Government of **Western Australia**
Department of **Transport**

Empowering a thriving community

Planning and Designing for Active Transport in Western Australia

All Ages and Abilities Contextual Guidance: Selecting and Designing High-Comfort Bicycle Facilities

Prepared by Department of Transport

About this report

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Amendment record

This document will be reviewed and developed as part of a suite of guidelines for the planning and designing for active transport in Western Australia, to ensure its continuing relevance to the systems and processes that it describes. If you would like to provide feedback or suggest any changes to this guidance, please contact the Department of Transport at activetransport@transport.wa.gov.au.

A record of contextual revisions is listed in the following table.

Revision number	Revision date	Description of key changes	Section/ page no.

Contents

Acknowledgment of Country

We acknowledge the Traditional Custodians throughout Western Australia and their continuing connection to the land, waters and community.

We acknowledge the lands on which all Western Australians live, work and play; we recognise the strong and invaluable connection that Aboriginal peoples have across this Country, from a cultural, social, environmental, spiritual and economic perspective.

Many of the paths, streets and trails where people walk, wheel and ride in Western Australia today, follow the song lines, trade routes and seasonal runs that Aboriginal peoples have followed for many thousands of years.

Experiencing these actively, increases our sense of connection to place, and strengthens respect for the Traditional Custodians, their journeys and experiences, their place, their Country.

We pay our respects to all members of Western Australia's Aboriginal communities and their cultures; and to Elders past and present.

Image: Extract of "Songlines", a collaborative artwork by Deanne Tann, Sister Kate's Home Kids Aboriginal Corporation and Department of Transport staff following Cultural Awareness Training workshops.

Figure 1: Key sections of this guidance

Section 1	Establishes the purpose of this guidance and highlights the intention to raise the benchmark for bicycle provision
Section 2	Sets the vision for an all ages and abilities bicycle network
Section 3	Details the rationale taken in this guidance
Section 4	Outlines how the LTCN is being planned, including network planning principles
Section 5	Describes different bike rider types, sets the target design profile for the network as the "interested but concerned" bike rider, and establishes six bicycle design outcomes and an all ages and abilities level of service
Section 6	Groups bicycle facility types based on the level of protection they provide for bike riders
Section 7	Provides information to support the selection of all ages and abilities bicycle facilities based on broad contextual factors and considerations

1. Introduction

1.1. About this guidance

This guidance has been developed to help practitioners in WA make informed decisions relating to the selection, design and delivery of bicycle facilities suitable for people of all ages and abilities.

Our aim is to complete the long-term cycle network (LTCN)[1] for WA, which is intended to be a low stress, high comfort network that appeals to the broadest spectrum of bike riders and supports bike riding as a viable, everyday mode of transport.

To provide a cycle network that will serve the needs of everyone, this guidance encourages practitioners to design infrastructure that will provide a high level of service to novice and less confident bike riders. Indicators related to six core bicycle design outcomes are used to describe what an all ages and abilities level of service can look like, with an emphasis on continuity of a high quality experience for the bike rider, rather than continuity of a specific facility type.

This document is not intended to replace existing design guides, but rather serve as a decision support tool and emphasise the importance of design flexibility in determining what type of bicycle facility – or facilities – should be chosen for a particular route based on real-world context, constraints and opportunities.

This guidance outlines the key components of bicycle facility selection and design (Figure 1).

1.2. How to use this guidance

This guidance should be applied on all planning and design projects delivering:

- active transport infrastructure;
- new and improved road and rail projects;
- new residential and commercial developments; and
- any other built environment initiative where place and movement are being considered.

The intention is to enable practitioners to achieve a consistently high level of service for all bike riders across WA.

To achieve this, practitioners will need to meet or exceed the bicycle design outcomes outlined as level of service indicators (Table 2) and described as preferred facility types for different road environments (Table 5). In instances where the preferred infrastructure requirement is not deemed feasible due to specific project constraints, the highest achievable level of service should be maintained with the safety of all path and road users at the forefront of design. Reductions below this service level will impact the safety and appeal of facilities and may result in facilities that inadequately support and encourage the intended bike rider type.

1.3. Raising the benchmark

Western Australia's first active travel strategy [2] (in development) will outline a whole-of-state vision for more people to walk, wheel and ride as part of their everyday journeys and experiences. Building quality infrastructure will be a central component to making this happen and will mean delivering consistently high levels of service that can support everyone to walk, wheel or ride more often, regardless of age or ability. This will require learning from the design and implementation of successful, well utilised infrastructure and improving on what has been done previously. Ultimately it means planning for growth in bike riding (as well as walking and micromobility) and delivering safer, more attractive paths, streets, roads, crossings and places for all.

