Network Technical Guideline

Supplement to Austroads Guide to Road Design (AGRD)

Part 6A: Paths for Walking and Cycling (2021)

Version 3.0, November 2022

VICTORIA State Government | Department of Transport

Supplement to Austroads Guide to Road Design Part 6A: Paths for Walking and Cycling (2021)

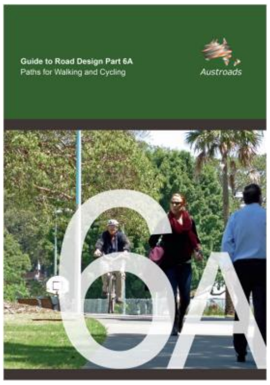
This Supplement must be read in conjunction with the Austroads Guide to Road Design Part 6A.

Reference to any Department of Transport or VicRoads or other documentation refers to the latest version as publicly available on the Department of Transport's or VicRoads website or other external source.

Document Purpose

This Supplement is to provide corrections, clarifications, and additional information to the *Austroads Guide to Road Design Part 6A: Paths for Walking and Cycling* (2021). This Supplement refers to the content published in Edition 2.1 (February 2021) of the Austroads guide.

If this Part to the Austroads Guide to Road Design is updated, or the information is moved to another Austroads publication, then the content in this supplement should be adopted as supplementary content to the current equivalent Austroads content. Where there is conflicting content in this Supplement with updated content, contact the Department of Transport for clarification as to which content takes precedence.



Document hierarchy

This document has been published as a *Guideline* in DoT's document hierarchy. A *Guideline* contains relevant design knowledge which MUST be acknowledged and considered by a practitioner.

Where information contained in this guideline cannot be followed, the practitioner should seek technical advice from DoT and gain acceptance (where necessary) for a departure from the content in this guideline.

Version	Date	Description of Change
1.0	July 2010	Development of Supplement
1.1	September 2010	Minor updates and edits to text
2.0	July 2011	General edits and corrections Additional references and web sites
3.0	November 2022	Refer below

<u>Additional notes on current version</u>

- Restructured to align with Austroads. New DoT Supplement document format.
- Section 2.1 – Path Selection Considerations
- Section 2.4 – Shared Path
- Section 2.5 – Separated Path
- Section 3.1 – Path User Considerations
- Section 5.1 – Widths of Paths
    - Section 5.1.1 – Clear Width
    - Section 5.1.4 – Shared Paths
    - Section 5.1.5 – Separated Paths
- Section 5.2 – Bicycle Operating Speeds
- Section 5.4 – Path Gradients
- Section 5.5 – Clearances, Batters and Need for Fences
- Section 7.3 – Treatments for Intersections of Paths with Roads
- Section 8.2 – Road Bridges
- Appendix VA – M&P Cycling and Walking Project Performance Indicator Descriptions and Targets
- Appendix VC – Additional Design Considerations for Raised Priority Crossings

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1 Introduction

1.1 Purpose

Additional Information

The purpose of this guide is to provide detailed design guidance and design values for off-road walking and cycling paths. This guide Supplements the *Austroads Guide to Road Design (AGRD) Part 6A.*

In addition, this guide should be used in conjunction with the Department of Transport's Movement and Place (M&P) framework, when evaluating competing interests on the transport network and the desired performance in terms of movement, place, environment, and safety outcomes. The M&P framework, as well as the M&P Cycling and Walking *Guidance Notes,* help turn strategic aspirations into potential interventions, by informing practitioners on how to interpret and apply M&P cycling and walking classifications, performance indicators and target levels of service (LoS).

As such, this guide integrates the key themes from the M&P documentation and provides more detailed descriptions of off-road path types and their functions, along with guidance on path width and geometric requirements.

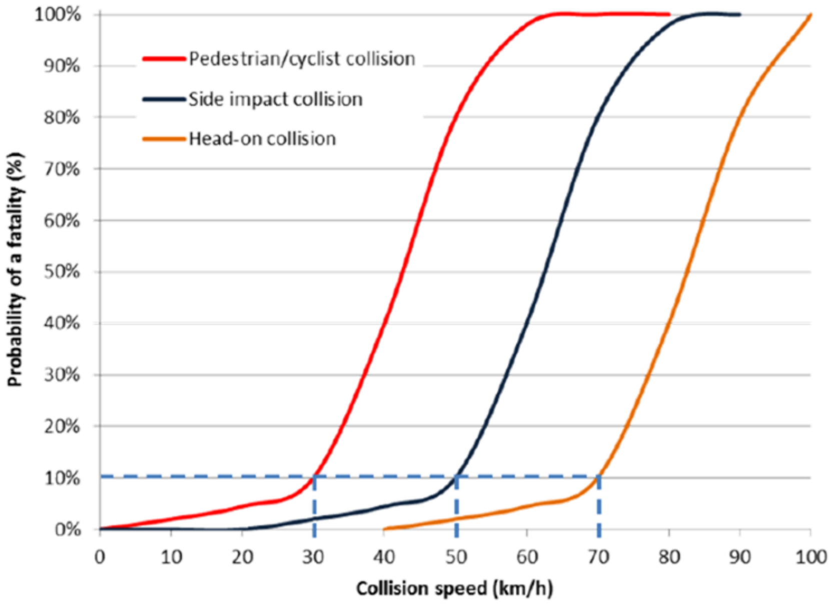
Figure V1.1: Overview of Complementary DoT Walking and Cycling Guidance Documents

1.3 Safe System Approach

Additional Information

A number of studies have shown the relationship between speed, crash likelihood and severity, with increases in speed increasing both the likelihood of a casualty crash occurring and the severity of injury to the crash participants (Jurewicz, Sobhani et al. 2015).

Categorised as vulnerable road users, pedestrians, and cyclists' risk of being fatally injured as a result of a collision increases dramatically at speeds above 30 km/h, as illustrated in Figure V1.2. For this reason, operational speeds ≤ 30 km/h should be considered wherever there is potential conflict with pedestrian or cyclist traffic.



Source: Jurewicz, Sobhani et al. (2015) and based on Wramborg (2005)

Figure V1.2: Relationships between collision speed and probability of a fatality for different crash configurations

2 Types of Path

2.1 General

Additional Information

Path Selection Considerations

Selecting a suitable off-road path type is essential in achieving transport network objectives, such as safety, comfort, and attractiveness levels, to encourage path use. As such, the following steps have been developed to ensure path selection is more consistent and has an appreciation of a route's context, strategic vision, and how this effects the desired function and needs of an off-road path.

- Step #1 Determine Strategic Intent
- Step #2 Identify Path Users and their Needs
- Step #3 Determine Path Demand
- Step #4 Identify Desired Path Type
- Step #5 Identify Constraints & Determine Suitability

Aligning these parameters with the off-road path types discussed within *AGRD Part 6A* and this Supplement, will help to ensure the envisaged demand and needs of path users are met, thereby maximising opportunities to encourage uptake in the use of active transport within the community.

Step 1: Determine the strategic intent and classification of a route

It's important to understand the strategic vision for a route in relation to pedestrians and cyclists. Identifying classifications for walking and cycling under the Movement and Place (M&P) framework and consulting with relevant transport agencies is essential to inform this step. Information on Victoria's Strategic Cycling Corridors can be found on DoT's website, as per the website link provided below. Practitioners should also consider connectivity to intersecting paths and the vision for the broader route or corridor, which will typically span beyond the limits of a project.

These considerations will inform the function needed from an off-road path, and the target levels of performance. For instance, while a shared use path (SUP) has the potential to provide a low-stress environment separate from on-road traffic, it can have limitations in terms of catering for moderate-to-high levels of demand, and in its ability to achieve desirable performance for all path users and their needs (discussed further in Section 3.1 of this Supplement).

https://transport.vic.gov.au/getting-around/walking-and-cycling/strategic-cycling-corridors

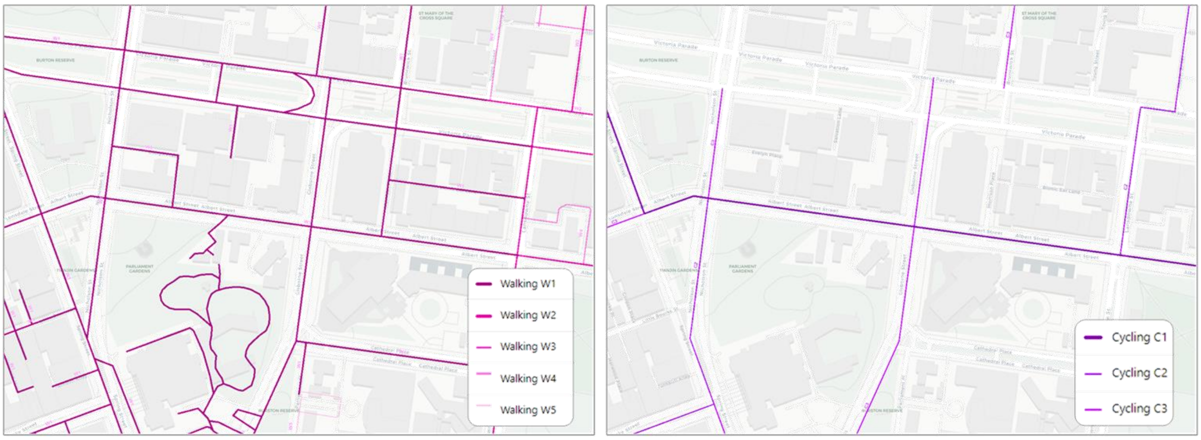


Figure V2.1: Example Walking and Cycling M&P classifications

Step 2: Identify target path users and their corresponding needs

To maximise path uptake, it is ideal for all off-road paths to cater for all ages and abilities. However, it is also important to appreciate that there is an array of path user 'types', each of which will have a unique (sometimes competing) set of needs and tolerances for how a path should perform. Understanding the target path user for a route will help to identify their corresponding needs, and which path type is best suited.

Similar to step 1, the target path user(s) can be informed via walking and cycling classifications under the M&P framework and consultation with relevant transport agencies. Using cyclists as an example, a *Direct Cycling route* (CD) will generally be geared toward catering for the "strong and fearless" cyclist type, who may be willing to tolerate a lower level of 'comfort' (e.g. effective width) if a route is more direct and/or caters for higher operational speeds.

Step 3: Determine path demand

Once the strategic intent and the user needs for a route have been established, an understanding of pedestrian and cycling demand is required to help inform which off-road path type is best suited to cater for identified objectives. Adopting a path type that is unable to cater for demand can lead to poor performance, a reduced uptake in path use, or users adopting less-safe routes.

It is important to consider the 'potential' or future demand for a route (i.e. allowing for path uptake once installed and for future growth) rather than solely relying on existing demand, as this runs the risk of tailoring a solution that will appeal only to path users already converted to active transport, which can be impacted greatly by the deficiencies of existing infrastructure. For instance, a route lacking attractive low-stress facilities will release only a small portion of overall potential demand, meaning existing use data does not incorporate user types likely to utilise a more attractive off-road alternative (e.g. the "interested but concerned" cyclist type).

Future demand can be informed by undertaking pedestrian and cyclist counts, leveraging off existing data through recent or historical jurisdictional counts, Bicycle Network's commuter counts (*Super Tuesday* and *Super Sunday* counts), or utilising VicRoads *Road Use and Performance* online dashboard. Tools such as the *Active Travel Economic Appraisal Tool,* developed by the Department of Transport and Main Roads (TMR), Queensland, can be utilised to readily assist in capturing future growth in path users.

For many paths the nature of use varies over the period of a day or week. In considering the suitability of a path to handle predicted demand, it is recommended that path volumes be assessed in the basis of the highest demand over the period of 2 separate hours of a typical day (weekday or weekend).

In scenarios where the predicted pedestrian and/or cyclist demand is unknown (e.g., greenfield sites where limited data is available, existing poor-quality path), practitioners should consider the long-term strategic vision for a corridor (established in Step 1) and which path type is best placed to achieve this. Further discussion regarding intersections of paths with paths, including consideration of concentrated demand for walking relating to pedestrian hubs, is provided in Section 6.2 of this Supplement.

Step 4: Identify desired path type

It's now necessary to align the strategic intent, path user needs, and predicted demand of a route with a suitable off-road path type. This step should be informed by:

a) Sections 2.4 and 2.5 - Shared and Separated Path Types
These sections detail the shared and bi-directional separated path types unique to the Victorian context based on their purpose, rather than their geographical location. These sections include a range of considerations associated with each path type, including suitability for accommodating predicted path demand.

b) Section 3.1 - Path User Considerations
This section provides guidance on pedestrian and cyclist types, user needs and performance indicators, which integrates common M&P concepts into the selection process. A comparison of the expected performance of common off-road paths against key cycling user needs is provided within this section, all of which will help inform their suitability to a given context.

c) **Section 5.1 - Widths of Paths**

This section details the recommended widths associated with each path type. While the identification of route constraints occurs in the step following this, it's important to note desired widths and clearances associated with path types best suited to meet various user needs and demand. Practitioners should avoid selecting a path type based primarily on available width, and instead focus on a paths ability to achieve the strategic intent of a route and cater for path user needs and predicted demand.

Where a path is intended to cater for both walking and cycling but a path type has not already been identified due to the absence of a relevant transport strategy or a lack of relevant data (e.g. existing pedestrian and cyclist counts, predicted pedestrian and cyclist demand), the path types detailed in Table V2.0 should be used as a suggested minimum bi-directional path type. These path types are considered appropriate to cater for a reasonable level of assumed demand and path user needs corresponding to each M&P cycling classification.

Table V2.0: Suggested minimum bi-directional off-road path types based on M&P cycling classifications

M&P Cycling Classification		Suggested Minimum Off-Road Path Type		
Cycling for Transport	**C1: Primary Routes**	Separated Type 2		
	C2: Main Routes	Separated Type 2		
	C3: Municipal Routes	Separated Type 1	or	SUP Type 2
	C4: Neighbourhood and Local Links	Separated Type 1	or	SUP Type 2
Specialised Cycling Classifications	**CD: Direct Cycling Routes**	Separated Type 2	or	SUP Type 1
	CNP: Non-Priority Routes	Separated Type 1	or	SUP Type 2
	CT: Training Routes	Separated Type 2		
	CR: Recreational Routes	Separated Type 2	or	SUP Type 3

Notes: 1. Definitions and further detail of off-road path types provided in Section 2.4, 2.5 and 3.1 of this Supplement.
2. Where suitable on-road cycling facilities are provided (e.g. those with low levels of traffic stress), the need for off-road facilities capable of catering for cyclists will decrease.

Step 5: Identify constraints and validate path suitability

Lastly, it is important to identify common constraints along a corridor (e.g. property fencing, street furniture, vegetation, power poles) and the associated clearance between each constraint, as this will inform which off-road path solutions are feasible and the ideal alignment.

Assessing the frequency of constraints on sections of a corridor will help determine when a particular path type or alignment is unsuitable, or where localised narrowing may be suitable.

To validate the suitability of the desired path type (identified in step 4), it's necessary to:

1. Compare the *available width* with the *recommended width* associated with the desired path type. Section 5.1 of this supplement details the desirable, minimum, and extended design domain values associated with SUPs and bi-directional separated facilities.

   Additionally, clearances to fixed objects beside the path need to be factored into path design, as detailed in Section 5.5.1 of *AGRD Part 6A*. This plays an important role in allowing for path users' natural shy line from hazards and determining the suitability of the available effective width of a path.

2. Undertake a Level of Traffic Stress (LTS) assessment, using DoTs *Level of Traffic Stress Tool*, to appreciate the how a route currently performs in comparison to a scenario incorporating the desired path and demands.

Where sufficient width is available to accommodate the desired path type and a desired LTS is achieved, a project can progress in the knowledge that there is strong alignment between the strategic intent, path user needs, and predicted demand for the corridor.

Where there is insufficient width, it may be necessary to adopt either:

a) **Localised narrowing** of the path where infrequent narrow points/sections occur, resulting in a temporary reduction in path function (e.g. a shift from SUP Type 2 to SUP Type 1 may be necessary).
b) **A lower order path type** where a corridor has constant insufficient width to accommodate the desired path type or frequent narrow points/sections, resulting in the adoption of low-order path type.
c) **Complementary solutions** to offset the residual demand and/or user performance needs caused by adopting either of the above (discussed further in Section 3.1).

In such scenarios, this has the potential to lead to residual demand and/or user needs, which is discussed further in Section 3.1.

2.4 Shared Path

Additional Information

DoT has divided SUPs into three categories, based on their purpose, rather than their geographical location. In practice, SUPs can provide a range of functions, based on their width and design. As such, it is important to distinguish and select from the below SUP types, so that the associated design criteria can be adopted. Detail on path categories and associated function and performance is provided in Table V2.1.

Commentary on suitable levels of path demand is based upon suggested path widths and accompanying figures found within Section 5.1.3 of *AGRD Part 6A*, sourced originally from *Queensland Department of Transport and Main Roads*. These are simplified values based on a representative split of path usage by pedestrians and cyclists and are considered appropriate in the absence of detailed predicted path demand.

Commentary on consideration of path user needs within the path selection process, along with a comparison of how these path types perform against certain user need performance indicators (Table V3.1), is provided within Section 3 of this Supplement. Further detail on associated path widths in the Victorian context can be found in Section 5.1.4 of this Supplement.

Table V2.1: Shared Path Categories and Characteristics in the Victorian Context

PATH TYPE	PATH CHARACTERISTICS
SUP Type 1: **Light Commuting &/or Local Access**	**Purpose** Lowest order shared path type intended for **light commuting and/or local access**.
	Suitability This path type may be suitable where: i) level of demand for the path is **low** < 50 pedestrians/hour during peak < 50 cyclists/hour during peak ii) a route is intended to primarily perform a **local access** role, with 'tidal' flow conditions, or iii) a route is intended to perform the role of **local access and commuting**, with regular path use in both directions

PATH TYPE	PATH CHARACTERISTICS *(continued)*
SUP Type 1: **Light Commuting &/or Local Access** *(continued)*	**Other Considerations** The use this path type in environments outside of the contexts detailed above are likely to result in a decline in performance, which may compromise path user safety, comfort, and attractiveness. In such scenarios, consideration should be given to: a) Adopting a higher order path type, such as the SUP Type #2, or Providing supporting cycling facilities to cater for any "excess demand" (refer Section 3.1 of this Supplement for further guidance).
SUP Type 2: **Commuting &/or Recreation**	**Purpose** Shared path type intended for **commuting and/or recreation**.
	Suitability This path type may be suitable where: i) there is a **low to moderate** level of demand for the path < 110 pedestrians/hour during peak < 100 – 200 cyclists/hour during peak ii) a route is intended to primarily perform a **commuting** role, with frequent and concurrent use in both directions of travel iii) a route is intended to primarily perform a **recreation** role, with regular use iv) a route is intended to perform the role of **commuting and recreation**, with frequent and concurrent use in both directions
	Other Considerations The use this path type in environments outside of the contexts detailed above are likely to result in a decline in performance, which may compromise path user safety, comfort, and attractiveness. In such scenarios, consideration should be given to: a) Adopting a higher order path type, such as the SUP Type #3 or Separated Facilities Type #1 (preferred), or b) Providing supporting cycling facilities to cater for any "excess demand" (refer Section 3.1 of this supplement for further guidance).
SUP Type 3: **Major Recreation**	**Purpose** Shared path type intended for **major recreation**.
	Suitability This path type may be suitable where: i) there is a **moderate to high** level of demand for the path < 200 pedestrians/hour during peak < 400 cyclists/hour during peak ii) a route is intended to primarily perform a **major recreation** role, with high and concurrent use in both directions of travel
	Other Considerations Major Recreation paths will generally only be recommended where: a) cyclist demand and speeds are predicted to remain low due to presence of more attractive parallel routes, or b) pedestrian demand is likely to exceed the pedestrian path component of separated facilities and there are concerns that path non-compliance (i.e. pedestrians regularly utilising the bicycle path) will be a common risk occurrence. As discussed in Section 3.1 of this Supplement, separated facilities are recommended where widths of 4.0 m or greater are available, given their ability to achieve higher levels of comfort for both pedestrians and cyclists, capacity to cater for higher levels of demand, and ability to accommodate higher cyclist speeds.

2.5 Separated Path

Additional Information

DoT has elected to distinguish bi-directional separated (or segregated) path types into three categories. Detail on path categories and their associated function and performance is provided in Table 2.2.

Commentary on suitable levels of path demand is based upon suggested path widths and accompanying figures found within Section 5.1.3 of *AGRD Part 6A*, sourced originally from *Queensland Department of Transport and Main Roads*. These are simplified values based on a representative split of path usage by pedestrians and cyclists and are considered appropriate in the absence of detailed predicted path demand.

Commentary on consideration of path user needs within the path selection process, along with a comparison of how these path types perform against certain user need performance indicators (Table V3.2), is provided within Section 3 of this Supplement. Further detail on associated path widths in the Victorian context, including consideration of separator widths, can be found in Section 5.1.5 of this Supplement.

Table V2.2: Bi-Directional Separated (or Segregated) Path Categories and Characteristics in the Victorian Context

PATH TYPE	PATH CHARACTERISTICS
Separated Path Type 1: **Commuting &/or Local Access**	**Purpose** Separated path type intended for **commuting and/or local access**.
	Suitability This path type may be suitable where: i) there is a **moderate to high** level of demand for the path < 200 pedestrians/hour during peak < 400 – 600 cyclists/hour during peak ii) there is adequate width and a desire to provide separate facilities for pedestrians and cyclists iii) a route is intended to primarily perform a **local access** role, with 'tidal' flow conditions, or iv) a route is intended to perform the role of **local access and commuting**, with regular path use in both directions
	Other Considerations The use this path type in environments outside of the contexts detailed above are likely to result in a decline in performance, which may compromise path user safety, comfort, and attractiveness. In such scenarios, consideration should be given to: a) Adopting a higher order path type, such as the Separated Facilities Type #2, or b) Providing supporting cycling facilities to cater for any "excess demand" (refer Section 3.1 of this supplement for further guidance).
Separated Path Type 2: **Commuting &/or Recreation**	**Purpose** Segregated path type intended for **commuting and/or recreation**.
	Suitability This path type may be suitable where: i) there is a **high** level of demand for the path < 200 – 800 pedestrians/hour during peak < 600 – 1,100 cyclists/hour during peak ii) there is adequate width and a desire to provide separate facilities for pedestrians and cyclists iii) a route is intended to primarily perform a **commuting** role, with frequent and concurrent use in both directions of travel, or

<table>
<tr><th>PATH TYPE</th><th>PATH CHARACTERISTICS (continued)</th></tr>
<tr><td rowspan="2">Separated Path Type 2:
Commuting &/or Recreation
(continued)</td><td>iv) a route is intended to primarily perform a recreation role, with regular use
v) a route is intended to perform the role of commuting <u>and</u> recreation, with frequent and concurrent use in both directions</td></tr>
<tr><td><u>Other Considerations</u>
The use this path type in environments outside of the contexts detailed above are likely to result in a decline in performance, which may compromise path user safety, comfort, and attractiveness. In such scenarios, consideration should be given to:
a) Adopting a higher order path type, such as the Separated Facilities Type #3, or
Providing supporting cycling facilities to cater for any "excess demand" (refer Section 3.1 of this supplement for further guidance).</td></tr>
<tr><td rowspan="3">Separated Path Type 3:

Commuting
&
Major Recreation</td><td><u>Purpose</u>
Segregated path type intended for <u>commuting and major recreation</u>.</td></tr>
<tr><td><u>Suitability</u>
This path type may be suitable where:
i) there is a very high level of demand for the path
> 800 pedestrians/hour during peak
> 1,100 cyclists/hour during peak
ii) there is adequate width and a desire to provide separate facilities for pedestrians and cyclists
iii) a route is intended to primarily perform a significant commuting <u>and</u> major recreation role, with very high volumes of frequent and concurrent use in both directions of travel</td></tr>
<tr><td><u>Other Considerations</u>
Widths associated with this highest order separated path result in the best possible alignment against key user needs and performance indicators, as discussed in Section 3.1 of this Supplement.</td></tr>
</table>

3 Path User Considerations

3.1 General

Additional Information

Consideration of User Needs within the Path Selection Process

When selecting a path type, it is essential that the key needs of pedestrians and cyclists are taken into consideration in an integrated manner. This will help to ensure infrastructure caters for the target path user demographics and provide the greatest opportunity for uptake in path use.

As an example, poor alignment with certain cyclist needs has the potential to act as a barrier to attracting the “interested but concerned” demographic, the largest of the cyclist types (as illustrated in Figure V3.0). Similarly, the needs of pedestrians that require special consideration, such as children, aged pedestrians, and pedestrians with disabilities (e.g. using wheelchairs or vision impaired) need to be factored into this selection process.

