkability.* Melbourne: Secret Agent.

Zegeer, C. (2013). *Evidence Base Associated with Safety Effects of Roadway Features for Pedestrians and Bicyclists.* Pedestrian and Bicycle Information Center.

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