Designs that only meet the needs of our most confident bike riders should be the exception and bike riding – regardless of the confidence or ability of the person riding – will be designed for as a distinct mode of travel with different needs to people walking, wheeling or driving a motor vehicle.

Ideally, the network will be realised through the delivery of routes that provide a consistently high comfort experience for all. Due to certain constraints and where it is unavoidable, there may be short sections of network that do not immediately meet the all ages and abilities vision and associated level of service. This should not be a reason to jettison an entire route that is otherwise good – safety and continuous improvement should be the aim.

1.4. Walking, wheeling and riding

While this guidance primarily focusses on bike riding, the design of bicycle infrastructure should be undertaken with the view that other travellers are likely to be on the network, including people walking, pushing and using wheeled mobility devices, and those using eRideables and other micromobility devices. These devices may be human or electric-powered and include standard bicycles, as well as power-assisted cycles (eBikes), cargo bikes, and those eRideables such as eScooters and eSkateboards (Figure 2).

Bicycle infrastructure will be integrated with facilities for other active travellers, with the movement of people walking and wheeling a primary consideration, including people with disability. Facilities for walking, wheeling and riding also need to be legible and visible to other road users, including people driving.

The glossary provides definitions for the key terms used in this guidance (Appendix 1).

1.5. Relationship with other guidance

This document is the primary reference for the selection of all ages and abilities bicycle infrastructure in WA. It forms part of the Active Transport Planning and Design Guidance Suite being developed by the Department of Transport (DoT) to better inform planning and design for bike riding in WA[3]. The suite will remain under review and will be updated regularly with new information to reflect emerging best practice and industry feedback.

This guidance has been developed in consideration of, and in accordance with, the following documents:

- *WA Active Transport Infrastructure Policy* [2]
- Austroads *Guide to Road Design* [4] and *Guide to Traffic Management* [5] and relevant Main Roads WA supplements
- Design WA policy suite[6]
- *Disability Services Act 1993*[7].

This is not an exhaustive list and designers are encouraged to refer to these documents – and any other relevant strategies and policies – to enable a full understanding of the requirements for the design of the built environment across WA.

2. Strategic underpinnings

2.1. Vision for an all ages and abilities network

At the core of planning and designing for bike riding is the vision for WA's all ages and abilities network as outlined in the LTCN for WA. Provision of this network will support more people to take up riding, or to ride more often, and in doing so will help realise the WA Bicycle Network Plan's[8] aim to make WA a place where active travel is safe, connected, convenient and a widely accepted form of transport.

The all ages and abilities approach is globally accepted as best practice and requires a strong understanding of what facilities are accessible to new, cautious, and differently abled bike riders as this will create a network that is equitable for the majority of people.

At the heart of this approach is fairness and enabling all people to use the network regardless of age, ability, or the wheels they use. By planning for and designing infrastructure that caters for our most vulnerable, we create a cycle network that everyone can use.

Completion of the all ages and abilities network in WA will take time and sustained investment. It relies on practitioners understanding (and experiencing) the needs of bike riders and providing an appropriate level of service to the broadest spectrum of people to get safely and comfortably where they want and need to go – from doorstep to doorstep.

The WA Bicycle Network Plan's aim is to make WA a place where active travel is safe, connected, convenient and a widely accepted form of transport.

Figure 2: People of all ages and abilities need to feel comfortable using the active transport network

2.2. Beyond infrastructure – the broader context of bike riding

Multilevel bike planning and programming approaches that consider both the physical and non-physical factors that influence people's choice to ride are more effective that those that only operate on a single-level (e.g. those that focus only on the built environment).