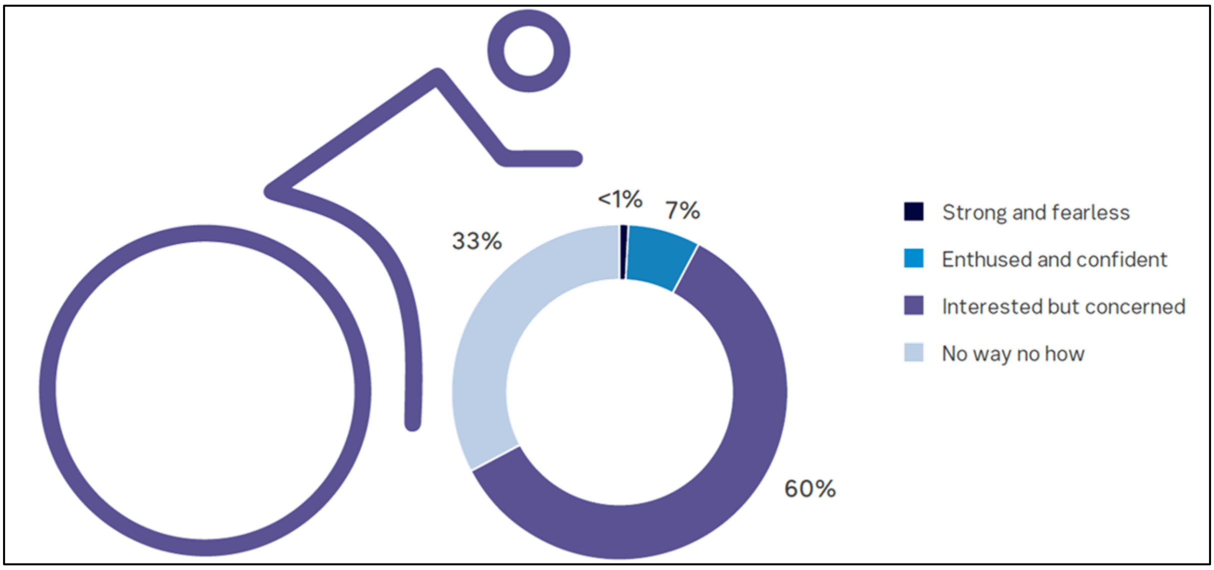


Figure V3.0: Peoples propensity to cycle, as noted in the Victorian Cycling Strategy 2018-2028
(source: Roger Geller, Four cyclist types, Richmond)

Austroads *Guide to Traffic Management (AGTM) Part 4: Network Management Strategies* discusses features considered important to forming a good bicycle and pedestrian network. DoT has subsequently developed guidance under the M&P framework which adopts many of these features as “user needs”, along with a range of performance “indicators” to measure against, as detailed in Table V3.0. The ***safety***, ***comfort***, and ***other*** indicators highlighted are directly influenced by both the nature of the path type and the associated path width.

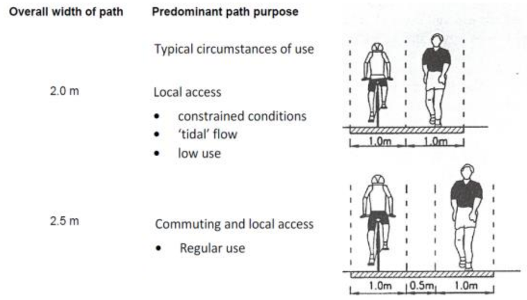
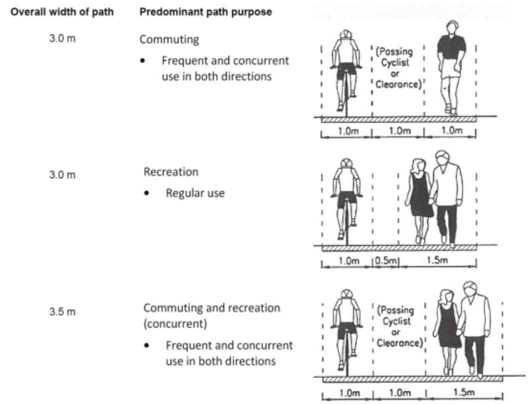
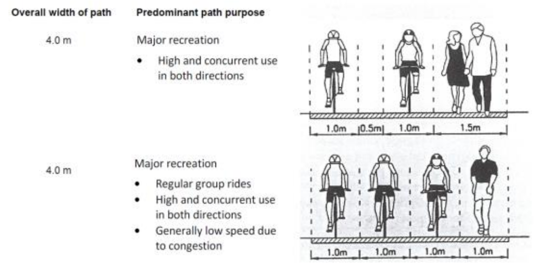
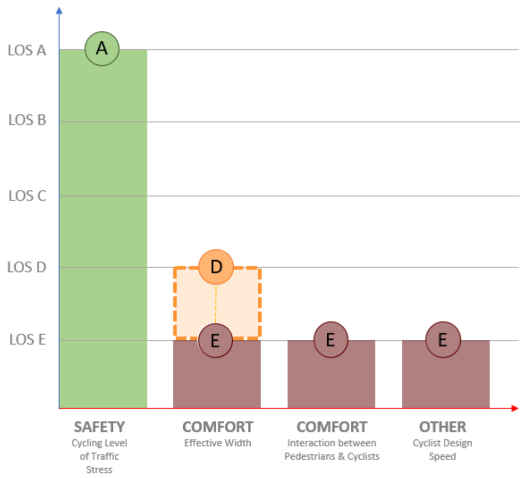
Table V3.0: Movement and Place Cycling User Needs and Performance Indicators

	User Need	Indicator	Description
CYCLING RELATED	SAFETY	Level of traffic stress (cycling)	Assessment of interaction with high speed or high volumes of traffic as well as kerbside activity and parking.
		Lighting provision & passive surveillance	Assessment of level of lighting and level of activity in vicinity of cycle route.
		Sight lines	Consider obstructions to lines of sight and whether enclosed spaces are avoided.
	COMFORT	Effective width for cycling	Assesses useable width of cycle facilities.
		Interaction with pedestrians & other non-motorised modes	Considers whether suitable separation is provided, and potential conflicts are well managed.
		Requirement to stop	Considers frequency of stops required along the route.
	COHERENCE	Connectivity to low stress cycling links	Assessment of connectivity to other C1-C4 routes.
		Wayfinding	Considers provision of signage and other wayfinding features to enable route planning.
	DIRECTNESS	Delay at intersections	Reviews the time delay at intersections for cyclists.
	ATTRACTIVENESS	Traffic nuisance	Considers exposure to noise and air related traffic.
		Wind protection	Reviews level of mitigation provided in areas of exposure to high wind.
	OTHER*	Design speed*	The maximum speed a path user should be able to travel at a mid-block location.
PEDESTRIAN RELATED	SAFETY	Interaction with motorised traffic	An indicator of safety through an assessment of posted speed limits and general traffic/freight classifications.
		Interaction with non-motorised modes	Considers whether suitable separation is provided, and potential conflicts are well managed.
		Footpath congestion	Considers the level of congestion of pedestrian routes.
		Lighting provision and feeling of safety	Levels of lighting (among other factors) are used as a means of assessing the feeling of safety for pedestrians.
		Sight lines	Sight lines (among other factors) are used as a means of assessing the feeling of safety for pedestrians.
	EFFECIENCY	Crossing opportunity	An indicator of safety and efficiency linked with the distance between safe road crossing points.
		Crossing Delay	An indicator of efficiency through an assessment of the average delay at crossing points
		Wayfinding	A key indicator to ensure users can easily navigate the network, finding their way intuitively across the transport network.

**The 'other' user need relating to design speed is not listed as one of the five M&P Cycling User Needs and Performance Indicators. However, it is recognised as a key design element in the context of this Supplement and is an important factor to attract certain cyclist "types". Further detail on corresponding Levels of Service (LoS) categories and definitions for both walking and cycling is provided in Appendix VA.*

To help planners and designers understand how off-road path types perform in relation to the user need indicators highlighted in the above table, Tables V3.1 and V3.2 have been developed. It should be noted that DoT has decided to distinguish shared and separated path types into the categories discussed in Sections 2.4 and 2.5. Further detail on path categories and associated widths in the Victorian context can be found in Section 5.1.4 and 5.1.5 of this Supplement.

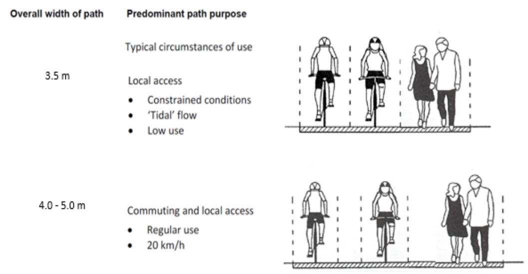
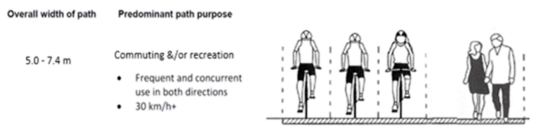
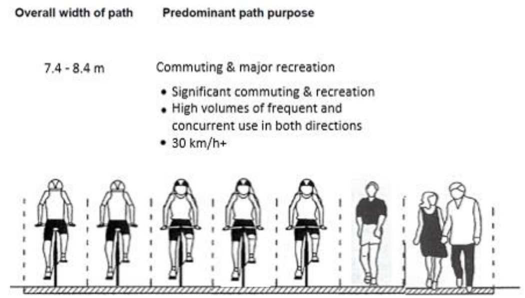
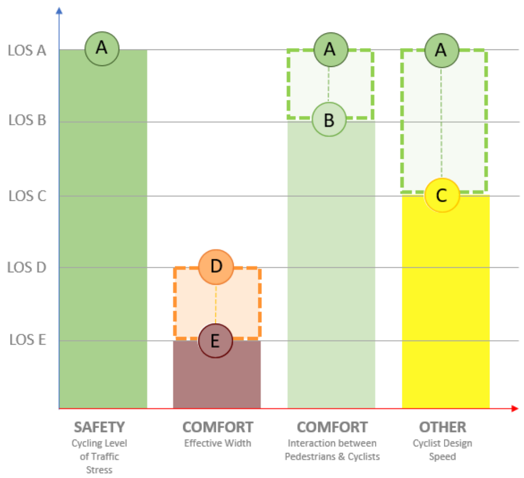
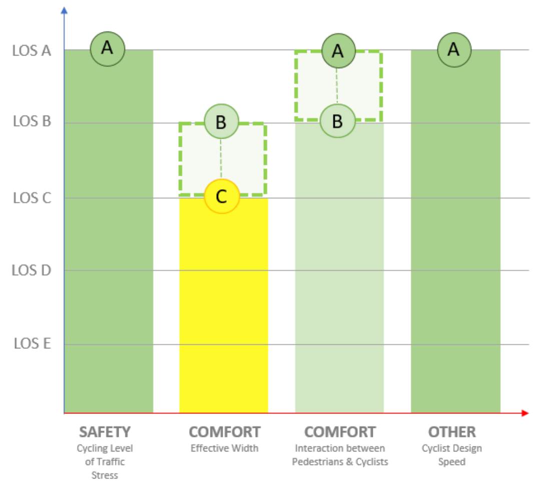
Table V3.1: Comparison of shared path type performance against select M&P cycling user need performance indicators

	SHARED USE PATH (SUP) TYPE		
	Type 1: Light Commuting &/or Local Access	**Type 2: Commuting &/or Recreation**	**Type 3: Major Recreation**
CROSS SECTION			
PERFORMANCE AGAINST KEY USER NEEDS			

	SHARED USE PATH (SUP) TYPE *(continued)*		
	Type 1: Light Commuting &/or Local Access	**Type 2: Commuting &/or Recreation**	**Type 3: Major Recreation**
	SAFETY		
	Cycling Level of Traffic Stress Provision of off-road facilities results in the lowest LoTS possible (1), and a corresponding **LoS A**.	***Cycling Level of Traffic Stress*** Provision of off-road facilities results in the lowest LoTS possible (1), and a corresponding **LoS A**.	***Cycling Level of Traffic Stress*** Provision of off-road facilities results in the lowest LoTS possible (1), and a corresponding **LoS A**.
	COMFORT		
	Effective Width The SUP effective width (one-way) range is 1.0-1.5 m, resulting in a **LoS E** to **D**. This is below the targets set within the M&P framework for C1 to C4 routes.	***Effective Width*** The SUP effective width (one-way) range is 1.5-2.0 m, resulting in a **LoS D**. This is below the targets set within the M&P framework for C1 to C4 routes.	***Effective Width*** The SUP effective width (one-way) will typically range in the order of 2.0-2.5 m, resulting in a **LoS C**. This LoS can be increased by adopting greater widths. This is below the targets set within the M&P framework for C1 to C2 routes, as well as lower order cycling routes with high 'place' function.
COMMENTARY ON PATH USER NEEDS	***Interaction between Pedestrians & Cyclists*** Cycling & walking share space in an environment < 3.0 m in width, resulting in a **LoS E**. This is below the targets set within the M&P framework for C1 and C2 routes, as well as lower order cycling routes with high 'place' function.	***Interaction between Pedestrians & Cyclists*** Cycling & walking share space in an environment ≥ 3.0 m in width, resulting in a **LoS C**. This is below the targets set within the M&P framework for C1 and C2 routes, as well as lower order cycling routes with high 'place' function.	***Interaction between Pedestrians & Cyclists*** Cycling & walking share space in an environment ≥ 3.0 m in width, resulting in a **LoS C**. This is below the targets set within the M&P framework for C1 and C2 routes, as well as lower order cycling routes with high 'place' function.
	OTHER		
	Cyclist Design / Operational Speed Given the shared nature of this path type, operational speeds of ≤ 20 km/h should be maintained (**LoS E**). The narrow width associated with this path type may increase the likelihood of cyclists being disadvantaged as a result of having to excessively reduce speed when encountering and passing slower path users.	***Cyclist Design / Operational Speed*** Given the shared nature of this path type, operational speeds of ≤ 20 km/h should be maintained (**LoS E**). Additional width will result in greater clearance between opposing path users, thereby reducing the likelihood of cyclists being disadvantaged as a result of having to excessively reduce speed when encountering and passing slower path users.	***Cyclist Design / Operational Speed*** Given the shared nature of this path type, operational speeds of ≤ 20 km/h should be maintained (**LoS E**). Additional width will result in greater clearance between opposing path users, thereby reducing the likelihood of cyclists being disadvantaged as a result of having to excessively reduce speed when encountering and passing slower path users.

	SHARED USE PATH (SUP) TYPE *(continued)*		
	Type 1: Light Commuting &/or Local Access	**Type 2: Commuting &/or Recreation**	**Type 3: Major Recreation**
CONSIDERATION OF CYCLIST TYPES	INTERESTED BUT CONCERNED		
	The low-stress nature of this path is likely to attract the *interested but concerned* demographic. Limitations in comfort factors has the potential to curtail uptake.	The low-stress nature of this path is likely to attract the *interested but concerned* demographic.	The low-stress nature of this path is likely to attract the *interested but concerned* demographic.
	ENTHUSED AND CONFIDENT		
	The low-stress nature of this path is likely to attract a portion of the *enthused & confident* demographic. Limitations in comfort factors and the low-speed nature will likely limit path use by this group.	The low-stress nature of this path is likely to attract a majority of the *enthused & confident* demographic. Limitations in comfort factors and the low-to-moderate speed nature may limit path use by a portion of this group.	The low-stress nature of this path and increased effective width is likely to attract the *enthused & confident* demographic.
	STRONG AND FEARLESS		
	Limitations in comfort factors, coupled with the low-speed nature of this path type is unlikely to tailor to the key needs of this group.	Limitations in comfort factors, coupled with the low-speed nature of this path type is unlikely to tailor to the key needs of this group. May be appealing to a portion of this group during periods with low path activity.	Increased effective width is likely to attract a majority of this group during times with relatively low path activity. Limitations in comfort factors, coupled with the low-speed nature of this path type may limit path use by a portion of this group.

Table V3.2: Comparison of bi-directional separated path type performance against select M&P cycling user need performance indicators

	BI-DIRECTIONAL SEPARATED PATH TYPE		
	Type 1: Commuting &/or Local Access	**Type 2: Commuting &/or Recreation**	**Type 3: Commuting & Major Recreation**
CROSS SECTION			
PERFORMANCE AGAINST KEY USER NEEDS			

	BI-DIRECTIONAL SEPARATED PATH TYPE *(continued)*		
	Type 1: Commuting &/or Local Access	**Type 2: Commuting &/or Recreation**	**Type 3: Commuting & Major Recreation**
	SAFETY		
	Cycling Level of Traffic Stress Provision of off-road facilities results in the lowest LoTS possible (1), and a corresponding **LoS A**.	***Cycling Level of Traffic Stress*** Provision of off-road facilities results in the lowest LoTS possible (1), and a corresponding **LoS A**.	***Cycling Level of Traffic Stress*** Provision of off-road facilities results in the lowest LoTS possible (1), and a corresponding **LoS A**.
	COMFORT		
	Effective Width The effective width (one-way) range for cyclists is 1.0-1.5 m, resulting in a **LoS D** to **E**. This is below the targets set within the M&P framework for C1 to C4 routes.	***Effective Width*** The effective width (one-way) range is 1.5-2.5 m, resulting in a **LoS C** to **D**.	***Effective Width*** The effective width (one-way) range is 2.5-3.0 m, resulting in a **LoS B** to **C**, noting that a LoS A for effective width is classified as > 3.0 m.
COMMENTARY ON PATH USER NEEDS	***Interaction between Pedestrians & Cyclists*** Cycling & walking are separated. Provided conflict points are well managed (signalised or designated uncontrolled crossing points), this corresponds to a **LoS A to B**.	***Interaction between Pedestrians & Cyclists*** Cycling & walking are separated. Provided conflict points are well managed (signalised or designated uncontrolled crossing points), this corresponds to a **LoS A to B**.	***Interaction between Pedestrians & Cyclists*** Cycling & walking are separated. Provided conflict points are well managed (signalised or designated uncontrolled crossing points), this corresponds to a **LoS A to B**.
	OTHER		
	Cyclist Design / Operational Speed Provision of separated facilities for cyclists and pedestrians will allow for moderate to high operating speeds (in the order of 20 - 40 km/h). However, the modest effective width will result in limited clearance to opposing flow, which will increase the likelihood of cyclists being disadvantaged through having to excessively reduce speed when encountering slower cyclists, thus resulting in a **LoS A to C**.	***Cyclist Design / Operational Speed*** Provision of separated facilities for cyclists and pedestrians will allow for moderate to high operating speeds (in the order of 20 - 40 km/h). Provision of sufficient width to allow for internal overtaking will decrease the likelihood of cyclists being disadvantaged through having to excessively reduce speed when encountering slower cyclists, thus resulting in a **LoS A**.	***Cyclist Design / Operational Speed*** Provision of separated facilities for cyclists and pedestrians will allow for moderate to high operating speeds (in the order of 20 - 40 km/h). Provision of sufficient width to allow for internal overtaking will decrease the likelihood of cyclists being disadvantaged through having to excessively reduce speed when encountering slower cyclists, thus resulting in a **LoS A**.

	BI-DIRECTIONAL SEPARATED PATH TYPE *(continued)*		
	Type 1: Commuting &/or Local Access	**Type 2: Commuting &/or Recreation**	**Type 3: Commuting & Major Recreation**
CONSIDERATION OF CYCLIST TYPES	INTERESTED BUT CONCERNED		
	✓ The low-stress nature of this path and provision of devoted cyclist space is likely to attract the *interested but concerned* demographic.	✓ The low-stress nature of this path and provision of devoted cyclist space is likely to attract the *interested but concerned* demographic.	✓ The low-stress nature of this path and provision of devoted cyclist space is likely to attract the *interested but concerned* demographic.
	ENTHUSED AND CONFIDENT		
	✓ The low-stress nature of this path, provision of devoted cyclist space, and moderate-to-high speed nature of this path is likely to attract the *enthused & confident* demographic.	✓ The low-stress nature of this path, provision of devoted cyclist space, and high-speed nature of this path is likely to attract the *enthused & confident* demographic.	✓ The low-stress nature of this path, provision of devoted cyclist space, and high-speed nature of this path is likely to attract the *enthused & confident* demographic.
	STRONG AND FEARLESS		
	✓/✗ Provision of devoted cyclist space and the moderate-to-high speed nature of this path is likely to attract a majority of this group, particularly during times with relatively low path activity. Limitations in comfort factors may limit path use by a portion of this group.	✓ Provision of additional width, devoted cyclist space and the high-speed nature of this path is likely to attract the *strong & fearless demographic.*	✓ Provision of additional width, devoted cyclist space and the high-speed nature of this path is likely to attract the *strong & fearless demographic.*

As Table V3.1 illustrates, the various shared and separated path types will perform differently when assessed against path user needs, with levels of safety, comfort, and overall attractiveness varying between each. When selecting an appropriate path type, practitioners should note the performance limitations mentioned within the table commentary, and how this aligns to the long-term strategic vision for the corridor.

In addition to the pedestrian and cyclist considerations discussed above and throughout Section 3 of *AGRD Part 6A*, practitioners should also refer to:

- *Australian Standard (AS) 1428.1 – Design for Access and Mobility – General Requirements for Access*
- *Austroads Guide to Traffic Management (AGTM) Part 4: Network Management Strategies*
  Section 4.6: Bicycle Networks
  Section 4.7: Pedestrian Networks
- *AGTM Part 7: Activity Centre Transport Management* (Austroads 20XXc)
  Appendix G: Design Considerations for Pedestrians with Special Needs
- *Disability Standards for Accessible Public Transport (2002)*

Considerations for Modal Separation/Segregation

As noted in Section 2.4 (Shared Path) of *AGRD Part 6A*, shared paths are considered appropriate where demand exists for both a pedestrian path and a bicycle path but where there is a low to moderate number of pedestrians or cyclists, and the use is not expected to be sufficiently great enough to provide separate (or segregated) facilities. Understanding path demand is therefore paramount to determining the suitability of a shared path type and how this will cater for path user needs (reference footnote of Section 5.1.4).

The ability to provide separated facilities, however, is often limited by the width available within the road corridor. Not only do desirable path widths need to be achieved, but associated clearances to hazards, right of way and back of kerb need to be catered for to provide functional and safe facilities (refer Section 5.5.1 of this Supplement for further information). In some instances, such constraints result in a form of shared path being the only viable option for off-road bicycle facilities.

Nonetheless, given separated facilities achieve a higher level of comfort for both pedestrians and cyclists, have capacity to cater for higher levels of demand, and ability to accommodate higher cyclist speeds, separation is always recommended where sufficient path width is available, provided pedestrian demand can be adequately catered for. To assist planners and designers in understanding typical width ranges for off-road path types, as well as a simplistic look at how each path type is likely to cater for certain cyclist “types”, Figure V3.2 has been developed. Further detail on path widths in the Victorian context, including consideration of separator widths, can be found in Section 5.1.4 and 5.1.5 of this Supplement.