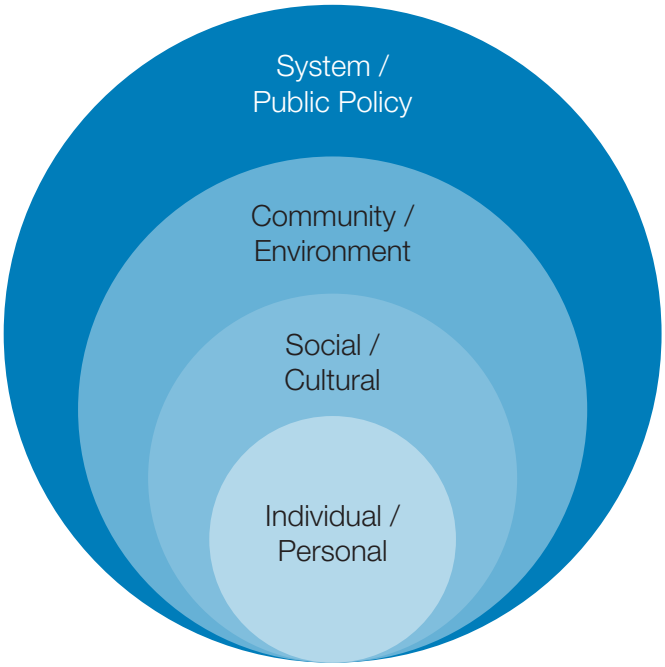
Drawing from what is known as the socio-ecological model[9], influences on bike riding can be divided into four main categories: personal influences, social and cultural influences, community and environmental influences, and system / public policy influences (Figure 3).

While this guidance focuses mainly on the built environment, it is crucial to note that simply engineering a bike-friendly physical environment – as important as this is – will not address all the barriers and enablers associated with people opting to travel by bicycle.

To foster a culture of bike riding we need to consider the influences on biking both for those already riding, as well as those who are not yet riding. WA based research consistently shows a large proportion of the population are keen to take up riding, or to ride more often, and that the influences on their travel choices are different from many of those already riding. For example, among those who are interested but not currently riding, a lack of self-efficacy (i.e. the belief in their ability to be able to ride) and a need for high-comfort facilities (as described throughout this guidance) are significant influences, whereas among regular, highly confident bike riders these influences are not as much of a barrier (Figure 8).

Combining an engineering approach with one that considers these broader influences provides a more complete picture of how we can successfully support bike riding as a form of travel for people of all ages and abilities.

Figure 3: Layers of the socio-ecological model



3. Rationale for approach taken in this guidance

3.1. A low stress, high comfort network gives people the confidence to ride

The all ages and abilities network is also referred to as a **low stress, high comfort network**, with the emphasis on the quality of the facilities – not just the presence of them – and ensuring they are designed to be safe and comfortable for all.

Peoples' choice to ride is heavily influenced by the stressors they encounter on their journeys which impact both their actual physical safety and their perceived comfort level.

High comfort networks are focused on protecting bike riders from stressful conditions and events, which primarily requires determining when and how to separate bike riders from other path or road users. For paths, this is typically a separation of bike riders from people walking and wheeling, particularly in high activity areas. On streets and roads, this is protection from motorised traffic or designing environments that can be shared safely (as detailed in Section 7). Comfort is also influenced by a range of other factors, including difficulty of the terrain, amenities and other activities and land uses in the area. These are discussed further in Section 5.6.

3.2. Bike rider types and bicycle design outcomes

This guidance describes three types of bike riders – interested but concerned, somewhat confident, and highly confident – each with unique behaviours, preferences and requirements. **The interested but concerned bike rider is the 'target design profile' as this group represents the largest proportion of the potential and active riding community in WA.** Prioritising their comfort creates a network that caters for the broadest range of needs.

The requirements of the interested but concerned rider are applied to six internationally recognised outcomes that must be balanced in the design of bike riding facilities: safety, comfort, coherence, directness, attractiveness and adaptability.

These outcomes – also referred to as design principles or requirements – have been widely adopted and together describe what good design for bike riding should achieve.

These outcomes are important, not just for bike riders, but for all people using streets, public spaces and other public services and facilities, where provision for bike riding has the potential to improve safety and accessibility.

The bike rider types and bicycle design outcomes are explored in Section 5.

3.3. Minimise differences in speed, direction, mass and size

Where integration of bike riders with other path or road users is necessary, differences in speed, volume and vehicle type need to be minimised to support safety outcomes. In the Dutch principles of Sustainable Safety, this is described as the 'homogeneity' of mass, speed and direction [10]. The principle means that these elements should be equalised as much as possible across and within different modes, with the intention to minimise the number and severity of interactions.

The homogeneity principle has recently been rephrased to '(bio)mechanics', with the emphasis remaining on **limiting differences in speed, direction, mass and size, and giving road users an appropriate degree of protection**. Balance of these elements is supported by road design, the road environment, the vehicle, and where necessary, protective devices. For two-wheeled devices, it is important that the road and the road environment contribute to the stability of the bike rider and minimise the physical effort required to ride.