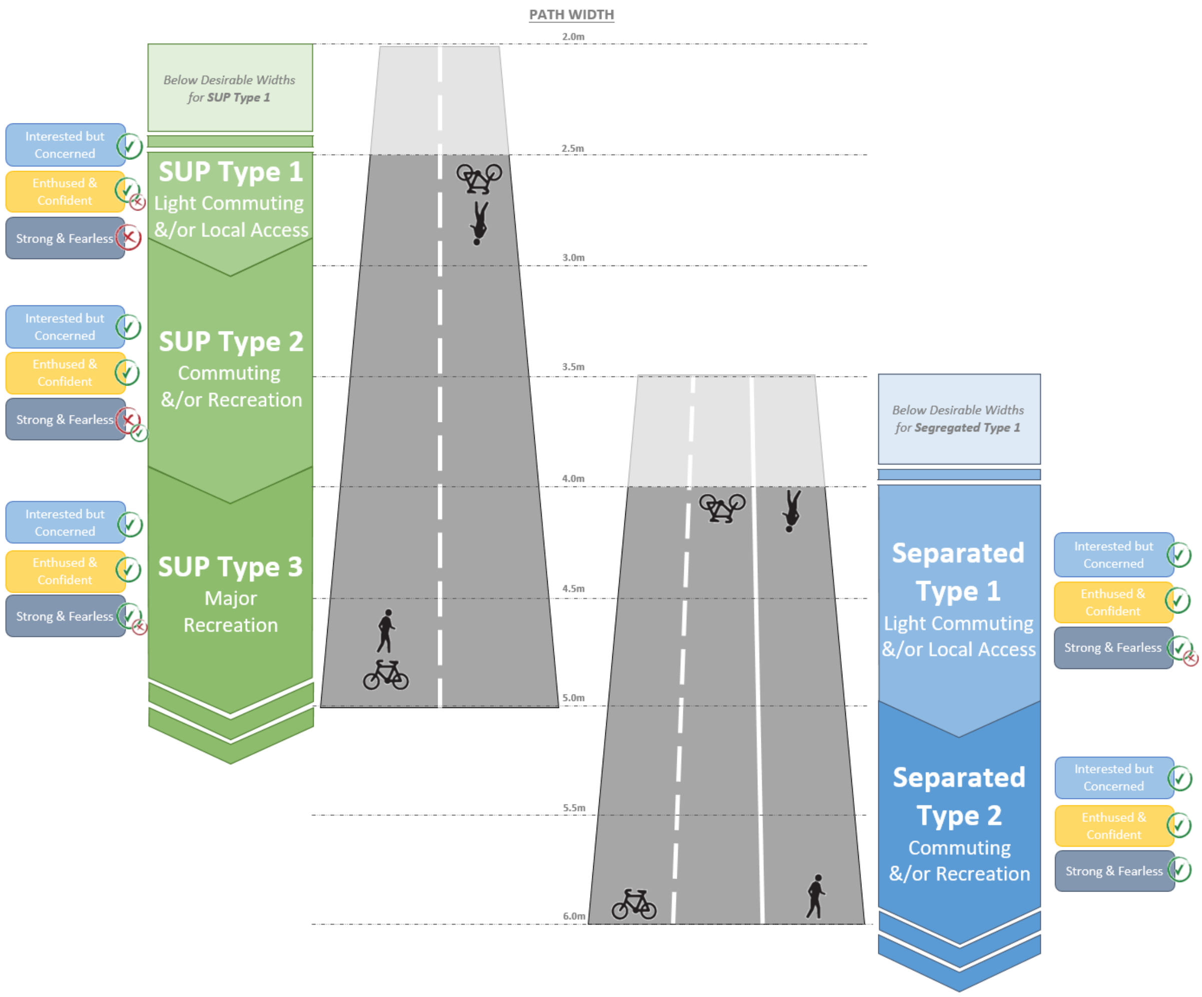


Figure V3.1: Typical width ranges for SUP and Bi-Direction Separated Path Types and their ability to cater to needs of common cyclist "types"

In scenarios where the predicted pedestrian and/or cyclist demand is unknown (e.g., greenfield sites where limited data is available), practitioners should consider the long-term strategic vision for a corridor when deciding which path type is best placed to achieve this.

Considerations for Complementary Solutions

In certain scenarios, it is unlikely to have adequate space within a road corridor to provide the desired path type to cater for all users.

For example, a route with a moderate pedestrian and cyclist demand may warrant a separated facility (Type 1: Light Commuting &/or Local Access) or a mid-order SUP (Type 2: Commuting &/or Recreation) to provide sufficient capacity and attract as many path users as possible. This would result in a strong alignment between predicted path demand and optimal path capacity, allowing room for growth in those choosing to adopt active transport.

However, if there is insufficient width available to provide these solutions, a lower order SUP may be the only practical off-road path option that can be achieved.

This can result in a misalignment between the predicted path demand and the optimal capacity of the feasible path type, as illustrated in Figure V3.3. When this occurs, it can lead to:

- Poor performance in safety, comfort, and attractiveness (refer Table V3.1 and V3.2)
- A reduced uptake in people adopting active transport

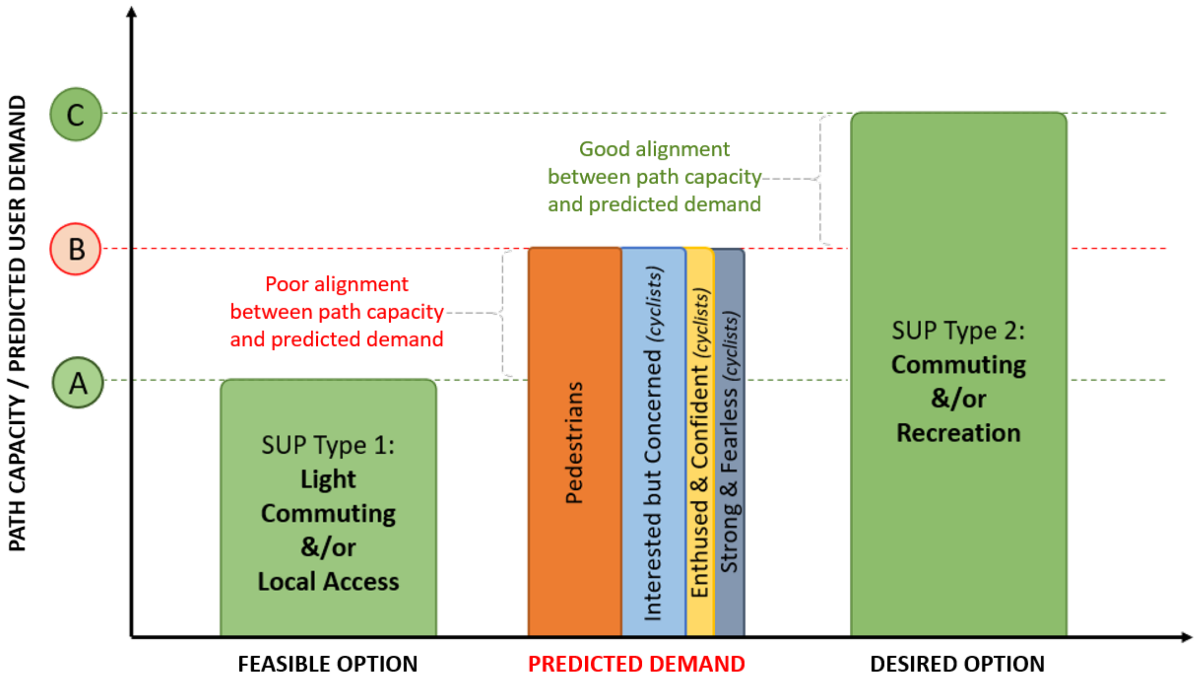


Figure V3.2: Alignment between path capacity vs. predicted path demand

To mitigate this misalignment, complementary solutions can be provided to offset the residual demand and/or user performance needs. To determine which complimentary solutions will be best placed to achieve this, the following steps should be followed:

Step 1: Understand residual demand

What is the gap between the capacity of the feasible option and the predicted demand for a route ('A' and 'B' in Figure V3.3)?

Practitioners should compare predicted pedestrian and cyclist volumes against optimal capacity outlined in Section 2.4 and 2.5 of this Supplement. It is acknowledged that while "optimal capacity" may not be an exact science, these figures represent an indicative point of decline in path performance due to inertia and/or discomfort caused by path congestion.

Expanding on the earlier example, where the only practical off-road solution is a Type 1 SUP; let's assume a predicted demand of 100 pedestrians and 100 cyclists per peak hour. The designer can then equate this to the optimal capacity for each shared path outlined in Section 2.4, as illustrated in Figure V3.4. This suggests a residual demand of 100 users associated with the use of a Type 1 SUP.

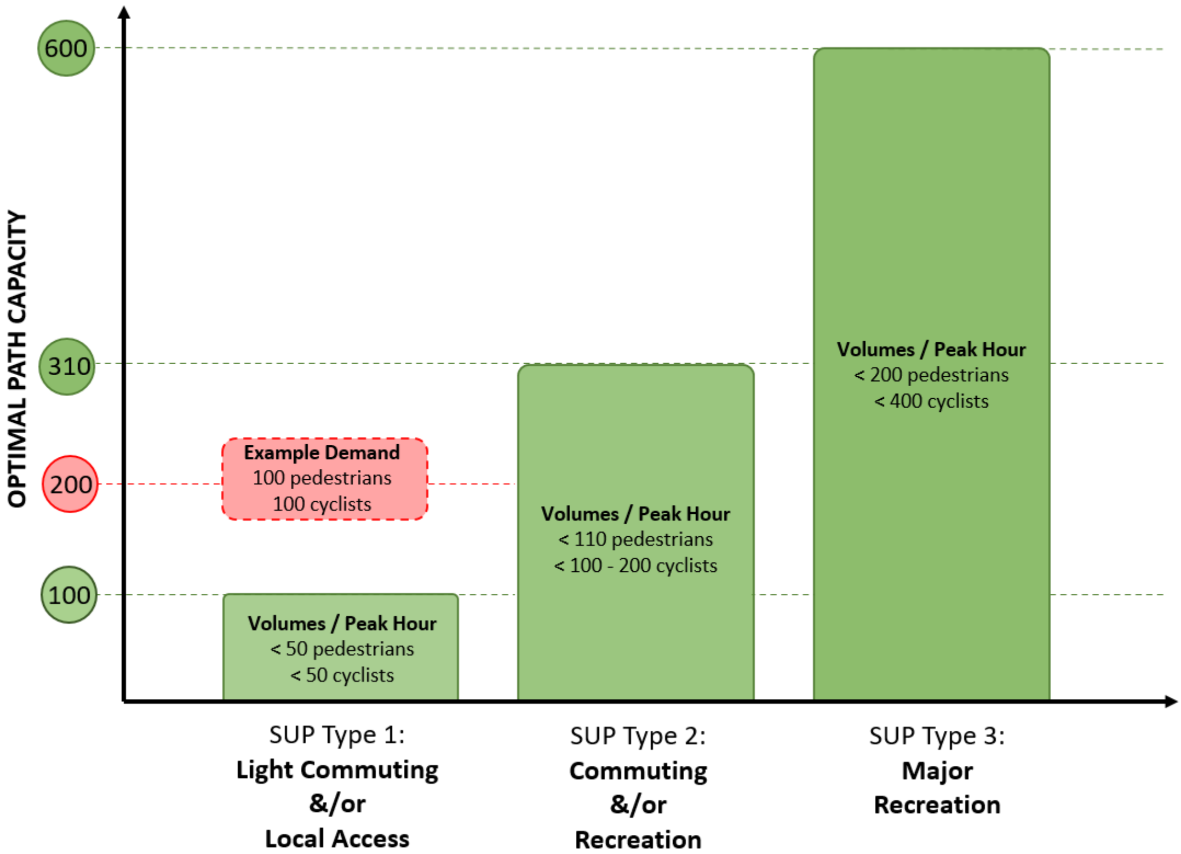


Figure V3.3: Shared path optimal capacity thresholds

Step 2: Understand residual user needs

How does the feasible/proposed solution align to the user needs of those likely to use this route?

As discussed in Section 2.1, there is a range of path user "types", each with a unique set of user needs and tolerances relating to how a path performs. Practitioners should compare the performance likely to be achieved, with the path user needs.

A path with greater demand than available capacity will result in path congestion, which can in turn impact the user needs of pedestrians with special needs. For instance, while a narrow width may still comply with AS1742 requirements, the impact upon the comfort of a pedestrian using a wheelchair or mobility scooter may be more greatly impacted due to their need for greater space to appropriately manoeuvre around a fellow path user or obstacle. Consideration should be given to how a complementary solution can minimise any negative impact to pedestrians with special needs.

When considering cyclists, the more confident cyclist types are typically going to find lower order off-road paths less attractive than other cyclist types due to their lower tolerance to certain comfort factors (e.g. interaction with pedestrians or pedestrians walking dogs). For this reason, confident cyclists will generally need to be the focus of any complementary solutions.

Step 3: Understand the performance gap

How does the feasible/proposed solution align with the cycling and walking performance indicators set under the M&P framework?

As discussed earlier in this section, the M&P walking and cycling *Guidance Notes* establish targets for various performance indicators based on walking and cycling route classifications (detailed further in Appendix K). Where these target minimums cannot be met with a single feasible off-road path type, due to a lack of available width for example, this will result in a performance gap (i.e. the level of service achieved is below the performance target set within the guidance note). This essentially means the selected path type will have a performance ceiling below what is desired under the framework.

The performance gap for the Safety, Comfort and Other user needs outlined in Table V3.0 should be documented to inform Step 4.

Step 4: Mitigate the residual risk with complementary solutions

Now that the residual demand, residual user needs, and performance gaps have been identified, it is possible to determine which complementary solution can best align a route with is strategic intent.

The potential benefits a supporting solution can provide will be influenced by various factors outlined in steps 1 to 3, meaning it's difficult to provide definitive rules for which supporting option(s) are "best fit" for a particular scenario. Instead, practitioners should consider common on-road solutions, listed below, ranging from the highest to lowest alignment with M&P walking and cycling objectives.

Table V3.3: Complementary off-road solutions (i.e.

Alignment with M&P Objectives	Off-Road Facility Type
Highest	Separated Type 3
	Separated Type 2
	Separated Type 1
	SUP Type 3
	SUP Type 2
Lowest	SUP Type 1

Note: Practitioners should consider the potential demand an off-road path can cater for (discussed in Section 2.4 and 2.5 of this Supplement) when determining its ability to accommodate residual demand identified in step 1.

Table V3.4: Complementary on-road solutions

Alignment with M&P Objectives	On-Road Facility Type
Highest	Protected bicycle lanes
	Shared streets
	Bicycle lanes with light separation
	Bicycle lanes with painted buffers
	Bicycle lanes
	Road shoulders
Lowest	Wide kerbside lane

DoT recognises that supporting solutions are not always practical and may not provide a quantifiable benefit in all situations. The concepts discussed and steps outlined within this section will serve to better inform potential operational gaps in scenarios where a desired path for a route is not achievable.

3.2 Operating Space

3.2.1 Pedestrians

Additional Information

Walking Speed (from GTEP Part 13, Section 1.2.2)

Walking speeds vary over a wide range, generally determined by crowd density and other traffic impediments. The distribution of free-flowing walking speeds varies as follows:

Minimum walking speed	0.74 m/s
Maximum walking speed	2.39 m/s
Average unimpeded free-flowing walking speed	1.35 m/s

The deviation from the mean has been shown to correlate not only with physical characteristics such as gender, age and physical condition, but also with additional external factors such as time of day, weather conditions and trip purpose. Over the lengths encountered by normal pedestrian movements, grades of up to 5% generally do not affect speeds.

Calculation of the duration of the green walk phase at traffic signals which is generally based on an ‘average’ pedestrian walking speed of 1.2 m/s, does not always ensure a safe and comfortable crossing for all pedestrians. For example, a study of the walking speeds of seniors in Western Australia (Main Roads, 1990) reported that 25% of the senior population would not be able to walk at this pace, even in a hurry. At busy intersections where crowding would reduce crossing speeds, or where elderly or physically impaired persons cross, the design walking speed should be reduced to 1.0 m/s.

Pedestrian Capacity (adapted from GTEP Part 13, Section 1.6)

The pedestrian transportation network consists of a number of elements including:

- Footways
- Elevated walkways/subways
- Stairs
- Ramps
- Escalators
- Travelators

For each of these elements, capacities may be defined to aid the analysis of operations and the selection of an appropriate pedestrian network and facilities to suit demand. In considering network capacity or the capacity of individual facilities, the concept of Level of Service becomes important and provides a useful model which can be applied to the design of pedestrian spaces, such as footpaths, stairs, entrances and queuing areas.

Fruin (1971) developed the classical theoretical work in the area of pedestrian traffic flow, modelling pedestrian flow from traffic flow relationships. Pedestrian service standards are based on the freedom to select normal travel speed, the ability to bypass slow moving pedestrians, and the relative ease of cross and reverse flow movements at various pedestrian traffic concentrations.

The following levels of services have been defined based on service volumes and qualitative evaluation of user convenience.

Six levels of service based on service volumes and qualitative evaluation of user convenience have been defined. These are depicted and described within Table 3.5.

Table V3.5: Walkway Levels of Service (LoS)
(based on GTEP Part 13, Figure 1.5 and M&P Walking Guidance Note v1)

GTEP LoS Descriptions	GTEP Illustration of Walkway LoS	M&P 'Footpath Congestion' LoS Descriptions*
LoS A Provides space for a free flow condition, which allows the bypass of slower pedestrians and avoids crossing conflicts with others.		**LoS A** Unrestricted speed and minimal manoeuvring < 7 ped/min/m (width)
LoS B Provides space which permits the selection of normal walking speeds and the bypass of other pedestrians in primarily one-directional flows. For a situation of bi-directional or crossing flows, minor conflict will occur, resulting in slightly lower mead pedestrian speeds and potential volumes.		**LoS B** Occasional need to adjust path to avoid conflicts 7 – 23 ped/min/m
LoS C Is a condition restrictive in the freedom to select individual walking speeds and to freely pass other pedestrians. With reverse and crossing flows, frequent adjustment of speed and direction would be required.		**LoS C** Walking speed and ability to pass slower pedestrians restricted 23 – 33 ped/min/m
LoS D Walkway conditions would have the majority of pedestrians with restricted and reduced normal walking speeds, due to the difficulties experienced in bypassing others and therefore avoiding conflicts. Reverse and crossing flows would be severely restricted due to frequent conflicts with others.		**LoS D** Walking speed restricted and reduced, with very limited ability to pass slower pedestrians 33 – 49 ped/min/m
LoS E Approaches the maximum attainable flow volume (capacity) of the walkway. Frequent stoppages and interruptions to the flow would be experienced by virtually all persons, due to insufficient area available to bypass others. Reverse and cross flow movements would be extremely difficult.		**LoS E** Walking speeds severely restricted, with unavoidable conflicts and frequent stoppages > 49 ped/min/m
LoS F Conditions would result in frequent, unavoidable contact with other pedestrians, and reverse and crossing movements would be virtually impossible. Walking speeds are extremely restricted with forward progress reduced to a shuffle.		Not defined

**Refer appendix VA for further detail on M&P walking indicator categories and corresponding LoS definitions.*

As one measure of the level of service, Fruin uses a variable of pedestrian module size, which relate to an individual's buffer zone. This is consistent with buffer zones around an individual, which is maintained in particular social contexts and situations, and where violation of this buffer results in a lowering of the level of service. Given the pedestrian area module, M (m2/ped), an expression of flow rate is derived, similar to the form of the traffic flow equation.

i.e. $P = S/M$

where:

P is the flow rate in pedestrians per metre width per minute (ped/m/min)

S is the mean horizontal space speed (m/min).

The six levels of service of pedestrian flow were derived and the results are summarised in Table V3.6. These show that as crowding increase, walking speed falls, while flow rate increases up to a critical point at which speeds become slow that movement virtually ceases.

Table V3.6: Levels of Service for Horizontal Pedestrian Movement (from GTEP Part 13, Table 1.3)

Level of Service	Module Size M (m2/ped.)	Flow Rate (ped/m/min)	Sample Applications
A	> 3.3	23	Public buildings or plazas without severe peaking fit this level.
B	2.3 – 3.3	23 – 33	Suitable for transport terminals or buildings with recurrent but not severe peaks.
C	1.4 – 2.3	33 – 49	Recommended design level for heavily – used transport terminals, public buildings or open space where severe peaking and space restrictions limit design feasibility.
D	0.9 – 1.4	49 – 66	Found in crowded public spaces where continual alteration of walking speed and directions required to maintain reasonable forward progress.
E	0.5 – 0.9	66 – 82	To be used only where peaks are very short (e.g. sports stadia or on a railway platform as passengers disembark.) A need exists for holding areas for pedestrians to seek refuge from the flow.
F	0.5	Variable up to 82	The flow becomes a moving queue, and this is not suitable for design purposes.

Source: Fruin (1971)

Fruin (1971) suggests that Level of Service standards provide a useful means of determining the environmental quality of a pedestrian space, but they are no substitute for judgement. All elements of pedestrian way design must be examined, including such traffic characteristics as the magnitude and duration of peaks, surging of platooning caused by traffic signal cycles or public transport arrivals, and all the economic ramification of space utilisation. When designing for extreme peak demands of short duration, a lower level of service may apply in order to obtain a more economical design. This in effect accepts that some 'backing up' of pedestrians will occur at critical bottlenecks.

Delay to pedestrians in crossing the road and pedestrian safety are additional measures of the level of service provided and the impacts of traffic on the pedestrian environment.

Details of calculation of delay and exposure are given in Appendix VB. When the design requires that maximum capacity volumes be used, such as in sports stadium design, the adequacy of holding areas at the approaches to the critical section must be examined. In such situations, pedestrians waiting and system clearance times should form the basis for the qualitative evaluation of the design. Consideration needs to be given to emergency evacuation situations as well as 'normal' design loads for these facilities and the presence of elderly people and people with disabilities.

The potential pedestrian capacity of the urban footpath is significantly reduced by the intrusion of various footpath impediments. Refuse bins, fire hydrants, fire alarm boxes, parking meters, traffic signals and poles, newsstands, telephone booths, kiosks, mailboxes, planters, sewer and ventilation gratings and similar devices reduce footpath capacity. Care needs to be exercised regarding the location of these items, in particular at corners of intersections. In many cases a balance will need to be made between the needs of pedestrians for an unobstructed footpath and the need to achieve adequate clearance to adjacent traffic lanes to meet safety objectives.

Obstruction Free Path (from GTEP Part 13, Section 2.1.3)

Any piece of street furniture on or near the footpath is a potential obstruction to free movement and should wherever possible be located to preserve an obstacle-free footpath width. People with physical and visual disabilities have particular difficulty in avoiding and moving around obstacles in their path. Street furniture of concern to pedestrians includes temporary or permanent structures or pieces of equipment located within a pedestrian environment. In general, obstructions should be kept clear of footpaths and overhanging objects (including trees) should not be lower than 2.0 m. Refer to *AGRD Part 6A, Section 5.5.1* for additional guidance on minimum envelope requirements.

Examples of street furniture include trees, signposts, traffic signals and light poles, parking meters, rubbish bins, seats, telephones, advertising signs and vending machines. In pedestrianised areas, street furniture should be carefully located (and preferably grouped) away from commonly used pedestrian routes.

Covers and Gratings (from GTEP Part 13, Section 2.1.4)

Placing manhole covers and gratings in major pedestrian walkways should be avoided. However, this is not always practicable and where it is necessary to locate them in the footpath area, they should be of a non-slip surface, laid flush with the footway. In the case of drainage grates, the openings should not be more than 13mm wide and not more than 150mm long (AS1428.1, 2021) and arranged perpendicular to the direction of pedestrian movement to prevent wheelchair wheels and canes from becoming trapped in the gratings.

Setback Distance (from GTEP Part 13, Section 2.1.5)

The setback distance of the footpath from the roadway is an important safety and design factor. Footpaths located too close to high-speed traffic discourage pedestrian travel, due to the high noise level and perception of hazard. Wider setbacks will add to the convenience and perceived safety of travel and should be used whenever possible.

Design Considerations for Pedestrians with Special Needs (from AGTM Part 7: Activity Centre Transport Management, Appendix G)

Pedestrian devices are often designed to cater for able bodied pedestrian, i.e. assuming that the pedestrian has satisfactory eyesight and hearing, is paying attention and is not physically hindered in any way. By virtue of these implicit assumptions, pedestrians under 12 years old and generally those over 50 can be misrepresented, as also are pedestrians with disabilities. These pedestrians will potentially experience difficulty and inconvenience with access.

Those groups who are most dependent on walking, who often do not have the option of driving a car, are often most impeded by some accessibility design practices. The following characteristics need to be considered in planning to reflect the needs of **all** pedestrians.

3.2.1.1 Older Pedestrians

Changes in physical factors associated with ageing affect the ability of the elderly to function as pedestrians in the traffic environment. Deteriorating physical, cognitive and sensory abilities can affect their behaviours within a road environment, and this is not always adequately accounted for in the design of traffic facilities. Characteristics of older pedestrians include those shown in Table V3.7.

Table V3.7: Characteristics of older pedestrians

Characteristic	Resulting in	Impacting
Reduced range of joint motion	Slower walking speed	• Crossing times • Mean journey length
Vision problems, such as reduced acuity and poor central vision	Reduced ability to scan the environment	• Ability to detect and avoid objects • Sign legibility • Kerb detection • Crossing locations • Trip hazards • Maps
Limited attention span, memory and cognitive abilities	Needing more time to make decisions, difficulties in unfamiliar environments, lack of understanding of traffic signals	• Positive direction signage • 'Legibility' of streetscape • Consistency of provision
Reduced tolerance for adverse temperature and environments	Preference for sheltered conditions	• Route location and exposure
Decreased agility, balance and stability	Difficulties in changing levels	• Provision of steps/ramps • Kerb height • Gradients • Handrails • Surface quality
Increased fear for personal safety and security	Fear of using all of part of a route	• Lighting • Surveillance • Lateral separation from cars • Provision of footpath • Traffic speed and density
Slower reflexes	Inability to avoid dangerous situations quickly	• Crossing opportunities
Reduced stamina	Shorter journeys between rests	• Resting places • Shelter
Reduced manual dexterity and coordination	Reduced ability to operate complex mechanisms	• Pedestrian-activated traffic signals

Source: NZ Transport Agency (2009), citing Axelson et al. (1999), ITE (1998), Organisation for Economic Co-operation and Development (2001) and Florida Department of Transportation (1999).

3.2.1.2 Child Pedestrians

A child's physical size limits their ability to see and be seen from the kerb. This is particularly so when there are parked cars or plantations along the verge of the road. It is important to recognise, however, that there are additional factors that significantly contribute to the vulnerability of children in the road environment.

It is inappropriate to consider children to be 'miniature adults' in terms of traffic engineering design. In addition to their smaller physical size, their intellectual, psychological and sensory capacities are limited by virtue of their age and stage of development. Children do not reach an adult level of performance in traffic, i.e. do not have the perceptual and cognitive capacity to make sound judgements about traffic safety, until about 10–12 years of age.

Understanding and integrating traffic information is a basic problem for children. Even the protection offered by signalised crossings is undermined (which is also common to the elderly), where a false sense of confidence and security contributes to the lack of attention and higher risk taking at these points. Therefore, traffic devices and treatments need to be reviewed from the child's perspective and appropriate measures taken to ensure their applicability in some situations. In order to maximise their safety, primary school age children generally need to be supervised (NZ Transport Agency 2009, based on Axelson et al. 1999). Characteristics of child pedestrians are shown in Table V3.8.

Table V3.8: Characteristics of child pedestrians

Characteristic	Resulting in	Impacting
Shorter height	Reduced ability to see over the tops of objects	• Sight lines and visibilities
Reduced peripheral vision	Reduced ability to scan the environments	• Sign legibility • Kerb detection • Crossing locations • Trip hazards
Limited attention span and cognitive abilities	Inability to read or understand warning signs and traffic signals	• Positive direction signage • 'Legibility' of streetscape • Use of symbols
Less accuracy in judging speed and distance	Inopportune crossing movements	• Provision of crossing facilities
Difficulty localising the direction of sounds	Missing audible cues to traffic	• Need to reinforce visual information
Unpredictable or impulsive actions	Poor selection of routes and crossings	• Lateral separation from cars • Provision of footpath • Traffic speed and density • Barriers
Lack of familiarity with traffic patterns and expectations	Lack of understanding of what is expected of them	• Complexity of possible schemes

Source: NZ Transport Agency (2009), citing Axelson et al. (1999), ITE (1998), Organisation for Economic Co-operation and Development (2001) and Florida Department of Transportation (1999).

3.2.1.3 Pedestrians with Disabilities

Disabilities have the potential to result in some form of functional loss or mobility impairment. Pedestrians with disabilities range from those who have the ability to walk, but have difficulty in doing so, (especially in negotiating steps and changes of grade), to those who require assistance to maintain balance and interpret directions, those that have impaired vision or hearing and those who require a mobility aide such as a wheelchair.

Surveys conducted of people with disabilities have found that 18.5% of the population in Australia and 17% in New Zealand are have a disability (Australian Bureau of Statistics 2009, Statistics New Zealand 2007).

a. Mobility-impaired Pedestrians

Mobility-impaired pedestrians are commonly thought of as using devices to help them to walk, ranging from canes, sticks and crutches to wheelchairs, walkers and prosthetic limbs. However, a significant proportion of those with mobility impairments do not use any visually identifiable device (NZ Transport Agency 2009, based on Axelson et al. 1999). Characteristics of mobility-impaired pedestrians are identified in Table V3.9.

Table V3.9: Characteristics of mobility-impaired pedestrians

Characteristic	Resulting in	Impacting
Extra energy expended	Slower walking speed	• Crossing times • Journey length • Surface quality
Use of mobility aids	Increased physical space and good surface quality needed	• Footpath width • Footpath condition • Obstructions • Step depth • Gaps/grates
Decreased agility, balance and stability	Difficulties in changing level	• Provision of steps/ramps • Kerb height • Gradients • Handrails • Surface quality
Reduced stamina	Shorter journeys between rests	• Resting places • Shelter
Reduced manual dexterity and coordination	Reduced ability to operate complex mechanisms	• Pedestrian-activated traffic signals
Vision problems, such as reduced acuity and poor central vision	Reduced ability to scan the environment	• Ability to detect and avoid objects • Sign legibility • Kerb detection • Crossing locations • Trip hazards • Maps

Source: NZ Transport Agency (2009), citing Axelson et al. (1999), ITE (1998), Organisation for Economic Co-operation and Development (2001) and Florida Department of Transportation (1999).

b. Sensory-impaired Pedestrians

Sensory impairment is often mistaken as being a complete loss of at least one sense, but a partial loss is far more common. Vision impairment mainly affects pedestrians' abilities, although to some extent hearing and proprioception (the ability to sense the location of parts of the body) can have an effect (NZ Transport Agency 2009, based on Axelson et al. 1999). Table V3.10 identifies characteristics of sensory-impaired pedestrians.

Table V3.10: Characteristics of sensory-impaired pedestrians

Characteristic	Resulting in	Impacting
Reduction in hearing ability	Missing audible cues to traffic	• Need to reinforce visual information
Lack of contrast resolution	Reduced ability to distinguish objects	• Sign legibility • Small changes in level
Reduced vision	Reduced ability to scan the environment	• Kerb detection • Crossing locations • Trip hazards • Consistency of streetscape
Severe vision impairment	Use of mobility aid, guide dog and/or tactile feedback to navigate	• Streetscape legibility • Tactile pavement use

Source: NZ Transport Agency (2009), citing Axelson et al. (1999), ITE (1998), Organisation for Economic Co-operation and Development (2001) and Florida Department of Transportation (1999).

c. Wheeled Pedestrians

Wheelchair and mobility scooter users can legitimately use the pedestrian network, but in many ways their characteristics are very different from those of walking pedestrians. This means the network has to function differently when taking these users into account (NZ Transport Agency 2009). Characteristics of wheeled pedestrians are summarised in Table V3.11.

Table V3.11: Characteristics of wheeled pedestrians

Characteristic	Resulting in	Impacting
More susceptible to the effects of gravity	Slower speeds travelling uphill, faster speeds travelling on level surfaces or downhill	• Route gradients • Interaction with walking pedestrians
Chair/scooter width effectively increases the width of the pedestrian	Greater width required to use a route to pass others	• Route widths (including across roads) • Street furniture placement • Passing places on narrow routes
Reduced agility	Increased turning radius (and turning circle)	• Places to turn around • Horizontal alignments • Surface quality
Reduced stability	Greater potential for overbalancing	• Sudden changes in gradient • Crossfall • Maximum forwards and sideways reach to pedestrians-activated traffic signals
User is seated	Eye level lower	• Location of pedestrian-activated traffic signals • Position of signs.

Source: NZ Transport Agency (2009), citing Axelson et al. (1999), ITE (1998), Organisation for Economic Co-operation and Development (2001) and Florida Department of Transportation (1999).

4 Design Considerations

4.2 Factors of Influence – Path Location

4.2.1 Factors Influencing Roadside Alignment

Additional Information

Additional Factors of Influence

The following factors of influence should be considered in addition to those listed in *AGRD Part 6A* when determining a preferred off-road path location:

- The anticipated catchment and source of demand for the path. For instance, where a corridor is expected to have urban growth and development primarily on one side of a carriageway, it would be preferred to locate the path on the same side to allow easy access.
- The cumulative impact of traffic stress caused by intersections and crossings. Not only should the frequency of crossings be taken into consideration, but the predicted volume of traffic at these points (i.e. the exposure to conflict for path users).
- The potential to provide safe priority crossings at intersections and crossings (refer Section 7.3.1 of this Supplement for further guidance).
- The ability to provide desired offset between the path's edge and back of kerb, right of way (discussed in Section 5.5.1 of this Supplement), and fixed objects near a paths edge.

Driveways Across Footpaths (from GTEP Part 13, Section 2.4)

Driveway location will be determined by factors other than pedestrian activity, however, off-street developments and car- parking facilities should be designed so that pedestrian entrances/exits are separate from vehicular entrances/exits. Circulation roadways and access driveways should be located where there is minimum conflict with heavy pedestrian movements between car parks, public transport stations and associated shopping facilities, etc. Splays, clear of obstructions, are required at the property line to ensure adequate visibility between vehicles on a driveway and pedestrians on the footpath, as shown in Figure V5.1. Suitable information or warning signs may need to be provided in order to control the speed of traffic and warn of the presence of pedestrians. Vehicle drivers exiting buildings and off-street car parks should be encouraged to give pedestrians an audible warning where sight distance is severely restricted. .

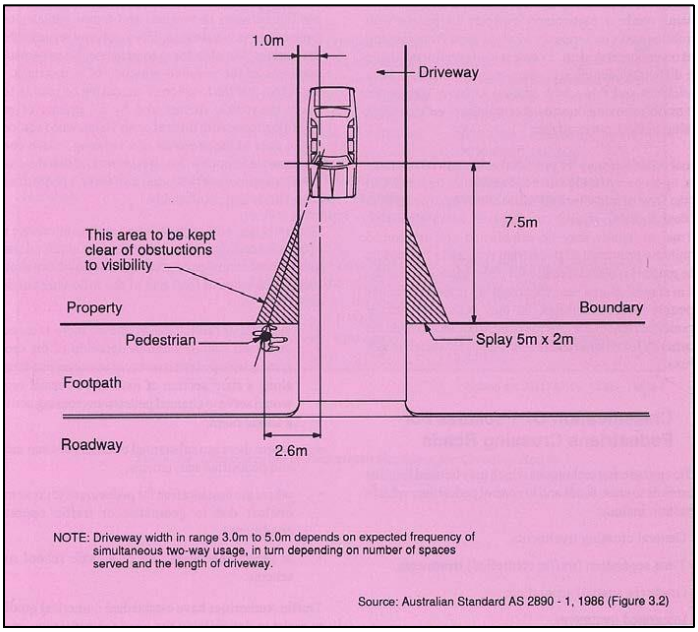


Figure V5.1: Minimum Sight Line Splays
(from GTEP Part 13, Figure 2.10)

5 Design Criteria

5.1 Widths of Paths

Additional Information

Capacity of Paths (from GTEP Part 14, Section 6.3.3)

The capacity of a 1.5 m wide path in one direction is in the order of 150 cyclists per hour. In general, this width is sufficient for the passage of a single stream of cyclists.

Generally, it is impractical to design for the peak annual or lifetime use of a path. For many paths the nature of use varies over the period of a day or week. In considering the suitability of a path to handle predicted demand, it is recommended that path volumes be assessed in the basis of the highest demand over the period of 2 separate hours of a typical day (weekday or weekend).

In the case of shared use paths, the volume of pedestrians can be added to that of cyclists. Opportunities for passing would be required either through the provision of additional path width (minimum width of 1.8– 2.0 metres in each direction), or through passing on the side of the path with opposing flow provided sufficient opportunities exist.

5.1.1 Clear Width

Provision of pedestrian paths need to comply with the objectives of an urban design strategy or existing Municipal standards. Any requirements should be clarified prior to the commencement of design.

Additional Information

Effective Width

In addition to clear width, practitioners must also consider the effective (or *usable*) width of a path.

As discussed in *AGRD Part 6A*, the *clear width* of a path factors in any intrusions in or over the paths edge (e.g. vegetation, poles, street furniture, etc.), thereby reducing the width of the clear path. Whereas the *effective width* goes a step further by factoring in a path users' natural inclination to 'shy away' from such intrusions, which can often be perceived as hazardous. This 'shy line' effect is generally more pronounced for fast moving path users, such as cyclists, due to the risk of 'snagging' of handlebars or pedal strikes that may occur as a result of a slight deviation from their intended path.

As such, when a hazard or obstacle is located close to the edge of an off-road path (< 0.3 m), a corresponding shy line needs to be factored into determining the paths effective width. Leveraging upon content from Section 5.5.1 of *AGRD Part 6A*, a clearance of 0.3 m should be adopted as the default shy line value. Examples of unimpeded, single-side constrained, and double-side constrained off-road paths are provided in the following figures.

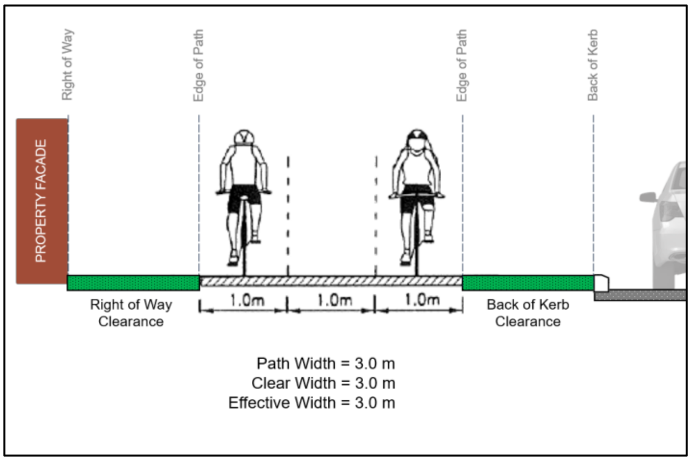


Figure V5.1: Unimpeded Off-Road Path (Effective Width = Clear Width)

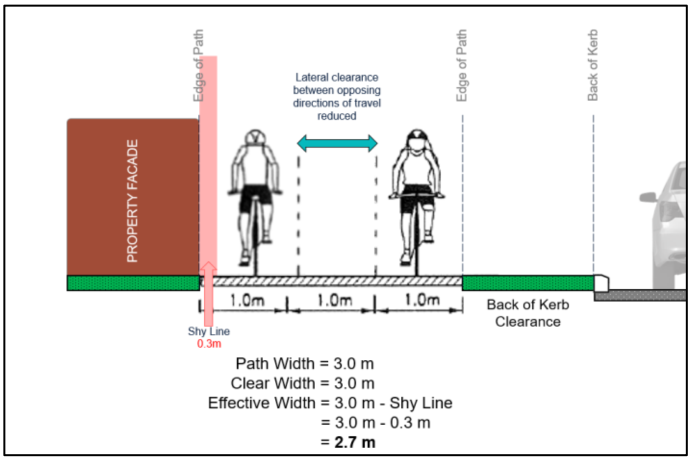


Figure V5.2: Single-Side Constrained Off-Road Path (Effective Width < Clear Width)

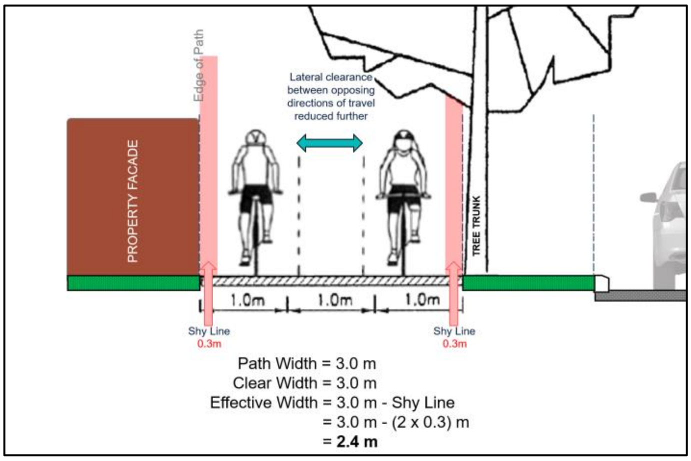


Figure V5.3: Double-Side Constrained Off-Road Path (Effective Width << Clear Width)

Guidance regarding how to deviate or narrow a path around constraints is provided in Section 5.5.1 of this Supplement.

5.1.4 Shared Paths

<u>Additional Information</u>

To provide additional clarity regarding the desirable, minimum, and extended design domain values associated with shared paths, Table V5.1 has been developed to inform planners and designers of DoTs expectations when it comes to shared path dimensions.

This table details the shared path types detailed in Section 2.4 and the widths are based on the desired function of each path type, with recommended widths provided within Table V5.1 to achieve this.

While a desirable width should be informed by the classification of a walking and cycling route, the safe and practical width should be driven by the predicted level of pedestrian and cycling demand. The optimal capacity of each path type is discussed in Section 2.4.

Table V5.1: Shared Path Widths in the Victorian Context

		Path Width (m)		
		SUP Type #1 Light Commuting &/or Local Access	**SUP Type #2** Commuting &/or Recreation	**SUP Type #3** Major Recreation
Normal Design Domain (NDD)	**Desirable width** [1]	2.5 – 3.0	3.0 – 4.0	≥ 4.0 [2]
	Minimum width	2.0	3.0	3.5
Extended Design Domain (EDD)	*(Refer Note 3)*	-	2.5 – 3.0 [3]	3.0 – 3.5 [3]

Notes:

1. The optimal capacity of each path type is discussed in Section 2.4 of this Supplement.
2. In general, separated facilities are recommended where widths of 4.0 m or greater are available. Refer Section 3.1. SUPs with width greater than 4.0 m will generally only be recommended where:
   a. cyclist demand and speeds are predicted to remain low due to presence of more attractive parallel routes, or
   b. pedestrian demand is likely to exceed the pedestrian path component of segregated facilities and there are concerns that path non-compliance (i.e. pedestrians regularly utilising the bicycle path) will be a common risk occurrence.
3. Adoption of EDD path widths will not provide the same operational performance for a particular path type when compared to NDD widths, particularly where demand levels approach capacity of the path. Adoption of EDD values at short, constrained locations (< 20 m in length) do not require approval, however, must be treated in accordance with guidance provided within Section 5.5 of this Supplement. Refer below.

Designers should note that adopting EDD widths essentially means that the path will no longer be able to provide the same operational performance as that which can be expected for NDD widths for the particular path types outlined in Section 2.4 of this Supplement. As such, while it may be considered necessary to propose adoption of EDD widths due to environmental or budgetary constraints, the associated reduction in operational performance needs to be considered, assessed, and documented as justification for adopting EDD criteria. Any proposal to adopt EDD criteria should also include clear discussion on the consequences of adopting NDD criteria.

As an example, if a SUP Type #2: Commuting &/or Recreation path is being provided for a corridor and there is a need to adopt EDD values (e.g. in constrained locations where NDD widths cannot be practically achieved), the ultimate performance of the path will essentially be reduced to that of a SUP Type #1: Light Commuting &/or Local Access.

In this scenario, the narrower width may result in an increased risk in conflict between path users due to reduced clearance between opposing direction of traffic, reduced operational speeds for cyclists, and reduced level of path user comfort (refer Table V3.1 of this supplement for further commentary on path user comfort), particularly as demands approach the capacity of the path. All of which may impact upon the attractiveness of the path as a whole for users if varying widths are adopted along a route, noting that a route is generally only considered as strong as its weakest link (in this instance, a lower order path type). In this case the possible outcomes could include either bottlenecks forming along the path (i.e. dramatically less level of service than desired) or diversion of users to other, possibly less suitable routes.

5.1.5 Separated Paths

Additional Information

Similar to Section 5.1.4 Shared Paths, to provide additional clarity regarding the desirable, minimum, and extended design domain values associated with bi-directional separated (or segregated) paths, Table V5.2 has been developed to inform planners and designers of DoTs expectations when it comes to two-way separated path dimensions. The table also provides greater clarity on which widths are considered narrow enough to trigger a design exception, something that has been left somewhat open to interpretation based on previous *AGRD Part 6A* content.

This table details the bi-directional separated (or segregated) path types detailed in Section 2.5 with the widths based on the desired function of each path type, with recommended widths provided within Table V5.2 to achieve this. Further detail on path categories and associated function and performance is provided in Section 2.5 of this document.

Table V5.2: Bi-Directional Separated Path Widths in the Victorian Context

		Path Width (m)											
		Bi-Directional Separated Path Type 1: Commuting &/or Local Access				Bi-Directional Separated Path Type 2: Commuting &/or Recreation				Bi-Directional Separated Path Type 3: Commuting & Major Recreation			
		Bicycle Path		Pedestrian Path	Total [1]	Bicycle Path		Pedestrian Path	Total [1]	Bicycle Path		Pedestrian Path	Total [1]
Normal Design Domain (NDD)	Desirable width [2]	2.0 - 3.0	SEPARATOR [3]	2.0	**4.0 - 5.0**	3.0 - 5.0	SEPARATOR [3]	2.0 - 2.4	**5.0 - 7.4**	5.0 - 6.0	SEPARATOR [3]	2.4	**7.4 - 8.4**
	Minimum width	2.0		1.5	**3.5**	3.0		1.8	**4.8**	5.0		2.0	**7.0**
Extended Design Domain (EDD)	*(Refer Note 3)*	N/A		N/A	N/A	2.0 - 3.0 [4]		1.5 - 1.8 [4]	**3.5 - 4.8** [4]	3.0 - 5.0 [4]		1.8 - 2.0 [4]	**4.8 - 7.0** [4]

Notes:

1. Total widths do not incorporate width of separator.
2. The optimal capacity of each path type is discussed in Section 2.5 of this Supplement.
3. Separator widths will vary. Refer below.
4. Adoption of EDD path widths will not provide the same operational performance for a particular path type when compared to NDD widths, particularly where demand levels approach capacity of the path. Adoption of EDD values at short, constrained locations (< 20 m in length) do not require approval, however, must be treated in accordance with guidance provided within Section 5.5 of this Supplement. Refer below.

To assist path users in distinguishing between cyclist and pedestrian space and to encourage path compliance (i.e. ensuring cyclists do not encroach into the pedestrian path and vice-versa), some form of separation is desirable. This can be achieved through the use of a landscaped dividing strip (e.g., low-growing vegetation), narrow median kerb (ensuring a pedal-strike friendly profile) or the use of a low-height fence (least preferred).

To inform whether physical separation is feasible and an appropriate corresponding separator width, practitioners should consider the desirable spatial requirements to accommodate common passing movements on a path. For example, ensuring a width ≥ 1.8 m is provided on a pedestrian path to accommodate passing space for wheelchairs. Similarly, providing a width ≥ 2.5 m on a bicycle path to provide lateral clearance between opposing directions of cyclist travel. Further guidance on pedestrian and cyclist envelopes is provided within Section 3.2 of *AGRD Part 6A*.

Where separation is not possible due to insufficient width, the bicycle and pedestrian paths can instead be segregated, which is typically achieved using visual cues such as linemarking (ideally raised tactile) or the use of different pavement colours or textures.

Designers should note that adopting EDD widths essentially means that the path will no longer be able to provide the same operational performance as that which can be expected for NDD widths for the particular path types outlined in Section 2.5 of this Supplement. As such, while it may be considered necessary to propose adoption of EDD widths due to environmental or budgetary constraints, the associated reduction in operational performance needs to be considered, assessed, and documented as justification for adopting EDD criteria. Any proposal to adopt EDD criteria should also include clear discussion on the consequences of adopting NDD criteria.

As an example, if a Separated Path Type #2: Commuting &/or Recreation is being provided for a corridor and there is a need to adopt EDD values (e.g. in constrained locations where NDD widths cannot be practically achieved), the ultimate performance of the path will essentially be reduced to that of a Separated Path Type #1: Commuting &/or Local Access.

In this scenario, the narrower width will result in a reduced clearance between opposing directions of cyclists, which may increase the risk of head-on conflict and/or an inability to comfortably accommodate overtaking, thereby impacting operational speeds for cyclists. All of which may impact upon the attractiveness of the path as a whole for users if varying widths are adopted along a route, noting that a route is generally considered only as strong as its weakest link (in this instance, a lower order path type). In this case the possible outcomes could include either bottlenecks forming along the path (i.e. dramatically less level of service than desired) or diversion of users to other, possibly less suitable routes.

5.2 Bicycle Operating Speeds

Additional Information

Consideration of Vertical Grades

Refer to Section 5.4 of this Supplement for commentary on the impact of vertical gradients upon cyclist operational speeds.

5.3 Horizontal Curvature

Clarification

A minimum radius of at least 30 metres is generally preferred for paths not constrained by topography or other physical features.

Curves with a radius less than 15 metres are generally considered to be ‘sharp’ and should not be used to achieve landscaping objectives to the detriment of the path operation for cyclists.

A small radius may be appropriate on the approach to intersections (e.g. 5.0 metres) and at ‘hairpin’ bends (e.g. 2.5 metres min.) of paths traversing steeply sloping land.

5.4 Path Gradients

Additional Information

Consideration of Vertical Grades

As noted in *AGRD Part 6A*, cyclist speeds are directly impacted by the vertical grade associated with a path – i.e. the steeper the gradient, the higher the operational speed of cyclists travelling downhill (and vice-versa for cyclists travelling uphill). To inform this, the following figure (reference in *AGRD Part 3: Geometric Design*) can be used to determine expected operational speeds of cyclists for a particular vertical grade.