This principle has been applied through this guidance, particularly in the bicycle design outcome of safety.

Figure 4: Minimise differences in speed, direction, mass and size

3.4. Motor traffic speed and volume amplify each other

Mixing with motor traffic is one of the main barriers to riding, with two of the biggest contributors to stress being vehicle speed and volume. These factors are inversely related – the stresses generated by speed are compounded by volume, and vice versa[11]. When speeds and volumes are low, more people feel comfortable riding in mixed traffic environments as they are able to maintain a reasonable and steady speed, feel less pressure to move over for passing motor vehicles, and experience fewer passing events. Where motor traffic is routinely above 30 km/h, or where volumes result in consistent passing events (i.e. more than 1,500 vehicles per day or congestion pressure at specific times), pressure on bike riders from passing vehicles increases perceived and actual risk and reduces comfort.

The number of passing events experienced over a 10-minute period by a bike rider travelling around 15 km/h substantially increase with motor vehicle volume and speed (Figure 5). Evidence shows that slower, less confident bike riders experience stressful events and near misses (or non-injury incidents that cause stress) much more frequently than faster or more confident bike riders[12].

Achieving a low stress network requires creating safe and comfortable mixed traffic environments with appropriate speed and volume conditions (Table 5).

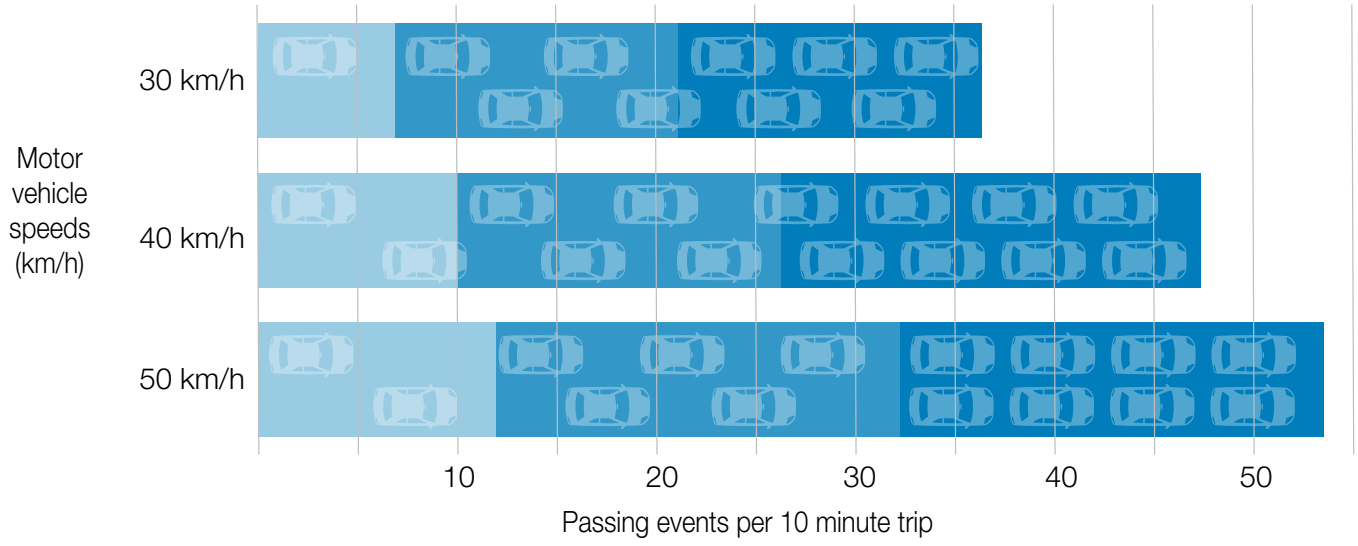
3.5. Movement and Place

The Movement and Place concept recognises that streets and roads perform multiple roles with different objectives and priorities. From providing the safe, legible and efficient movement of people and goods (i.e. movement), to providing welcoming and inclusive places people can spend time, interact and participate in social, community and economic activities (i.e. place). It supports a holistic, integrated approach to land use and transport planning, allowing for balanced and equitable strategic consideration of the Movement and Place roles, across all modes of transport for a road or street.

Different modes of transport have different interactions and impact on place. Walking, wheeling and bike riding engender place creation, highlighting the importance of context-sensitive design to encourage these modes of transport; from creating low-speed, shared environments in high activity areas, to providing greater levels of separation where faster or higher volume vehicle movements are prioritised.