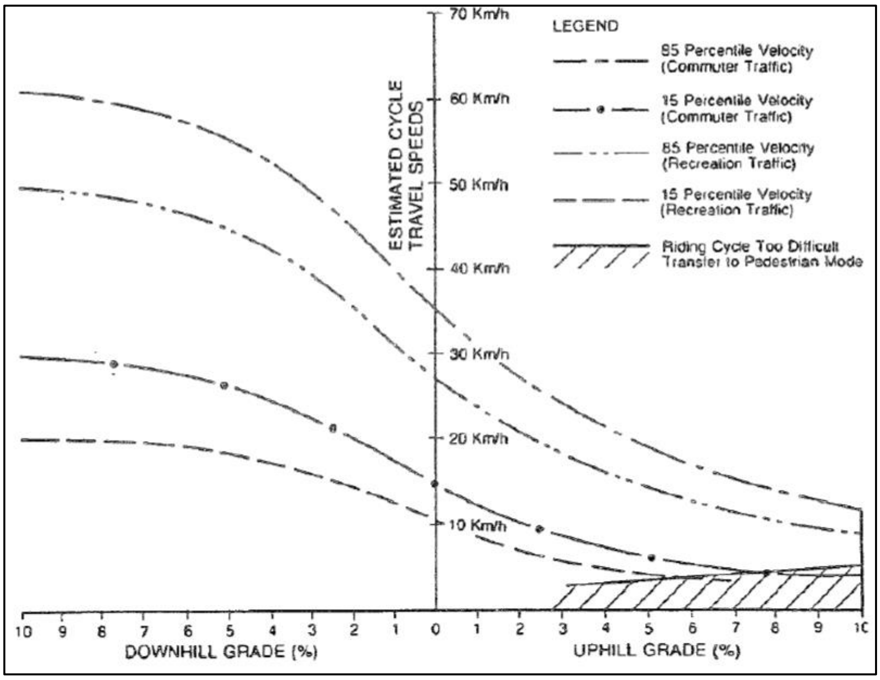


Figure V5.1: Impact of Vertical Gradients on Bicycle Operating Speeds
(from AGRD Part 3, Figure 4.26)

These expected operational speeds should be considered when determining the suitability of an off-road path type. For instance, if a path is expected to have regular moderate-to-high gradients (e.g. ≥ 5%), this is likely to result in a significant proportion of cyclists travelling in excess of the desired 20 km/h considered appropriate for SUPs. This increase in speed differentials between pedestrians and cyclists may in-turn have a negative impact upon a pedestrian's comfort and safety (perceived or actual) levels, potentially curtailing uptake in path use.

Furthermore, when a cyclist is required to climb a path with a steep gradient, experienced cyclists will often need to work the bicycle from side to side whilst the inexperienced tend to wobble, each resulting in a larger dynamic envelope (1.5 m wide). This additional envelope width should also be considered when determining desired lateral clearance between opposing directions of travel. In scenarios where moderate to high grades cannot be avoided and therefore downhill operational speeds of cyclists will be high and uphill cyclist envelopes will increase, practitioners should consider the following:

1. locating the path in an alternate location (e.g. the opposite side of a road carriageway) where gradients may be more forgiving
2. providing separated bi-directional facilities for cyclists and pedestrians
3. providing uni-directional separated facilities for downhill cyclists only and provide a shared space for pedestrians and uphill cyclists where speeds will remain low
4. providing 0.25 to 0.8 m of additional path width in the uphill direction of travel. This will result in path widths greater than the values listed in Section 5.1 of *AGRD Part 6A* and this Supplement
5. providing rest and/or pull-off areas for cyclists that choose to come to a stop or dismount, so they are able to do so off the path of travel of fellow cyclists. The location and frequency of these areas should be informed by the 'acceptable' limits depicted within the figure provided within Section 5.4.2 of *AGRD Part 6A*.

5.5 Clearances, Batters and Need for Fences

DoT or Municipal agreement, as appropriate, should be obtained before using the minimum clearance.

5.5.1 Clearances

<u>Additional Information</u>

Lateral Movements at Localised Pinch Points

Where there is a need to deviate or narrow a path due to localised constraints (e.g. vegetation, poles, street furniture, etc), tapered linemarking is required to safely guide users through these areas. An offset of 0.2 m should be provided between the constraint and the tapered linemarking, with a 1 in 10 rate of horizontal deflection. A tactile surface or diagonal linemarking can also be used to provide additional visual cues to path users for the approaching pinch point.

These tapers may be complemented by supplementary treatments to provide further delineation to users, including tactile surface or diagonal linemarking, bollards, narrow chevrons or 'Path Narrows' signs. Examples of such treatments are provided in Figures V5.3 – 5.4.


Figures V5.3 – V5.4: Examples of Supplementary Treatments

Paths in Constrained Environments

In situations where an off-road path is required to traverse through a constrained environment (e.g., an area with limited cross-sectional width available within the right of way boundary), it will often be necessary to narrow one or more of the following design elements to provide a functional path:

1. **Right of Way (RoW) Clearance:** the clearance between the edge of the path and the right of way boundary, such as a property fence or the wall of a building.
2. **Path Width:** the width between each path edge.
3. **Back of Kerb (BoK) Clearance:** the clearance between the edge of path and the back of kerb. It should be noted that signage will commonly be situated in this area and needs to be taken into consideration when determining appropriate clearances between a path and potential hazards.

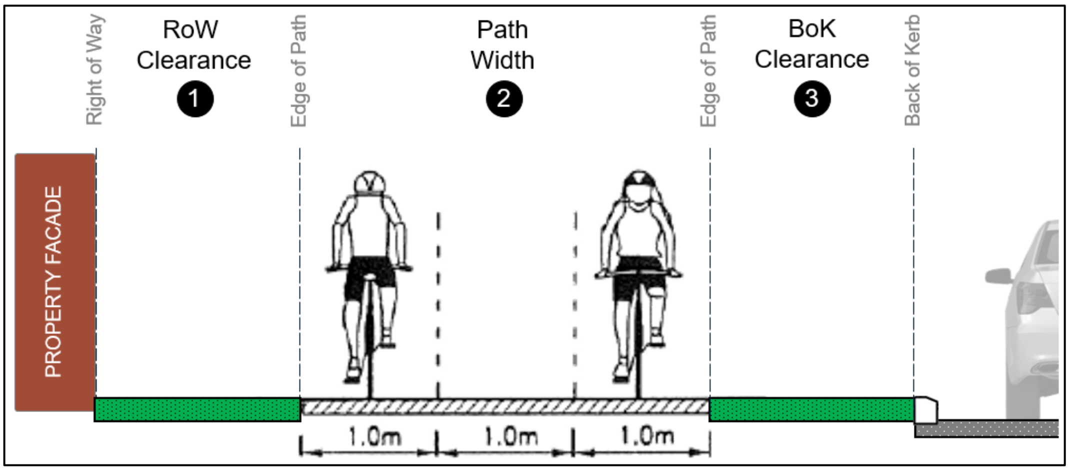


Figure V5.6: Off-Road Path Design Elements

Narrowing these elements has the potential to negatively impact important path characteristics, such as:

- **Safety** – reducing clearance to hazards such as property fences and/or a reduced lateral clearance between opposing directions of travel could lead to a greater risk of crashes within the path; and
- **Comfort** – having a reduced clearance from carriageways to create a physical separation from motor traffic can increase the level of traffic stress imposed upon path users.

To assist designers in minimising these potential negative impacts, the below figure has been developed to capture the preferred hierarchy for narrowing these off-road path elements.

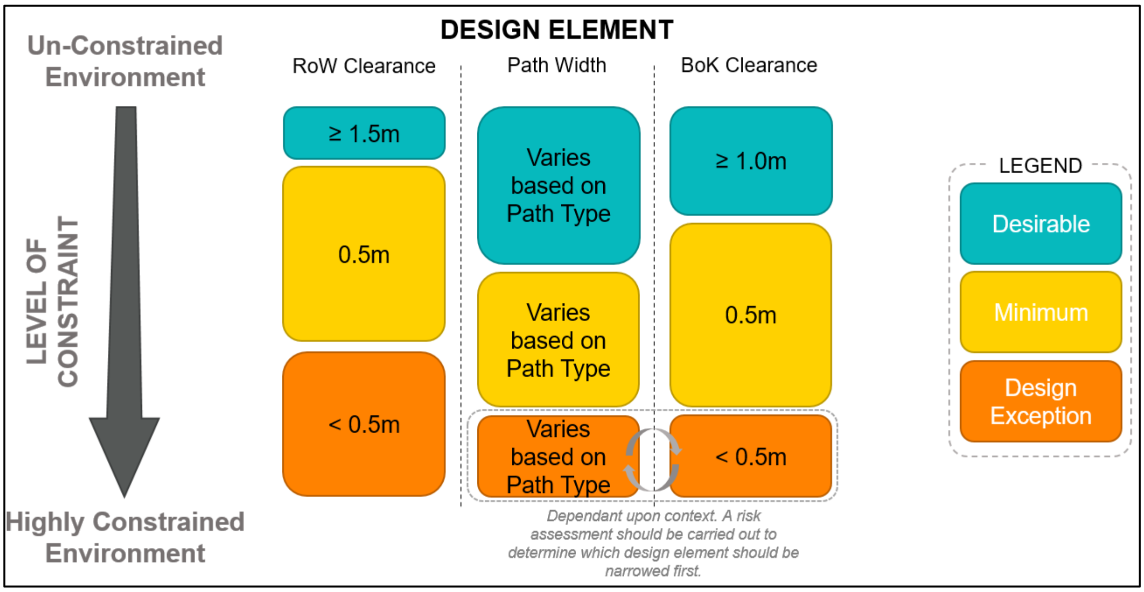


Figure V5.7: Hierarchy for Narrowing Off-Road Path Design Elements

As an example, if a site were to become so constrained that a designer can no longer achieve the 'desirable' widths for all three elements:

1. The **RoW Clearance** would reduce from 1.5m to ensure the 'desirable' widths are achieved for both **Path Width** and **BoK Clearance**.
2. This narrowing would continue until the **RoW clearance** reaches 0.5m (the 'minimum' width). At this point, the **BoK Clearance** would reduce from 1.0m to ensure the 'desirable' width is achieved for the **Path Width**.

3. This narrowing would continue until the **BoK Clearance** reaches 0.5m (the 'minimum' width). At this point, the **Path Width** would reduce from the 'desirable' width (dependent upon the path type).
4. This narrowing would continue until the **Path Width** reaches the 'minimum' width (dependent upon the path type), at which point the **RoW Clearance** would then be reduced to the point of triggering a design exception (typically 0.3 m where a hazard or obstacle has smooth features).
5. Should further narrowing be required, the decision to narrow either **Path Width** or **BoK Clearance** will be dependent upon the nature of the neighbouring traffic lane (operational speed, traffic lane widths, presence of a shoulder, proportion heavy vehicles), as this will have a direct impact upon path user safety and comfort. BoK clearance is particularly important when bi-directional facilities are provided, given path users will be travelling in the opposing direction of the neighbouring traffic lane. As such, a risk assessment should be carried out to determine which design element to narrow, taking into consideration clearance requirements to adjacent trucks as outlined in *AGRD Part 3*, Section 4.9.4.

It should be noted that in scenarios where a path is proposed to be fully traversable/paved between edge of path and back of kerb, an edge line should still be provided to delineate the path and associated clearance from the carriageway. Similar examples of path edge linemarking to delineate a clearance between a path edge and hazards (in this instance fencing a bridge abutment) are provided in the below figure.

Figure V5.8: Examples of Off-Road Path Edge Linemarking to Hazards

5.5.3 Batters and Fences

Fences constructed in close proximity to bicycle lanes or paths should be designed to prevent injury to cyclists who may brush against it at speed or get caught. Refer to *AGRD Part 6A, Appendix D – Bicycle Safety Audit Checklist* for further information.

Where it is proposed to use fences or similar structures in association with bicycle lanes or path facilities, the following factors should also be considered:

- The various fence elements (posts, railings, etc) should be designed to minimise the possibility of cyclists snagging their handlebars or pedals;
- Care needs to be exercised in the choice of fences to avoid those that would give rise to spearing injuries if struck (by any vehicle);
- The ends of fences should be at least 1 metre away from the riding surface but may taper closer to the edge of the path if necessary (refer to Figure V5.9). They should also be appropriately delineated by signs and reflective tape, and preferably be of a light colour;

- The width of paths and lanes should account for the presences of fences (see *AGRD Part 6A, Section 5.5.1* for further details on clearances);
- The presence of a fence positioned close to the edge of an off-road path (< 0.3 m) is likely to have an impact upon the effective (or *useable*) width of the path. Refer Section 5.1.1 of this Supplement for further guidance.

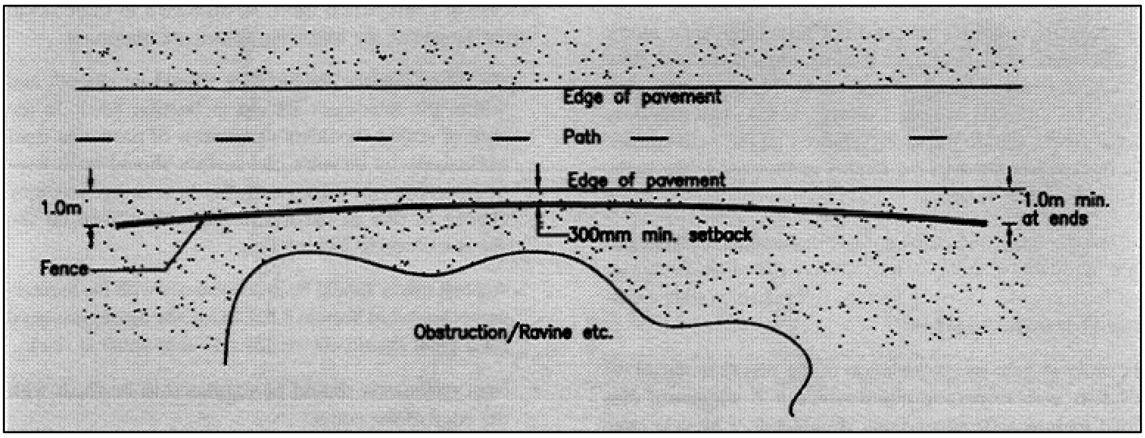


Figure V5.9: Fence Construction Details
(from GTEP Part 14, Figure 7.18)

5.6 Crossfall and Drainage

5.6.2 Drainage

Additional Information

Where the path may traverse a floodway or overland flow path, the shared user path should meet Melbourne's Water's Low Hazard criterion for a 100 year ARI flood where the product of water depth (metre) and water velocity (metres per second) shall be less than 0.35 m^2/s, along footpath/cycle path alignments.

i.e. $V_{av}.d_{av} \leq 0.35\ m^2/s$

Refer to Melbourne Water's *Shared Pathways Guidelines* (Melbourne Water, 2009) for further guidance on the design of pathways along waterways.

More generally, in areas subject to flooding, refer to Australian Rainfall and Runoff 2019 Book 6 Chapter 7 for Safety Design Criteria and hazard classification levels for different path users.

5.7 Sight Distance

Additional Information

As noted in *AGRD Part 4A: Unsignalised and Signalised Intersections*, Section 3.3: Pedestrian Sight Distance Requirements, minor obstructions, such as posts, poles and tree trunks less than 200 mm diameter within the sight line may be ignored. Unnecessary removal of trees or vegetation considered 'minor obstructions', can also have a negative impact from an amenity of 'Place' perspective, which can negatively impact the attractiveness of a path.

5.8 Changes in Level

Additional Information

Walkways, ramps and landings (from AS1428.1, Section 7)

Changes in the vertical level that paths may need to negotiate will require compliance with *AS1428.1: Design for Access and Mobility.* Table V5.1 summarises the maximum gradients allowable and the landing spacing where required.

Typical road gradients will generally result in grades flatter than 3% and hence landings are not usually provided. Where a road is constructed on a steeper grade as part of an overpass or similar, consideration must be given to the gradient that an adjacent path will follow. Should the requirements of Table V6.1 be incorporated, independent grading of the path is one option that could be considered noting that it will result in a level difference between the path and the road and possible access challenges to properties.

Where there is difficulty meeting the requirements of AS1428.1, the *Disability Discrimination Act* (Cth.) requires proponents to show why provision of the standard will result in undue hardship. Practitioners should also refer to DoTs *Traffic Engineering Manual Volume 3 – Additional Network Standards & Guidelines Part 2.19 Accessibility (DDA) Guidelines for Road Infrastructure* (Edition 2, July 2021).

Table V5.1: Summary of Section 7, AS1428.1

Walkways - gradient	**Landing Spacing**
Less than 1 in 33	N/A
1 in 33 (3%)	25m maximum
1 in 20 (5%)	15m maximum
Between 1 in 33 and 1 in 20 e.g. 1 in 25 (4%)	Linear interpolation 20m
Ramp - gradient	
1 in 14 (7%)	9m maximum
1 in 20 (5%)	15m maximum
Between 1 in 14 and 1 in 20 e.g. 1 in 16.5 (6%)	Linear interpolation 12m
Landing Length No change in direction = no less than 1200mm Change in direction <900 = no less than 1500mm 1800 turn = at least 2000mm x 1540mm The intervals specified above may be increased by 30 where at least one side of a walkway is bounded by: (a) a kerb or kerb rail and a handrail (b) a wall or handrail	

5.9 Surface Treatments

Additional Information

Refer to *VicRoads Traffic Engineering Manual (TEM) Volume 1* for guidance on surface treatments for shared users.

5.11 Lighting

Additional Information

VicRoads Guidelines for Road Lighting Design TCG006-2-2010 (VicRoads, 2010) provides guidance on the design of new road lighting schemes on freeways and arterial roads. Lighting must be designed to accommodate both existing and proposed tree canopies at maturity. Trees may be pruned/uplifted to ensure adequate light is provided to path users as the tree matures.

5.12 Underground Services

Additional Information

Underground services should be co-located or placed beneath a path to ensure path amenity is not compromised by asset offsets. Any inspection regime required for the service should be considered in the design process.

6 Intersections of Paths with Paths

6.2 Intersection Priority

Additional Information

Provision of priority around pedestrian hubs

It is becoming increasingly more common to encounter scenarios where a path intersects with the natural desire lines of pedestrians looking to access major attractors, such as train stations, tram stops, bus stops and shopping precincts. When this occurs, the designer or path manager should consider the following, alongside guidance contained within Section 6.2 of *AGRD Part 6A*:

1. Strategic function of both the path and conflicting movement(s)

   As noted in *AGRD Part 6A*, the strategic function of each route or direction of travel can be used to inform which path (or mode of transport) is most deserving of holding priority. Similar to the initial step outlined in Section 2.1 *(Path Selection Considerations)* of this Supplement, this can be informed by the walking, cycling, and interchange classifications under the M&P framework and consulting with relevant transport agencies. The path with the higher classification will generally be the most appropriate to path to hold priority, provided the following design principles can be me to appropriately mitigate the risk of conflict between path users.

2. Predicted volumes of conflicting movements

   Predicted volumes associated with conflicting movements will inform the level of potential ‘exposure’ to conflict, which will have a direct relationship to the associated safety risk (i.e. the higher the volumes, the higher the risk). This should include not only walking and/or cycling demand along a route, but concentrated walking and/or cycling demand related to pedestrian hubs.

   This is of particular importance at interchanges during peak times, where demand will swell. While path demand for an interchange may be relatively low throughout the majority of a day, it may be significant enough during certain windows to warrant full-time priority when this risk is at its highest.

3. Demographic of users

   It is important to consider the planned path user demographic when selecting an appropriate path type and determining movement priorities at path intersections. This is particularly important for pedestrians that require special consideration, such as children, aged pedestrians, and pedestrians with disabilities (e.g. using wheelchairs or vision impaired).

   Where it is anticipated that a path will have a high proportion of such path users, such as a path located near a primary school or aged care facility, it may warrant providing this path priority to compensate for certain characteristics that may increase the risk of a collision at the path intersection (e.g. older pedestrians may have a reduced ability to scan an environment due to impaired vision, or a child’s lack of familiarity with how to behave at such junctions).

When selecting a path type, it is integral that the key needs of pedestrians and cyclists are taken into consideration. This will help to ensure infrastructure caters for the target path user demographic and provide the greatest opportunity for uptake in path use.

As an example, poor alignment with certain cyclist needs has the potential to act as a barrier to attracting the “interested but concerned” demographic, the largest of the cyclist types (as illustrated in Figure V3.0). Similarly, the needs of pedestrians that require special consideration, such as children, aged pedestrians, and pedestrians with disabilities (e.g. using wheelchairs or vision impaired) need to be factored into this selection process.

Regardless of which path holds priority, the following design principles must be met where an intersection of paths occur:

1. **Adequate mutual sight distance** is provided between path users to allow for appropriate decision making;

2. **Intuitive visual cues** (e.g. linemarking, signs, pavement messaging) are provided to path users identifying path priority and raising awareness of the conflicting movements;
3. **Cyclists' speeds are reduced** to a target of 10 – 15 km/h at the point (or 'zone') of conflict. This can be achieved by
    a. Providing a lateral shift in path geometry approaching the conflict point
    b. Introducing rumble strips or transverse bars utilising contrasting exposed aggregate
    c. Localised narrowing of the path through linemarking as a perceptual countermeasure to reduce cyclist speeds
    d. Warning signs, linemarking, and pavement marking to complement each of the above.

Ensuring each of the above principles are met will reduce the likelihood of crashes occurring at the path intersection and provide greater opportunity for path users to appropriately observe and react to avoid a collision at conflicting path movements.

7 Intersections of Paths with Roads

7.3 Treatments for Intersections of Paths with Roads

7.3.1 Road Crossings where the Path has Priority over the Road

<u>Additional Information</u>

Design Principles and Objectives for Raised Priority Crossings

A Raised Priority Crossing (RPC) gives priority to pedestrians and cyclists travelling on a shared-use path (SUP), footpath or cycle path over vehicles & other road users when crossing a road.

The key features of an RPC are noted below;

- The crossing is raised to bring the crossing to the same level as the SUP/path to give a continuous level path to pedestrians and cyclists
- The raised crossing manages speed of vehicles at the crossing/conflict point through the ramp profile grades
- Skid resistant paint (Y14 yellow paint for SUP crossings and green paint on cycle paths where there are separated crossings) and "Give Way" signs and linemarking communicate the priority to road-users

The RPC at Amess Street in Carlton North is a good existing example of an RPC on the network. The crossing is offset from the Main Road carriageway (Park St) and provides good sight lines for vehicles and cyclists approaching the conflict/crossing point. Linemarking (including the yellow paint on the crossing) and signs clearly communicate to motorists that they must give way to pedestrians and cyclists on the crossing who have priority. The approach to the crossing on the SUP has a lateral shift to accommodate the offset from the Main Road, alert cyclists to the crossing location and assist with managing speeds on the approach to the crossing.

Figure V7.1: Amess St, Carton North Raised Priority Crossing

RPCs should be designed with the following objectives:

1. Crossing locations should be located at desire lines for pedestrians and cyclists to ensure that facilities best serve the road user through efficient and effective crossings
2. The crossing should be flat, continuous, and convenient for path users
3. Raised Priority Crossings should be "safe"
4. Raised Priority Crossings should be considered at a Network level and ensure that there is consistency along a corridor

To achieve the above objectives, RPCs should be designed based on the following principles, which are based on Crossing Sight Distance (CSD) and Safe Intersection Sight Distance (SISD) models from *AGRD Part 4A Section 3*:

1. Manage speeds for cyclists and vehicles at the crossing/conflict point
2. Manage speeds for vehicles and cyclists on the approach to the crossing/conflict point
3. Provide adequate mutual sight distance to allow for appropriate decision-making

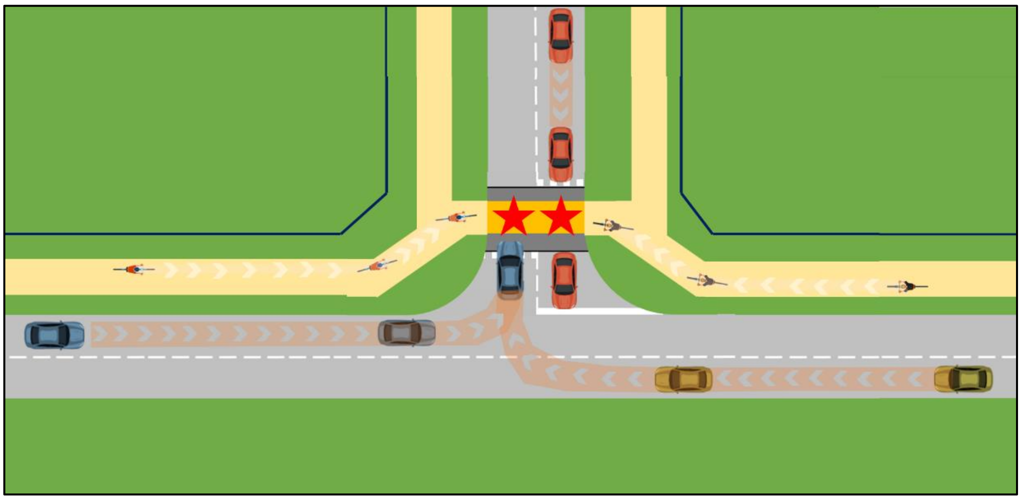


Figure V7.2: Conflict Points at an 'offset' Raised Priority Crossings between vehicles and cyclists

While RPCs provide priority to an intersecting off-road path, it is acknowledged that there may be situations where an approaching vehicle fails to give-way. As such, the *adequate mutual sight distance* principle will help to ensure paths users are able to observe and appropriately respond to such situations.

Further guidance on the following aspects of RPC design is provided within Appendix VC – *Additional Design Considerations for Raised Priority Crossings*:

- How to consider sight distance for approaching off-road path and road users
- Measures to control approaching off-road path and road user speeds
- Preferred configurations for an RPC based on the speed environment of the major route
- Worked example and case study of RPCs

Manage Speeds at the crossing/conflict point

The first principle of a well-designed RPC is to manage the speeds, and therefore energy, at the conflict point. The greater the speed when a conflict occurs, the greater the energy, which results in higher severity injuries for pedestrians and cyclists.

Vehicle speeds at the conflict point are managed by the profiles of the Raised Safety Platforms. These should be designed in accordance with *AS 1742.10* to encourage maximum speeds of 30km/h for vehicles at the conflict point.

Cyclists' speeds also need to be managed at the crossing/conflict point to a target crossing speed of 10km/h-15km/h. The reasons for this target crossing speed of 10km/h-15km/h for cyclists include;

- substantially reduces the likelihood of a high severity injury should a collision occur
- provides greater flexibility for manoeuvring to avoid a collision
- reduces the risk of complex interactions with pedestrians and other cyclists
- provides greater opportunity for motorists to react to avoid a collision

Where there are on-road cycle facilities on approach to the crossing, consideration should be given as to how to transition these cycling facilities safely so that cyclists joining the off-road facility or crossing the road are crossing at a low speed.

Manage speeds on the approach to the crossing/conflict point

Speed management tools need to be used for vehicles and cyclists on the approach to the crossing/conflict point in order that the target speeds at the conflict point are met.

The operating speed of the cycle path will generally be 30km/h and 20km/h for SUP's[1]. Various speed management tools exist to gradually reduce speed on the approach to the crossing to a target speed of about 10km/h. These management tools include;

- Providing a lateral shift in the geometry on the approach to the crossing point. This is achieved when the RPC is offset. It is largely dependent on the available space between the back-of-kerb (BoK) and the right-of-way (RoW)
- Narrowing of the cycle path/SUP to discourage overtaking and reduce speed (similar principles to a "gateway" treatment).
- Introducing rumble strips on approach to the crossing
- Introducing visual countermeasures such as 'SLOW' messaging (on-path &/or sign posted) &/or transverse bars with exposed aggregate to minimise cyclist discomfort

It is important when considering speed management tools for cyclists that they do not reduce safety by introducing unnecessary hazards or complexity for the cyclists. More information about speed management tools on the approach to a crossing are included in Appendix VC-A.

Vehicle speeds are managed on the approach to the crossing point through a number of tools;

- The kerb return radius dictates the maximum turn speed (20km/h or less)
- The offset RPC provides an area to slow (and stop) just before the crossing/conflict point and observe whether any pedestrians or cyclists are about to cross the road. The offset RPC provides an area for vehicles from the main road turning right into the side road to prop. This reduces the complexity of decisions by separating the turning manoeuvre into two stages; choosing a safe gap in the traffic to turn right into the side road and choosing a gap to cross the RPC. Offset RPCs are highly desirable in intermediate speed environments (See Table VC-5, within Appendix VC).
- Left turn deceleration/auxiliary lanes provide an area for vehicles on the main road to decelerate out of the through travel lane and reduce the risk of rear end crashes on the main road while managing approach speeds to the crossing/conflict point on the side road. Left turn deceleration/auxiliary lanes are desirable in low/very low speed environments and highly desirable in intermediate speed environments (See Table VC-5, within Appendix VC)

Provide adequate mutual sight distance to allow for appropriate decision-making

The concepts of providing mutual sight distance for cyclists and vehicles on the approach to the crossing is built on the principles of Safe Intersection Sight Distance in *AGRD Part 4A* Section 3.2.2. Irrespective of who has priority at the crossing point, safe intersection sight distance is provided for all users to allow for appropriate decision-making. These distances for sight distance requirements are based on the approach operating speeds[2]. The sight distances in this document assume that there is adequate lighting (in the form of street lighting) provided on the approach and at the crossing to ensure that there is sight distance during low light conditions.

The maximum practical sight distance should be provided to vehicles and cyclists approaching the conflict/crossing point to create a forgiving environment and allow for time and distance for road-users to adjust and avoid a conflict.

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[1] AGRD Part 6A Section 5.2 states that bicycle paths should generally be designed for a speed of at least 30 km/h. On shared-use paths, *Victoria Walks* recommends that cyclists speeds should be 20km/h or less as supported by Figure C1-1 from AGRD Part 6A.

[2] See AGRD Part 3 Section 3.2.2 for more information about the operating speed

The sight lines between motorists and pedestrians and cyclists should be clear of obstructions (as much as is reasonably practical) such as buildings, vegetation, property boundaries (fences), roadside furniture (signs and bus stops), and parked vehicles. Sight lines are measured from a driver's eye height of 1.1m to a cyclist height of 1.4m.

The sight distance that is provided is linked to the selection of a "travel time" for which sight distance scenarios should be checked. Higher "travel times" are required for higher speed environments to take into account the higher risk of severity outcomes and also the effect speed has on the narrowing of the field of view (lateral perception).

Where higher "travel times" result in sight distances that cannot be met, designers should firstly introduce greater speed management tools for pedestrians and cyclists. However, there may be limited opportunities to introduce speed management tools in constrained environments. If, after introducing further speed management tools, reasonable sight distance values still cannot be met, designers should check lower "travel times".

If sight distances still cannot be achieved when checking lower "travel times", then designers should consider whether priority can be provided safely for pedestrians and cyclists.

7.4 Ancillary Devices for Intersections of Paths with Roads

7.4.2 Holding Rails

Additional Information

Holdings rails (*AGRD Part 6A, Figure 10.8*) should only be provided where there is a reasonable likelihood that cyclists will have to stop at intersections with roadways or paths. For example, they should not be provided at the intersections of paths with local streets where it is unlikely cyclists will have to stop and wait.

To avoid the unnecessary proliferation of holding rails, they should not be installed at traffic islands or approaches to signalised intersections unless demand has been identified.

A sign extension (*AGRD Part 6A, Figure 10.8*) should not be used in close proximity to road carriageways or where cyclists would turn in close proximity to the sign extension.

Figure V10.1 shows DoTs preferred kerb ramp and holding rail layout details.

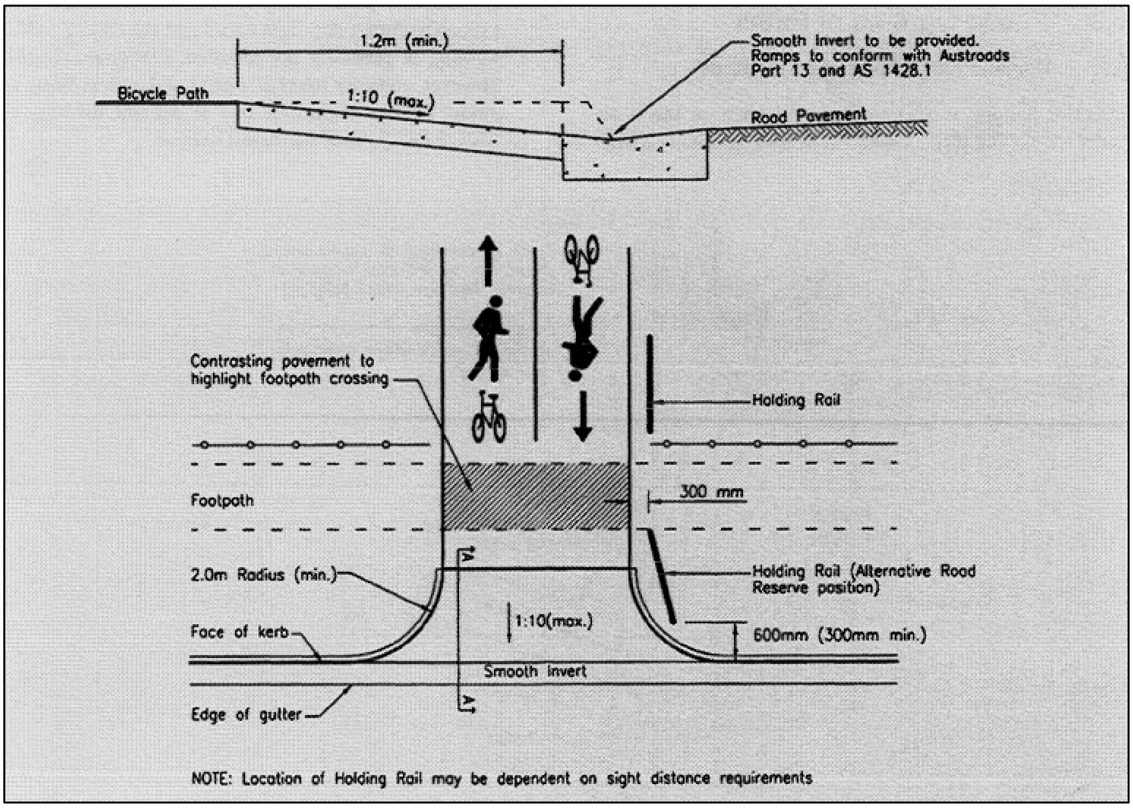

Figure V7.3: Kerb Ramp & Holding Rail Layout Details (from GTEP Part 14, Figure 6.44)

8 Paths at Structures

8.2 Road Bridges

Additional Information

In addition to providing a bicycle and/or pedestrian path across (or under) a structure equivalent to an approaching path type, practitioners should consider steps outlined within Section 2.1 of this Supplement regarding *Path Selection Considerations* when determining an appropriate on-structure path type. This will help to ensure that the adopted path type is able to meet the predicted demand and needs of path users across the lifespan of the structure.

Furthermore, bicycle operating speeds (discussed in Section 5.4 of this Supplement) should be considered where notable path gradients are being introduced on approach to a structure. In such instances, an equivalent approaching path type, which may have lower gradients and bicycle operating speeds, may be insufficient to appropriately cater for path user needs (discussed in Section 3.1 of this Supplement), meaning a higher order path type may be more appropriate.

8.2.1 Use of Pedestrian Paths on Narrow Bridges

Additional Information

Full Integration of Cyclists

Where it is not possible to meet the criteria identified in *AGRD Part 6A* it may be necessary for commuter cyclists to share narrow traffic lanes with motor vehicles. Integration of all cyclists with motor vehicles is only appropriate on roads having an Annual Average Daily Traffic (AADT) of less than 3000 vehicles per day, and where a low-speed traffic environment exists, particularly where the proportion of young and inexperienced cyclists is significant. Bicycle access should be maintained, but the route should not be signed as part of the local bicycle route network. If the bicycle demand is significant (e.g. > 200 bicycles per day), then the provision of bicycle specific facilities on the bridge should be considered.

References

Acronyms

AGRD: Austroads Guide to Road Design
AGTM: Austroads Guide to Traffic Management
AS: Australian Standard
DoT: Department of Transport
LoTS: Level of Traffic Stress
LoS: Level of Service
M&P: Movement and Place
GTEP: Guide to Traffic Engineering Practice (superseded)
RDN: Road Design Note
SUP: Shared Use Path

Documents:

AS 1428.1 (2021). Design for Access and Mobility Part 1: General requirements for access.
AS 1742.10 (2009). Manual for uniform traffic control devices, Part 10: Pedestrian control and protection
Austroads (2021). Austroads Guide to Road Design – Part 3: Geometric Design.
Austroads (2021). Austroads Guide to Road Design – Part 4: Intersections and Crossings - General.
Austroads (2021). Austroads Guide to Road Design – Part 4A: Unsignalised and Signalised Intersections.
Austroads (2021). Austroads Guide to Road Design – Part 5: Drainage – General and Hydrology Considerations.
Austroads (2022). Austroads Guide to Road Design – Part 6: Roadside Design, Safety and Barriers.
Austroads (2021). Austroads Guide to Road Design – Part 6B: Roadside Environment.
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VicRoads (latest). VicRoads Supplement to AGRD Part 6B: Roadside Environment.
VicRoads (various). VicRoads Standard Drawings for Roadworks.
VicRoads Traffic Engineering Manual Volume 1 – Traffic Management.
VicRoads Traffic Engineering Manual Volume 2 – Signs and Markings.

Appendices

Appendix VA

Movement and Place Cycling and Walking Project Performance Indicator Descriptions and Targets

Appendix VB

Pedestrian Delay and Exposure (From GTEP Part 13 Appendix E)

Appendix VC

Additional Design Considerations for Raised Priority Crossings

Appendix VA M&P Cycling and Walking Project Performance Indicator Descriptions and Targets

Additional information

User need	Indicator	Levels of service					Performance targets							
		LOS A – Very high levels of performance	**LOS B – High levels of performance**	**LOS C – Fair levels of performance**	**LOS D – Low levels of performance**	**LOS E – Very low levels of performance**	C1	C2	C3	C4	CD	CNP	CT	CR
Safety	Level of traffic stress - cycling	LTS is 1 throughout	LTS is 2 throughout	LTS is 2 or better for over 80% of route, and LTS is not worse than LTS 3 in any location	LTS is 2 or better for over 50% of route, and LTS is not worse than LTS 3 in any location	LTS is 2 or better for under 50% of the route, or any section of the route is LTS 4.	B	B	B	B	D	E	D	B
Safety	Lighting provision and passive surveillance	Route is well lit (typical column spacing <25m, path fully visible) Route is overlooked at all times.	Route is well lit (typical column spacing <25m, path fully visible) Route passes close to activity at all times.	Route is well lit (typical column spacing <25m, path fully visible) Route passes close to activity for most of the day.	Route is not well lit (typical column spacing >25m, path not fully visible) Route passes close to activity for most of the day.	Route is not well lit (typical column spacing >25m, path not fully visible) Route is largely away from activity.	A	B	B	C	C	C	C	B
Safety	Sight lines	Clear line of sight (15m) from all directions. No enclosed areas/hiding spots through obstructions such as landscaping or fencing.	Route is largely open with no enclosed areas. There are no obstructions obscuring line of site.	For short distances along the route obstructions such as landscaping or fencing obscure line of sight.	Sight lines are obstructed for long distances along the route. Sections of route are enclosed, limiting escape opportunity.	Sight lines are obstructed along the length of the route. Route is enclosed limiting escape opportunity.	A	B	B	C	C	C	C	B
Comfort	Effective width for cycling (one-way)	Over 3m effective width	2.51-3m width	2.01-2.5m	1.5-2m	Less than 1.5m	Varies by Place (see additional table)							
Comfort	Interaction with pedestrians & other non-motorised modes	Cycling and walking are separated, and conflict points are well managed (signalised or designated uncontrolled crossing points of cycle routes).	Cycling and walking are separated, and conflict points are generally well managed (signalised or designated uncontrolled crossing points of cycle routes).	Cycling and walking share space, minimum of 3m path width provided	Cycling and walking are separated, and conflict points are poorly managed (uncontrolled crossing of cycle routes in non-designated locations).	Cycling and walking share space, less than 3m path width provided	Varies by Place (see additional table)							
Comfort	Requirement to stop	No stopping required – 0.4 stops/km	Required to stop 0.5 to 2 times every km	Required to stop 3 to 5 times every km	Required to stop 6 to 8 times every km	May be required to stop more than 8 times every km	Varies by Place (see additional table)							
Coherence	Connectivity to low stress cycling links	Less than 200m to connection with C1-C4 route	200-400m to connection with C1-C4 route	400-600m to connection with C1-C4 route	600-800m to connection with C1-C4 route	Over 800m to connection with C1-C4 route	A	A	B	B	B	B	D	D
Coherence	Wayfinding	Complete and consistent cycle specific wayfinding at decision points with confirmatory wayfinding at least every 150m	Complete and consistent wayfinding at decision points with confirmatory wayfinding every 150-250m	Consistent wayfinding at key decision points, no confirmatory wayfinding in between, or spaced >250m.	Some wayfinding, but large parts inadequate or missing.	Other than street signs no wayfinding is provided.	A	A	B	B	C	C	C	B
Directness	Delay intersections	Less than 10 second delay	10-30 second delay	30 – 60 second delay	60-120 second delay	> 120 second delay	B	B	C	C	C	C	C	C
Attractive-ness	Traffic nuisance (noise smell, air quality)	No nuisance from passing motorised traffic	Minimal nuisance from passing motorised traffic	Some traffic nuisance from passing motorised traffic	High traffic nuisance from passing motorised traffic	Very high traffic nuisance from passing motorised traffic	B	B	B	B	D	D	C	A
Attractive-ness	Wind protection	Route is largely protected from wind by vegetation and/or structures	N/A	Route is partially protected from wind by vegetation and/or structures	N/A	Large sections of route are exposed to wind	C	C	C	C	C	C	C	C

Source: Movement & Place Guidance Note – M&P Cycling (DoT) – Version 2.0 (26/11/2020)

Additional information

Below are performance requirements for local level indicators where the target varies by Place.

Effective width for cycling (one-way)

Place/Cycle classification	C1	C2	C3	C4	CD	CNP	CT	CR
P1	B	B	B	B	D	B	B	B
P2	B	B	C	C	D	C	B	B
P3	B	B	C	C	D	C	B	B
P4	B	B	C	C	D	C	B	B
P5	B	B	C	C	D	C	B	B

Interaction with pedestrians & other non-motorised modes (local level)

Place/Cycle classification	C1	C2	C3	C4	CD	CNP	CT	CR
P1	A	A	B	B	B	B	B	C
P2	A	A	B	B	B	B	B	C
P3	A	B	B	B	B	B	B	C
P4	A	B	C	C	C	C	B	C
P5	A	B	C	C	C	C	B	C

Requirement to stop

Place/Cycle classification	C1	C2	C3	C4	CD	CNP	CT	CR
P1	B	C	C	C	C	C	C	C
P2	B	B	B	C	C	C	B	C
P3	A	B	B	C	C	C	B	C
P4	A	B	B	C	C	C	B	C
P5	A	B	B	C	C	C	B	C

Source: Movement & Place Guidance Note – M&P Cycling (DoT) – Version 2.0 (26/11/2020)

User need	Indicator	Levels of service					Performance targets					
		LOS A – Very high levels of performance	**LOS B – High levels of performance**	**LOS C – Fair levels of performance**	**LOS D – Low levels of performance**	**LOS E – Very low levels of performance**	**W1**	**W2**	**W3**	**W4**	**W5**	**WR**
Safety	Interaction with motorised traffic	Permanent low speed (≤40 km/h)	Low to moderate speed (between 41km/h and 50 km/h). This includes 50km/h service roads on the arterial network. e.g. residential streets	Moderate to high speed (between 51 km/h and 60 km/h) **AND** moderate levels of traffic AADT < 10,000 e.g. Booran Rd (5,500), Tooronga Road (7,500), Burwood Roads (9,500), GT3 if no other data available	Moderate to high speed (between 51 km/h and 60 km/h) **AND** higher levels of traffic AADT >10,000 e.g. Warrigal Road (16,000), Williams Road (11,000), GT2 arterial roads if no other data available	High speed (>60 km/h)	A	B	B	A	C	A
	Interaction with non-motorised modes	Walking and cycling are separated, and conflict points are well managed.	Walking and cycling are separated, and conflict points are generally well managed.	Walking and cycling share space, minimum of 3m path width provided	Walking and cycling share space, less than 3m path width provided	Walking and cycling share space, less than 3m path width provided and conflict points are poorly managed	B	B	C	C	C	C
	Footpath congestion	Unrestricted speed and minimal manoeuvring <7 ped/min/m (width)	Occasional need to adjust path to avoid conflicts 7 – 23 ped/min/m	Walking speed and ability to pass slower pedestrians restricted 23 – 33 ped/min/m	Walking speed restricted and reduced, with very limited ability to pass slower pedestrians 33 – 49 ped/min/m	Walking speeds severely restricted, with unavoidable conflicts and frequent stoppages >49 ped/min/m	B	B	B	A	A	B
	Lighting provision and feeling of safety	Route is well lit (typical column spacing <25m, path fully visible) Route passes close to activity for the majority of the day.	N/A	Route is well lit (typical column spacing <25m, path fully visible) Route passes close to activity for some of the day.	N/A	Route is not well lit (typical column spacing >25m, path not fully visible) Route is largely away from activity.	A	C	C	C	C	C
	Sight lines	Clear line of sight (15m) from all directions. No enclosed areas/hiding spots through obstructions such as landscaping or fencing.	Route is largely open with no enclosed areas. There are no obstructions obscuring line of site.	For short distances along the route obstructions such as landscaping or fencing obscure line of sight.	Sight lines are obstructed for long distances along the route. Sections of route are enclosed, limiting escape opportunity.	Sight lines are obstructed along the length of the route. Route is enclosed limiting escape opportunity.	A	B	B	C	C	B
Efficiency	Crossing opportunity	Can cross safely* more than every 50m	Can cross safely* every 50-100m	Can cross safely* every 100-200m	Can cross safely* every 200-400m	Can cross safely* every 400m or less frequently	B	C	C	C	E	D
	Crossing delay	Less than 10 second delay	10-30 second delay	30 – 60 second delay	60-90 second delay	> 90 second delay	B	B	B	C	D	D
	Wayfinding	Complete and consistent wayfinding at decision points with confirmatory wayfinding at least every 250m	Complete and consistent wayfinding at decision points with some confirmatory wayfinding	Consistent wayfinding at key decision points, no confirmatory wayfinding in between.	Some wayfinding, but large parts inadequate or missing.	Other than street signs no wayfinding is provided.	B	B	C	C	C	B

Source: Movement & Place Guidance Note – M&P Walking (DoT) – Version 1.0 (26/11/2020)

Appendix VB Pedestrian Delay and Exposure (from GTEP Part 13 Appendix E)

Appendix E
Pedestrian Delay And Exposure

E1 DELAY TO PEDESTRIANS CROSSING THE ROAD

Considerable research effort has been expended in developing methods of predicting the proportion of pedestrians likely to be delayed and their average delay for a variety of road crossing situations. In the case of an uncontrolled crossing situation on a road having a low degree of platooning, the proportion delayed may be calculated using traditional gap acceptance theory:

$$Pr = 1 - (1 - t_m q)e^{-\lambda(t_c - t_m)}$$

where

Pr is the probability of a pedestrian being delayed

q is the vehicle flow on the road to be crossed (veh/s)

t_m is the average headway between bunched vehicles. Use 2 divided by the number of lanes.

t_c is the critical acceptance gap required by pedestrians to cross the road (s). This is dependant upon the assumed walking speed of pedestrians.

λ is the delay constant given by

$$\lambda = \frac{(1 - \theta)q}{1 - t_m q}$$

θ is the proportion of bunched vehicles. A good estimate of the proportion of bunched vehicles is given in the AUSTROADS GTEP Part 6 (Roundabouts) for circulating flow. Recommended values are between

$$1 - e^{-2.5t_m q} \quad \text{and} \quad 1 - e^{-3.0t_m q}$$

The average delay to all pedestrians is given by:

$$d = \frac{e^{\lambda(t_c - t_m)}}{(1 - \theta)q} - t_c - \frac{1}{\lambda} + \frac{\lambda t_m^2 - 2t_m\theta}{2(\lambda t_m - 1 - \theta)}$$

The average delay to those pedestrians who are delayed is given by the following equation:

$$d_{d>0} = \frac{d}{Pr}$$

However, when platooning of the flow exists (as it does on most urban arterial roads) , or where the crossing occurs at a 'controlled traffic ' facility, the relationships become somewhat more complex and the data input requirements increase. Models for the latter have been developed in the UK (by Compton and Goldschmidt). No similar pedestrian related research has been undertaken in Australia although the work done by Troutbeck (1990a), (1990b) and Akcelik and Troutbeck (1991), in taking account of 'traffic bunching' in the analysis of traffic operation at roundabouts and other unsignalised intersections, could be applied to the analysis of delay to pedestrians crossing heavily trafficked urban roads.

E2 PEDESTRIAN SAFETY:EXPOSURE AND CONFLICT

Any street in which space is intermittently shared by pedestrians and vehicles places pedestrians at "risk". Whilst it is not easy to predict this "risk" directly, positive correlations have been found between levels of pedestrian activity and vehicular traffic volumes.

Appendix VC Additional Design Considerations for Raised Priority Crossings

The following should be read in conjunction with *Design Principles and Objectives for Raised Priority Crossings (RPCs),* discussed in Section 7.3.1 of this Supplement. This guidance provides design principles for the safe and efficient design of RPCs, along with an assessment process for checking an RPC design against these principles. This content should be treated as a guideline and not a technical standard.

1 Design Principles for an RPC

1.1 Manage speeds at the crossing/conflict point

The first principle of a well-designed RPC is to manage the speeds, and therefore energy, at the conflict point. The greater the speed when a conflict occurs, the greater the energy, which results in higher severity injuries for pedestrians and cyclists.

Vehicle speeds at the conflict point are managed by the profiles of the Raised Safety Platforms. These should be designed in accordance with *AS 1742.10* to encourage maximum speeds of 30km/h for vehicles at the conflict point.

Cyclists' speeds also need to be managed at the crossing/conflict point to a target crossing speed of 10km/h-15km/h. The reasons for this target crossing speed of 10km/h-15km/h for cyclists include;

- substantially reduces the likelihood of a high severity injury should a collision occur
- provides greater flexibility for manoeuvring to avoid a collision
- reduces the risk of complex interactions with pedestrians and other cyclists
- provides greater opportunity for motorists to react to avoid a collision

Where there are on-road cycle facilities on approach to the crossing, consideration should be given as to how to transition these cycling facilities safely so that cyclists joining the off-road facility or crossing the road are crossing at a low speed.

1.2 Manage speeds on approach to the crossing/conflict point

Speed management tools need to be used for vehicles and cyclists on the approach to the crossing/conflict point in order that the target speeds at the conflict point are met.

The operating speed of the cycle path will generally be 30km/h and 20km/h for SUP's[3]. Various speed management tools exist to gradually reduce speed on the approach to the crossing to a target speed of about 10km/h. These management tools include;

- Providing a lateral shift in the geometry on the approach to the crossing point. This is achieved when the RPC is offset. It is largely dependent on the available space between the back-of-kerb (BoK) and the right-of-way (RoW)
- Narrowing of the cycle path/SUP to discourage overtaking and reduce speed (similar principles to a "gateway" treatment).
- Introducing rumble strips on approach to the crossing
- Introducing visual countermeasures such as 'SLOW' messaging (on-path &/or sign posted) &/or transverse bars with exposed aggregate to minimise cyclist discomfort

[3] AGRD Part 6A Section 5.2 states that bicycle paths should generally be designed for a speed of at least 30 km/h. On shared-use paths, *Victoria Walks* recommends that cyclists speeds should be 20km/h or less as supported by Figure C1-1 from AGRD Part 6A.

It is important when considering speed management tools for cyclists that they do not reduce safety by introducing unnecessary hazards or complexity for the cyclists. More information about speed management tools on the approach to a crossing are included in Appendix VC-A.

Vehicle speeds are managed on the approach to the crossing point through a number of tools;

- The kerb return radius dictates the maximum turn speed (20km/h or less)
- The offset RPC provides an area to slow (and stop) just before the crossing/conflict point and observe whether any pedestrians or cyclists are about to cross the road. The offset RPC provides an area for vehicles from the main road turning right into the side road to prop. This reduces the complexity of decisions by separating the turning manoeuvre into two stages; choosing a safe gap in the traffic to turn right into the side road and choosing a gap to cross the RPC. Offset RPCs are highly desirable in intermediate speed environments (See Table VC-5).
- Left turn deceleration/auxiliary lanes provide an area for vehicles on the main road to decelerate out of the through travel lane and reduce the risk of rear end crashes on the main road while managing approach speeds to the crossing/conflict point on the side road. Left turn deceleration/auxiliary lanes are desirable in low/very low speed environments and highly desirable in intermediate speed environments (See Table VC-5)

1.3 Provide adequate mutual sight distance to allow for appropriate decision making

The concepts of providing mutual sight distance for cyclists and vehicles on the approach to the crossing is built on the principles of Safe Intersection Sight Distance in *AGRD Part 4A* Section 3.2.2. Irrespective of who has priority at the crossing point, safe intersection sight distance is provided for all users to allow for appropriate decision-making. These distances for sight distance requirements are based on the approach operating speeds[4]. The sight distances in this document assume that there is adequate lighting (in the form of street lighting) provided on the approach and at the crossing to ensure that there is sight distance during low light conditions.

The maximum practical sight distance should be provided to vehicles and cyclists approaching the conflict/crossing point to create a forgiving environment and allow for time and distance for road-users to adjust and avoid a conflict.

The sight lines between motorists and pedestrians and cyclists should be clear of obstructions (as much as is reasonably practical) such as buildings, vegetation, property boundaries (fences), roadside furniture (signs and bus stops), and parked vehicles. Sight lines are measured from a driver's eye height of 1.1m to a cyclist height of 1.4m.

The sight distance that is provided is linked to the selection of a "travel time" for which sight distance scenarios should be checked. Higher "travel times" are required for higher speed environments to take into account the higher risk of severity outcomes and also the effect speed has on the narrowing of the field of view (lateral perception).

Where higher "travel times" result in sight distances that cannot be met, designers should firstly introduce greater speed management tools for pedestrians and cyclists. However, there may be limited opportunities to introduce speed management tools in constrained environments. If, after introducing further speed management tools, reasonable sight distance values still cannot be met, designers should check lower "travel times".

If sight distances still cannot be achieved when checking lower "travel times", then designers should consider whether priority can be provided safely for pedestrians and cyclists.

[4] See AGRD Part 3 Section 3.2.2 for more information about the operating speed

2 Assessing an RPC by checking Sight Distance

Assessing sight distances for an RPC is a way designers can evaluate the safety of a RPC against the principles in Section 2. The values that are documented in this section have been developed from theoretical sight distance models contained in Austroads Guide to Road Design. It is important that as more RPCs are installed across the network, that the values and parameters in this section are updated to reflect best practice for providing safe and efficient crossings.

This section steps through the process of checking sight distance for motorists and cyclists approaching the crossing. This section focusses on cyclists (on the path) and motorists (on the road) as these represent the fastest approach speeds. It is assumed that if sight distance criteria is adequate for cyclists and motorists, that it will also meet requirements for pedestrians (on the path) and cyclists (on the road).

Designers should refer to Appendix VC-C which demonstrates a worked example.

2.1 Select "travel time" for sight distance check

To be able to check sight distance scenarios, firstly a 'travel time'[5] for a motorist approaching the intersection must be selected. The selected travel time is the time that passes as a motorist travels from where they first observe a cyclist approaching the crossing, to the point of conflict on the crossing. The highest practical 'travel time' should be selected as this will result in greater mutual sight distance between cyclists and motorists and allow for safer decisions to be made.

For intermediate speed zones, 3 seconds travel time should be considered a minimum with 4 seconds travel being desirable and 5 seconds travel as highly desirable. In lower speed environments, it may be appropriate to select lower travel times depending on the context. Based on *AGRD Part 4A Section 3.2.2*, 3 seconds of mutual observation time be provided on the approach to the crossing/conflict point. Observation times of less than 3 seconds are commented in *AGRD Part 4 Section A.2.4*. In addition to observation time, reaction time should be provided to allow for the motorist to respond (brake) to a cyclist approaching or on the crossing.

Table VC-1: Selected Travel Times for Sight Distance Checks

Selected Travel Time	Comment
5.0 seconds travel time (3.0 sec observation time + 2.0 sec reaction time)	Highly Desirable for Intermediate Speed Environments (70km/h and 80km/h)
4 sec travel (2.0 sec observation time + 2.0 sec reaction time)	Desirable for Intermediate Speed Environments (70km/h and 80km/h)
3 sec travel (1.5 sec observation time + 1.5 sec reaction time)	Minimum for Intermediate Speed Environments (70km/h and 80km/h). This value is generally acceptable for low-speed environments
2 sec travel (0.5 sec observation time + 1.5 sec reaction time)	Should only be used in scenarios that are highly constrained. Not recommended for Intermediate Speed Environments (70km/h and 80km/h). This value may be appropriate in some low-speed environments.

[5] The 'travel time' is the same as the 'decision time' (refer to AGRD Part 4A) and is a combination of the observation time and the reaction time

2.2 Checking sight distance from the Main Road

The diagrams and table below demonstrate how sight distance checks are undertaken to ensure mutual sight distance is achieved for motorists and cyclists. Essentially, the distance “a” is dictated by the speed of cyclists. The higher the speed, the greater the distance from the RPC that cyclists need to be visible by motorists.

The distance “b” is dictated by the approach speed of motorists. The higher the speed, the greater the distance from the RPC that a motorist needs to be able to see a cyclist.

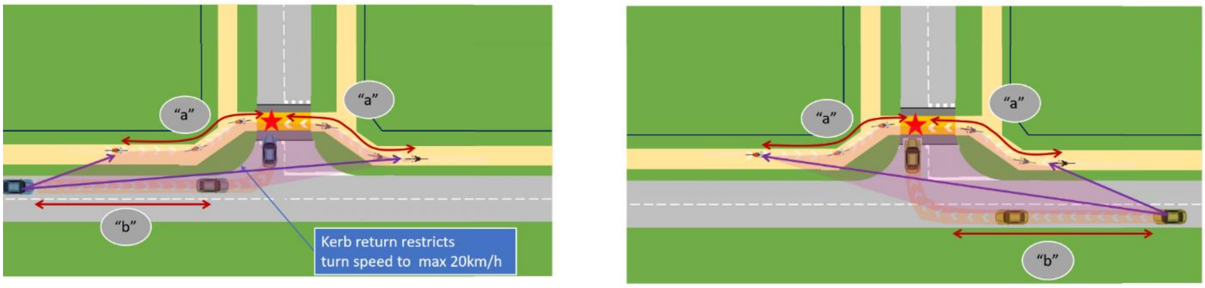


Diagram VC-1: Sight Distance Check Scenario 1 (left) and Sight Distance Check Scenario 2 (right)

Distance “a” is based on the travel time on the approach where a cyclist must be visible to a motorist. Distance “a” measured from the conflict point along the travel path based on average cyclist approach speed.

The average approach speed needs to be selected based on the speed management devices that have been used. If no speed management has been implemented, then it must be assumed that the average approach speed will be 30km/h. For SUP’s, a maximum average approach speed of 20km/h should be used.

Determining the average speed requires engineering judgement about how effective speed management devices are at reducing the speed from the operating speed the bicycle path or SUP to the target crossing speed of around 10km/h.

Table VC-2: Distance “a” for sight distance checks based on approach speed and selected travel time

Selected Travel Time	“a” for average approach speed of **30km/h (8.33m/s)**	“a” for average approach speed of **25km/h (6.94m/s)**	“a” for average approach speed of **20km/h (5.55m/s)**	“a” for average approach speed of **15km/h (4.16m/s)**
5.0 sec travel (3.0 sec observation time + 2.0 sec reaction time)	42m	35m	28m	21m
4 sec travel (2.0 sec observation time + 2.0 sec reaction time)	34m	28m	22m	17m
3 sec travel (1.5 sec observation time + 1.5 sec reaction time)	25m	21m	17m	13m
2 sec travel (0.5 sec observation time + 1.5 sec reaction time)	17m	14m	11m	8m

Distance “b” is the point where mutual sight distance from a motorist to a cyclist must be provided. This is depicted by the purple arrows in diagrams showing Check Scenario 1 and Check Scenario 2. Sight distance should be checked from a driver’s eye height of 1.1m to a cyclist’s eye height of 1.4m. The purple shaded area shows the area where sight distance to a cyclist must be maintained (as much as is as reasonably practicable).

Distance “b” is based on the travel time selected to determine distance “a”. Distance “b” is measured from the start of the kerb return to the point in the travel lane for Check Scenario 1. Distance “b” is measured to the start of the turn radius for Check Scenario 2.

The distance “b” is determined by the proportion of time[6] required to decelerate from the operating[7] speed to exit curve speed of 20km/h from *AGRD Part 4A* Table 5.2. The exit curve speed in this case is the maximum turn speed for Check Scenario 1 and 2 of 20km/h. The deceleration rate that has been used for vehicles is 2.5m/s.

[6] This is the proportional time of the deceleration distance from *AGRD 4A Table 5.2.* Distance “b” = (selected travel time/deceleration time for the distance in Table 5.2) * deceleration distance from Table 5.2

[7] The operating speed on the approach to the RPC may be lower than the posted speed. The operating speed may be dictated by the approach geometry (horizontal curve controlling operating speed) of speed management treatments (such as speed cushions). See Austroads Guide to Road Design Part 3 Section 3.2.2.

Table VC-3: Distance "b" for sight distance checks based on approach speed and selected travel time

Operating Approach Speed of Main Road	Distance "b" measured to the start of the kerb return for various travel times			
	5 sec travel time	4 sec travel time	3 sec travel time	2 sec travel time
80km/h (22.22m/s)	74m	59m	44m	30m
70km/h (19.44m/s)	68m	54m	41m	27m
60km/h (16.67m/s)	65m	50m	38m	25m
50km/h (13.89m/s)	62m	48m	35m	23m
40km/h (11.11m/s)	56m	44m	33m	22m
30km/h (8.33m/s)	46m	38m	30m	25m

For Sight Distance Check Scenario 2, a vehicle may prop if they are not able to turn due to insufficient gaps in the opposing traffic. Sight lines should be checked from the prop point to ensure that there is visibility to cyclists approaching the crossing once they have selected an appropriate gap and commenced the turn.

2.3 Sight distance checks for the Side Road

The sight distance check for the Side Road is similar to the Main Road. However, the speed environments may be lower compared with the Main Road.

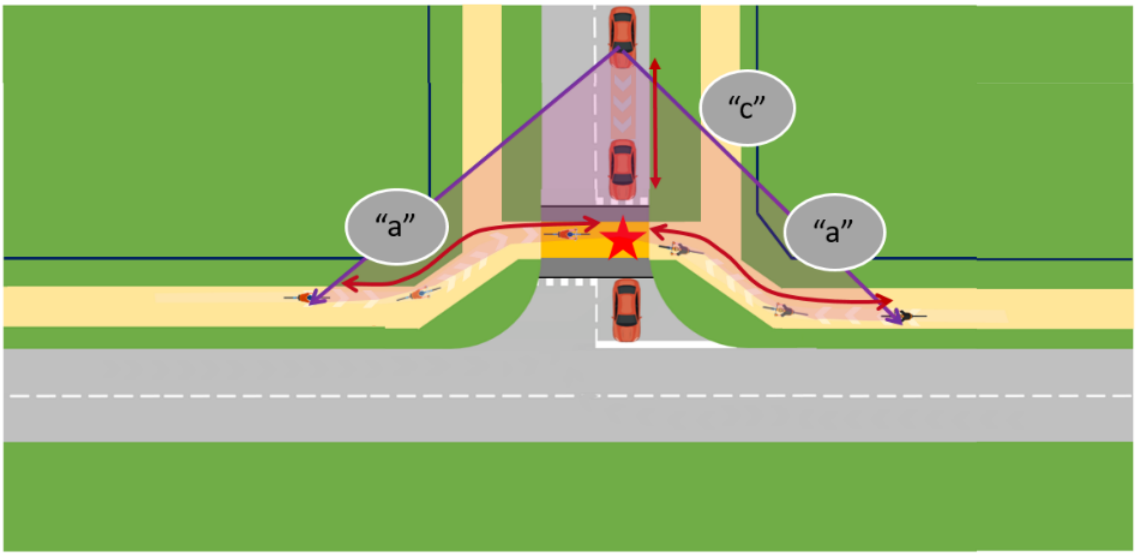


Diagram VC-2: Sight Distance Check Scenario 3

The distance "c" is calculated based on the travel time selected for Sight Distance Check Scenario 1 and 2.

The distance "c" is determined by the proportion of time required to decelerate from the operating speed to the give-way line on the approach to the RPC (deceleration distances have been used from *AGRD Part 4A* Table 5.2). The deceleration rate that has been used for vehicles is 2.5m/s.

Table VC-4: Distance "c" for sight distance checks based on approach speed and selected travel time.

Operating Approach Speed of Side Road	Distance "c" measured to the start of the kerb return for various travel times			
	5 sec travel time	4 sec travel time	3 sec travel time	2 sec travel time
80km/h (22.22m/s)	56m	44m	33m	22m
70km/h (19.44m/s)	49m	39m	29m	19m
60km/h (16.67m/s)	42m	33m	25m	17m
50km/h (13.89m/s)	35m	28m	21m	14m
40km/h (11.11m/s)	28m	22m	17m	11m
30km/h (8.33m/s)	21m	17m	13m	8m

For local streets, it may not be possible to achieve sight distances due to property boundaries. Engineering judgement will need to be used to determine the safety of RPC's where sight lines may be partially obstructed. Additional traffic calming measures (such as speed cushions) may need to be installed to ensure a very slow approach speed for vehicles on approach to the crossing.

3 RPCs in Very Low, Low and Intermediate Speed Environments

Table VC-5 provides a summary of the criteria for Raised Priority Crossings for side roads in various contexts. The various arrangements for RPCs on Side Roads is dependent on the speed environment and the factor of safety required to reduce the likelihood and severity of a fatal or serious injury should a crash occur.

It is desirable in intermediate speed environments to offset an RPC and provide a deceleration lane (where required) to reduce the risk of sudden braking resulting in an increased risk of rear-end crashes.

Table VC-5: Raised Priority Crossing (RPC) criteria on side roads for differing speed environments

Posted Speed of Main Carriageway		Offset of RPC to Main Carriageway	Left turn auxiliary lane on Main Carriageway	Speed Management for Cyclists	Sight Distance Checks for Vehicles and cyclists
Intermediate Speed	**80km/h**	Highly Desirable	Highly Desirable	Highly Desirable	Highly Desirable
	70km/h	Highly Desirable	Desirable	Highly Desirable	Highly Desirable
Low Speed	**60km/h**	Desirable*	Based on traffic volumes	Desirable	Desirable
	50km/h	Kerb Build Outs or RPC offset	Based on traffic volumes	Where assessed as required	Desirable
Very Low Speed	**30km/h or less**	Kerb Build Outs or RPC offset	Based on traffic volumes	Where assessed as required	Desirable

* Offset of RPC to Main Carriageway may be dictated by Sight Distance (SISD) requirements of Side Road vehicles

4 Raised Priority Crossings at Slip Lanes

The design and check for safety for Raised Priority Crossings at slip lanes follows the same objectives and principles that have been documented in this RDN. Vehicle and cyclist speeds should be managed on the approach and at the crossing/conflict point. Sight distance checks should be done to ensure there is adequate mutual sight distance. The distances “a” and “c” are based on the assumed speeds on the approach to the crossing/conflict point. The same methodology for the distances for designing RPCs at Side Roads should apply to slip lanes as shown in diagram VC-3.

The geometry on the approach to an RCP on a slip lane should be designed to keep the average speed of cyclists on the approach to 15km/h (see Table VC-2). High-speed approaches (often straight alignments with little or no speed management devices) for cyclists should be avoided.

It should be assumed that the speeds of cyclists on approach to the crossing from the signalised crossing (from the right on diagram VC-3) should be measured at 15km/h. It is most likely that speeds on the signalised crossing will be much lower than this, but an approach speed of 15km/h represents a conservative value.

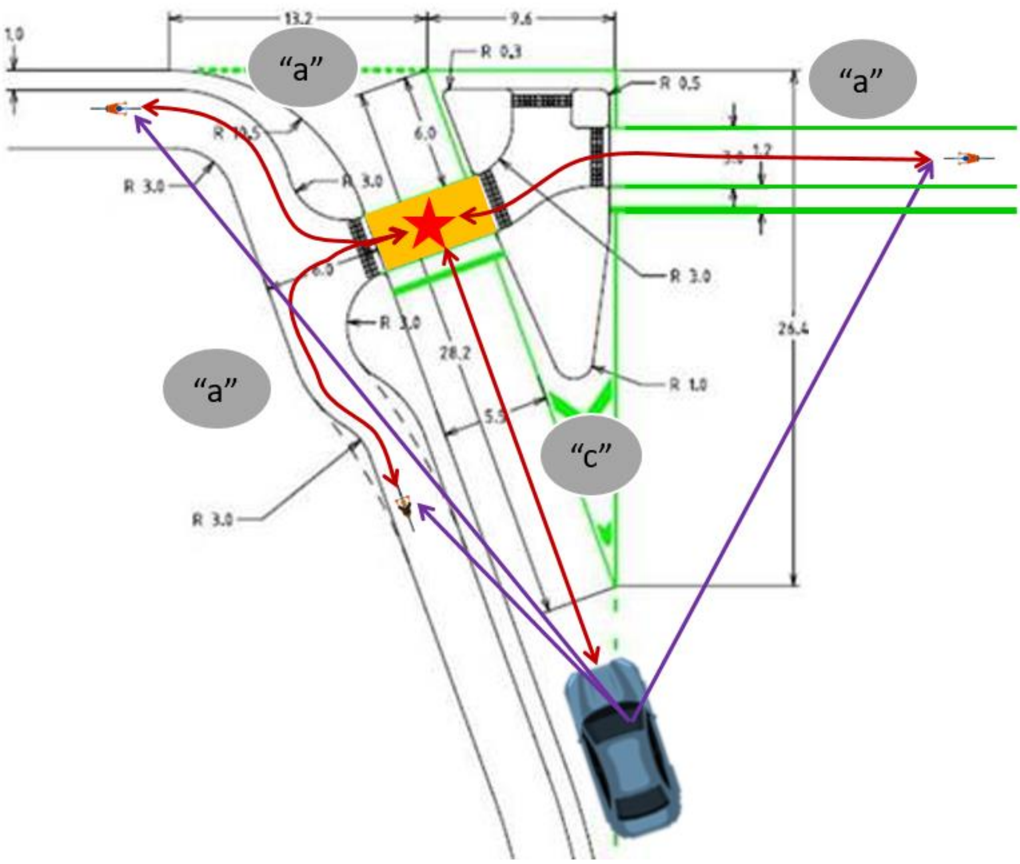


Diagram VC-3: Sight Distance Check for Raise Priority Crossings on slip lanes

5 Midblock Raised Priority Crossings

Midblock Raised Priority Crossing's follow the same principles as crossing on side roads.

It is important that the speeds of cyclists are managed on the approach to the crossing to enable adequate mutual sight distance for motorists on the approach to the crossing.

Sight lines from motorists to cyclists should be as free of visual obstructions such as parked vehicles, property boundaries, vegetation, buildings, and roadside furniture as much as is reasonably practical.

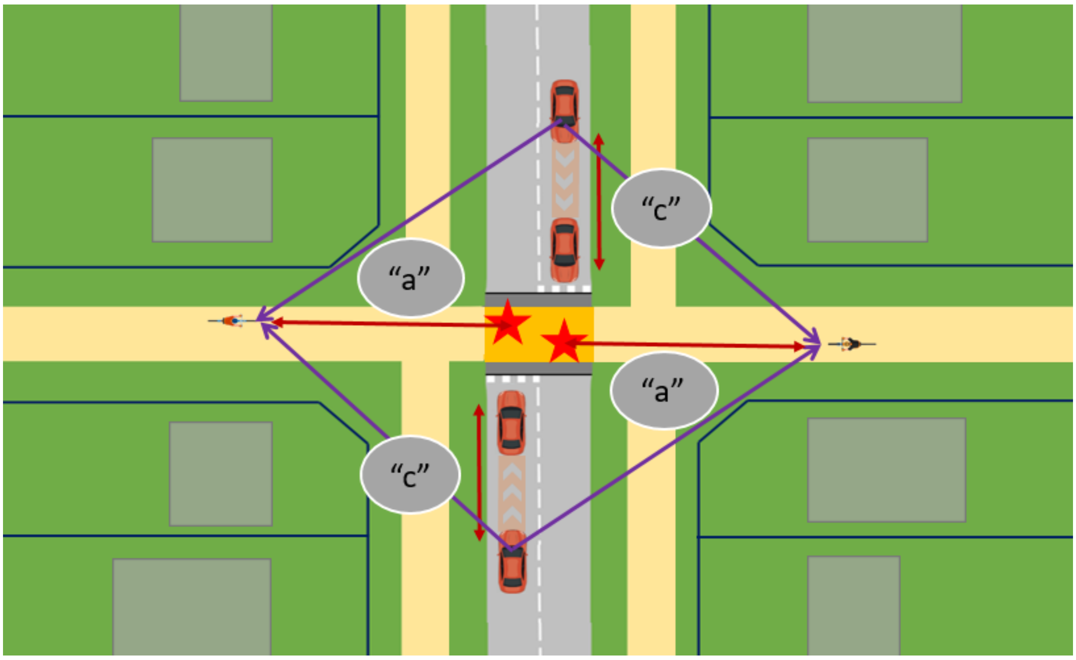


Diagram VC-4: Sight Distance Check for Midblock Raise Priority Crossings

In very low and low speed environments, there may be opportunities to manage vehicle speeds on the approach to the crossing through additional speed cushions. This is particularly important where sight lines may be partially obstructed.

Adequate lighting should be provided at and on the approach to the crossing to ensure that sight distance is available in low light conditions.

6 Raised Priority Crossings at Service Lanes

Raised priority crossings to provide a continuous and consistent shared use path may require crossings at service lanes ingress and egress to connect a path in the outer separator (as demonstrated in the image below).

Image VC-1: Raised Priority Crossing on a Service Lane

It may be more desirable to place the SUP in the outer separator than adjacent to the ROW property boundary where the SUP will regularly conflict with driveway accesses.

However, this will introduce a crossing point at the ingress and egress of the service lane which will be required to be raised to provide priority to the SUP users.

The same three principles (manage speeds at the conflict points, manage speeds on the approach, provide adequate mutual sight distance) apply to RPC at service lanes.

The following additional considerations should be reviewed when designing and assessing RPCs at service lanes;

- Service lanes are usually provided in intermediate speed environments (70km/h and 80km/h). Motorists entering the service lane may be more concerned with managing their speed to avoid a possible rear-end crash as they decelerate to enter the service lane than looking for a cyclist at a crossing. Therefore, RPCs should not be placed at or close to the edge of the carriageway as it may introduce potential safety issues for motorists (and cyclists) entering the service lane
- RPCs should be placed so that a vehicle can store within the service lane when yielding at the give-way line to pedestrians and cyclists
- Consideration should be given to the function and volume of traffic using the service lane. Is the service lane being used to access a major traffic generator (such as a service centre or a large hardware supplier)?
  If the volumes are significant and size of vehicles accessing the service lane are large, the RPC should be located where there is adequate storage and deceleration. In some circumstances it may not be safe to provide a safe RPC and designers should consider alternatives.

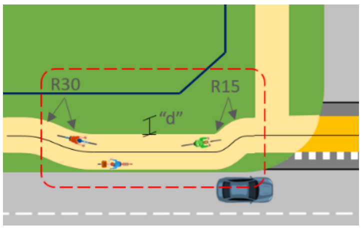
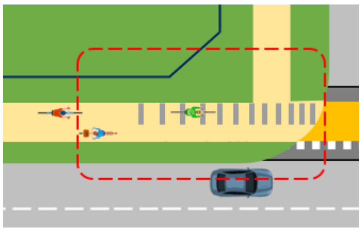
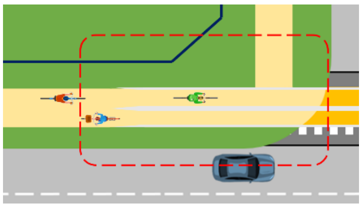
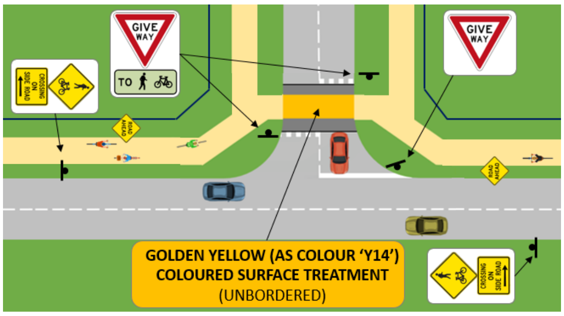
7 References

1. *Austroads, Austroads Guide to Road Design Part 4A*
2. *Austroads, Austroads Guide to Road Design Part 6A*
3. *TMR, Raised priority crossings for pedestrians and cycle paths, January 2019*
4. *Victoria Walks, Shared Paths – the issues, Version 3.0, March 2015*

Appendices

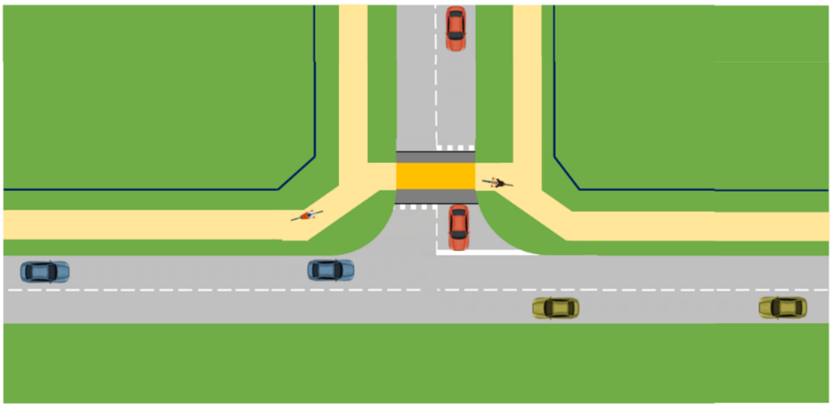
APPENDIX VC-A	Speed management tools for cyclists on the approach to a crossing/conflict point
APPENDIX VC-B	General Configurations for Raised Priority Crossings on side roads
APPENDIX VC-C	Worked Example
APPENDIX VC-D	Example of challenges with RPCs

Appendix VC-A: Speed management tools for cyclists on the approach to a crossing/conflict point

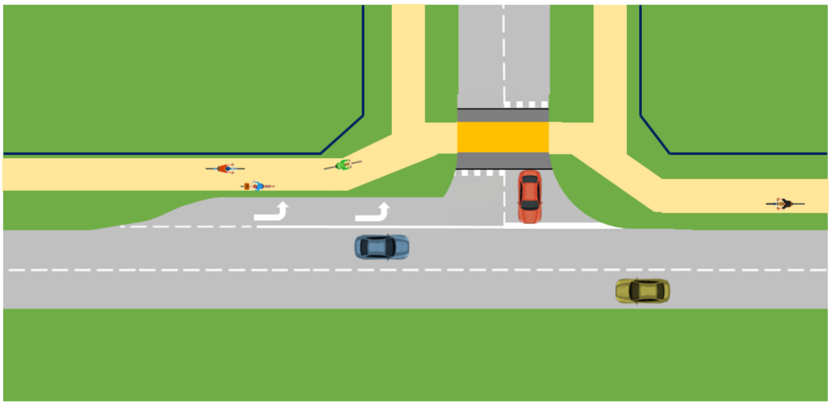
Treatment	Image/Picture	Comments
Lateral shift in path alignment		A lateral shift created by a series of reverse curves gradually reduces the approach speed of cyclists in stages. The first set of reverse curves should result in a maximum angle of 20 degrees and the second set of reverse curves should result in a maximum angle of 15 degrees (See *AGRD Part 6A* Appendix VC-B) For the path lateral shift to be effective in reducing approach speeds, the lateral shift "d" should be the width of the path (minimum is half the width of the path). A lateral shift can also be combined with narrowing of a path (for example, from 3m to 2m) to discourage overtaking in this transition zone.
Rumble strips & Transverse bars		Rumble strips can be used through the transition zone to provide a visual-tactile cue to cyclists for the approaching conflict zone. Transverse bars utilising a contrasting exposed aggregate (or paint-only as a minimum) can also be used to minimise cyclist discomfort. In either scenario, strips/bars need to commence approx. 15-20 m from the conflict zone, gradually becoming more closely spaced on approach to the conflict zone.
Narrowing of path		A localised narrowing of a path can be implemented as a perceptual countermeasure to reduce cyclist speeds and discourage overtaking within the transition zone. One-way path widths should maintain a width of 1.4 m.
Chicanes and Fencing Treatments		An alternate treatment to the 'lateral shift' is the use of chicanes or fencing. This requires cyclists to slow to an appropriate speed to negotiate the chicane/fencing on approach to the conflict zone. Given this treatment involves the use of potentially rigid hazards, it should be seen as a last resort.
Warning signs and linemarking	Warning signs & linemarking should be used to complement each of the above treatments. The following figure outlines the preferred signing and linemarking arrangement. Note that locations shown are indicative only and needs to be tailored to context. 	

Appendix VC-B: General Configurations for Raised Priority Crossings on side roads

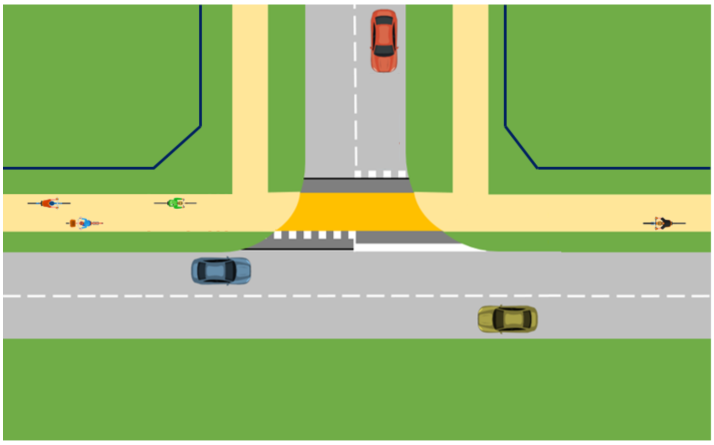
Layout 1: Offset Raised Priority Crossing



Layout 2: Offset Raised Priority Crossing with left turn deceleration lane



Layout 3: Raised Priority Crossing with no offset



Appendix VC-C: Worked Example

Let's assume that the Main Road Speed is 70km/h and the Side Road speed is 60km/h.

While it is desirable that we have a left turn deceleration lane, there is insufficient room to provide one without acquiring land.

The Raised Priority Crossing has been offset to allow for 1 car storage (7m) between the toe of the ramp and the hold line. The ramp profiles are 1:15 and in accordance with RDN 03-07 for a maximum of 30km/h.

From Table VC-C1 we have selected a 4 seconds travel time as our project is in an Intermediate Speed Environment.

Table VC-C1: Selected Travel Times for Sight Distance Checks

Selected Travel Time	Comment
5.0 seconds travel time (3.0 sec observation time + 2.0 sec reaction time)	Highly Desirable for Intermediate Speed Environments (70km/h and 80km/h)
4 sec travel (2.0 sec observation time + 2.0 sec reaction time)	Desirable for Intermediate Speed Environments (70km/h and 80km/h)
3 sec travel (1.5 sec observation time + 1.5 sec reaction time)	Minimum for Intermediate Speed Environments (70km/h and 80km/h). This value is generally acceptable for low speed environments
2 sec travel (0.5 sec observation time + 1.5 sec reaction time)	Should only be used in scenarios that are highly constrained. Not recommended for Intermediate Speed Environments (70km/h and 80km/h). This value may be appropriate in some low speed environments.

We then determine the distances for the car and the cyclist to check mutual sight distance for safety on approach to the crossing.

As we have significant lateral shifts in the path (largely due to the offset RPC) we can assume that the average speed will be between 20-25km/h for the cyclist approaching the crossing.

Table VC-C2: Distance "a" for sight distance checks based on approach speed and selected travel time

Selected Travel Time	"a" for average approach speed of 30km/h (8.33m/s)	"a" for average approach speed of 25km/h (6.94m/s)	"a" for average approach speed of 20km/h (5.55m/s)	"a" for average approach speed of 15km/h (4.16m/s)
5.0 sec travel (3.0 sec observation time + 2.0 sec reaction time)	42m	35m	28m	21m
4 sec travel (2.0 sec observation time + 2.0 sec reaction time)	34m	28m	22m	17m
3 sec travel (1.5 sec observation time + 1.5 sec reaction time)	25m	21m	17m	13m
2 sec travel (0.5 sec observation time + 1.5 sec reaction time)	17m	14m	11m	8m

To be conservative, we will assume a higher average approach speed of 25km/h for cyclists.

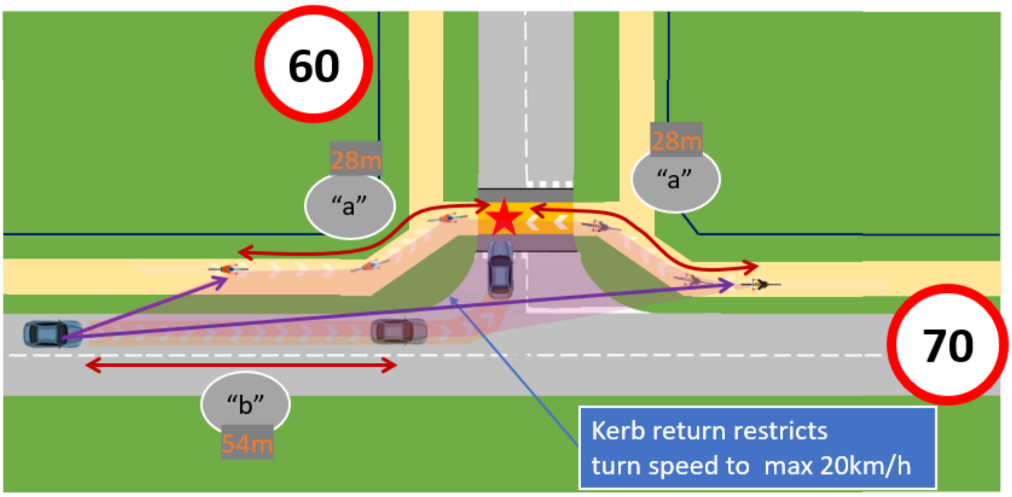
Therefore, the distance "a" from the conflict point to the point at which a cyclist will be able to be first observed is 28m.

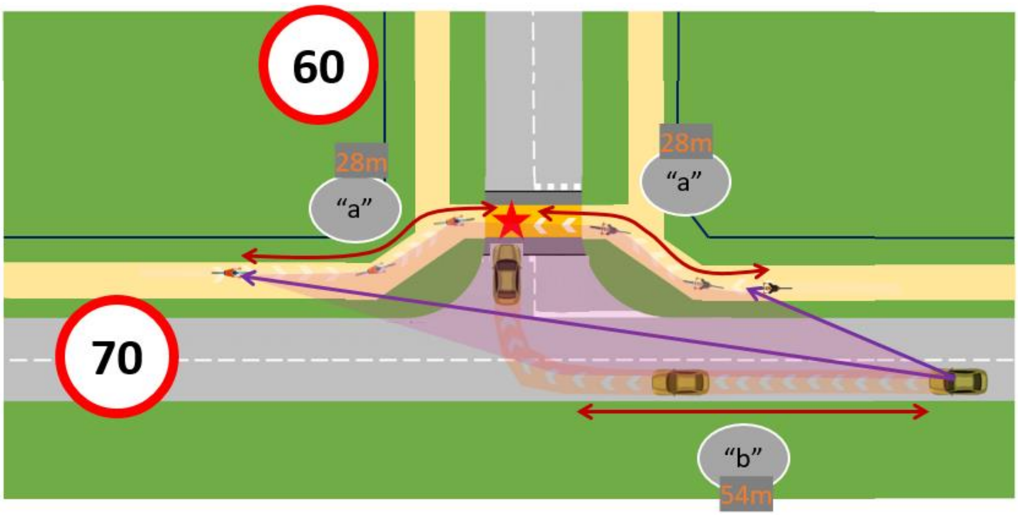
Table VC-C3: Distance "b" for sight distance checks based on approach speed and selected travel time

Operating Approach Speed of Main Road	Distance "b" measured to the start of the kerb return for various travel times			
	5 sec travel time	4 sec travel time	3 sec travel time	2 sec travel time
80km/h (22.22m/s)	74m	[illegible]	44m	30m
70km/h (19.44m/s)	[illegible]	54m	41m	27m
60km/h (16.67m/s)	65m	50m	38m	25m
50km/h (13.89m/s)	62m	48m	35m	23m
40km/h (11.11m/s)	56m	44m	33m	22m
30km/h (8.33m/s)	46m	38m	30m	25m

The distance "b" is calculated from Table VC-C3 for 70km/h with 4 seconds of travel and will be 54m.

So, for Sight Distance Check Scenario 1 and 2, the values for a = 28m and the value for b = 54m. These are shown in the images below.



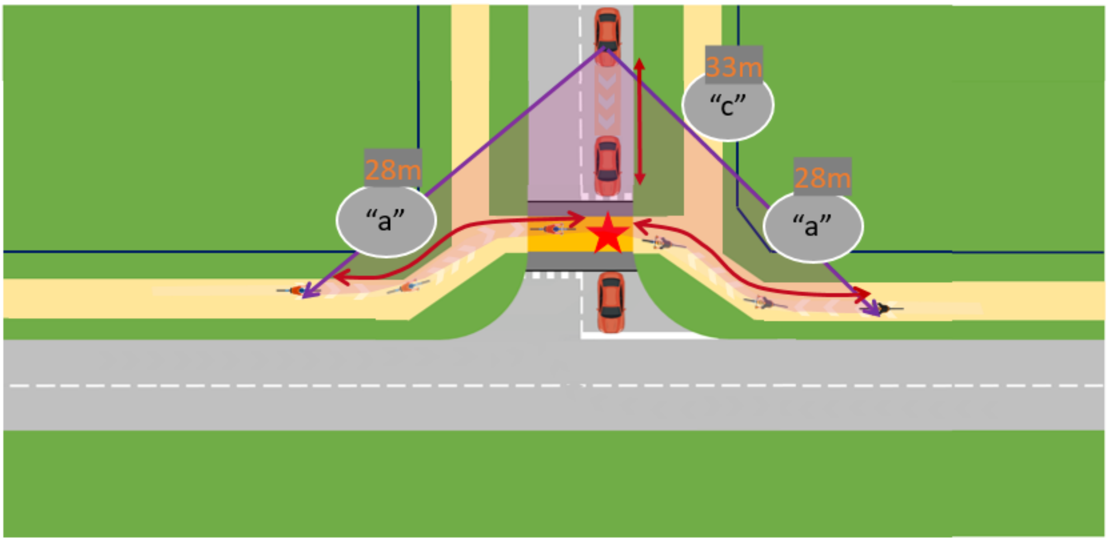


For Sight Distance Check Scenario 3 for the Side Road, we use Table VC-C3 to determine the distance "c".

Table VC-C3: Distance "c" for sight distance checks based on approach speed and selected travel time

Operating Approach Speed of Side Road	Distance "c" measured to the start of the kerb return for various travel times			
	5 sec travel time	4 sec travel time	3 sec travel time	2 sec travel time
80km/h (22.22m/s)	56m	[illegible]	33m	22m
70km/h (19.44m/s)	49m	39m	29m	19m
60km/h (16.67m/s)	[illegible]	33m	25m	17m
50km/h (13.89m/s)	35m	28m	21m	14m
40km/h (11.11m/s)	28m	22m	17m	11m
30km/h (8.33m/s)	21m	17m	13m	8m

As the Side Road is 60km/h, we require a distance of 33m for 4 seconds of travel time.



Now that we have all our distances, we can than check all of our sight lines (bold purple lines) and then finally check the purple shaded areas to ensure that sight lines are maintained (as much as is reasonably practicable) for the approaching vehicle and cyclist.

If sight lines cannot be achieved for the selected travel time of 4 seconds, then firstly increase the speed management for cyclists to reduce the distance "a". If this cannot be achieved, or if the reduced distance of "a" still does not meet sight distance checks, consider selecting a lower travel time (3 seconds).

If sight lines are not able to be met with reduced travel times and reduced distances of "a", then the project should consider whether a Raised Priority Crossing can be provided safely. If it cannot be provided safely, alternative options such as a signal operated crossing or a non-priority crossing should be explored.

Appendix VC-D: Example of challenges with RPCs

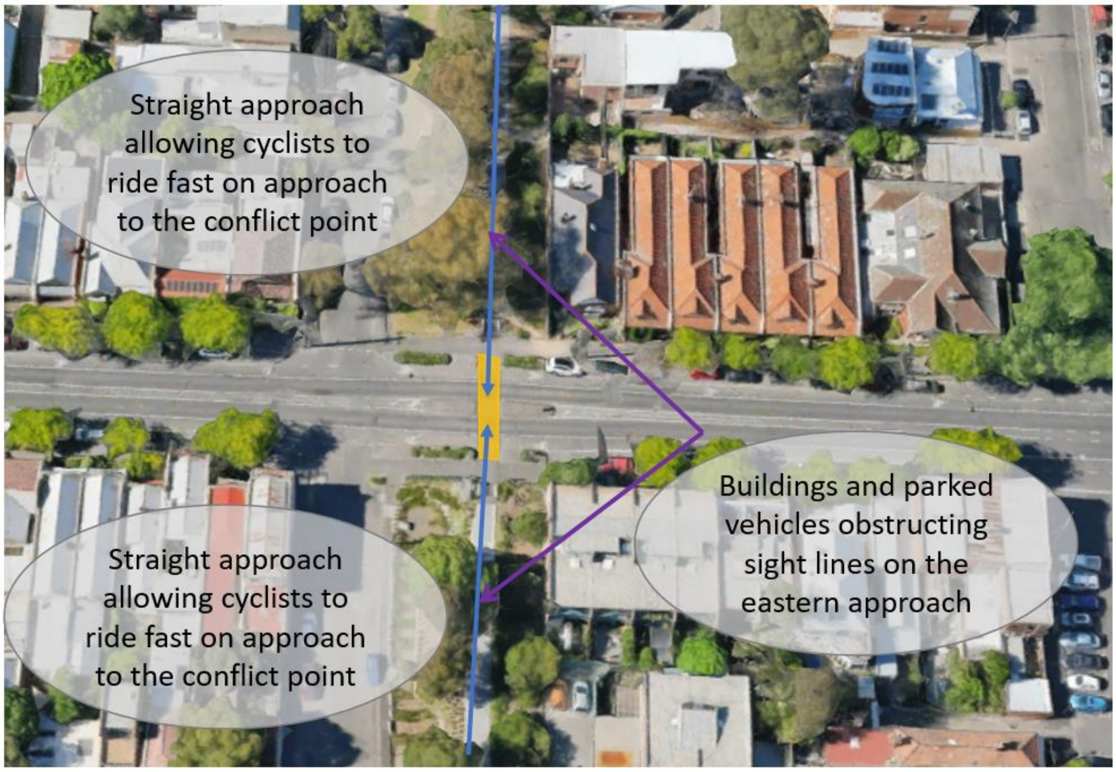
This section gives a few examples of challenges presented on existing Raised Priority Crossings (RPC).

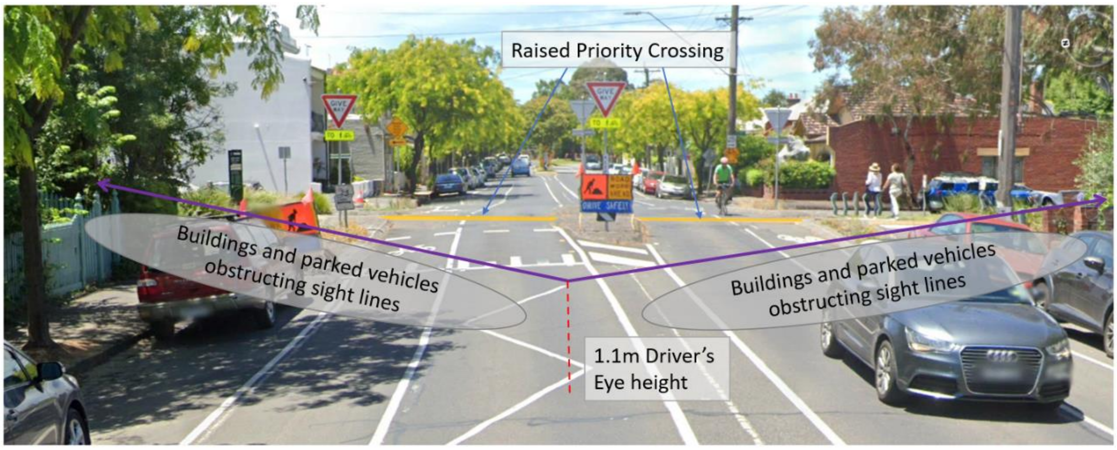
As outlined in this document the safety of RPCs is compromised when a site has a combination or all of the following features;

1. Straight approaches for cyclists which enables cyclists to maintain high speeds on the approach and at the conflict point
2. Restricted sight distance for motorists approaching the crossing to be able to see a cyclist approaching the crossing and for the motorist to react
3. High speed environments with little or no speed management for vehicles on the approach to a crossing

Example VC-D.1: Restricted sight distance and straight approaches for cyclists

This example demonstrates how sight lines are obstructed for motorists approaching the RPC by buildings and parked vehicles. In addition to this, the approaches to the crossing for the cyclist are straight allowing them to maintain higher speeds on the approach and at the crossing. This combination reduces the overall safety of the crossing.




Raised Priority Crossing
Buildings and parked vehicles obstructing sight lines
Buildings and parked vehicles obstructing sight lines
1.1m Driver's Eye height


Buildings obstructing sight lines
Straight approach allowing cyclists to ride fast on approach to the conflict point


Straight approach allowing cyclists to ride fast on approach to the conflict point
Buildings obstructing sight lines