A Movement and Place Framework[13] is currently in development for WA which may result in future updates to this document.

Figure 5: Passing events per 10-minute trip



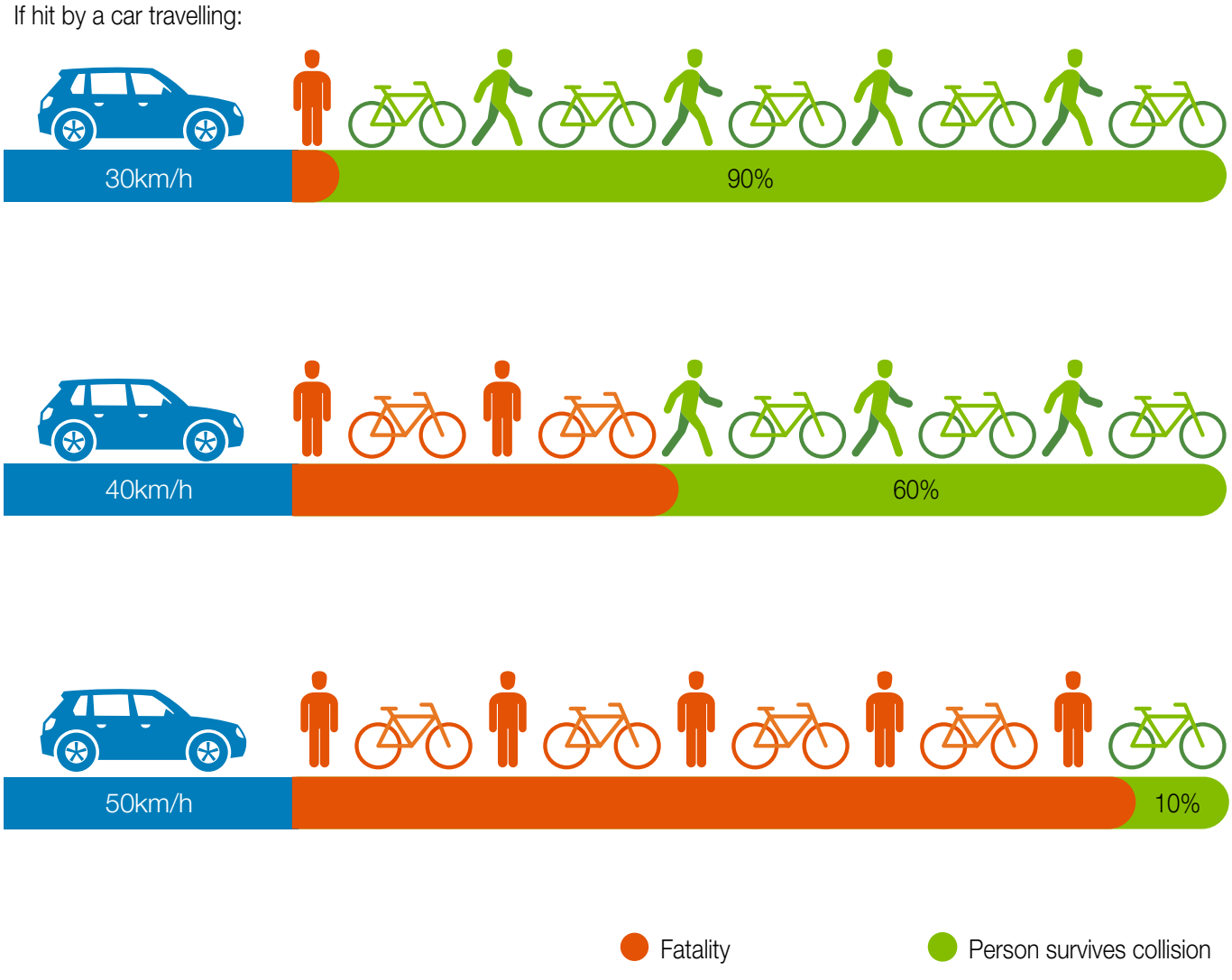
3.6. Safe System approach

The National Road Safety Strategy 2021-30[14] promotes the Safe System framework as a systematic approach to preventing crashes or limiting crash forces by making them survivable and reducing the severity of the injury. The Safe System framework acknowledges road users will continue to make mistakes and therefore, roads and vehicles should be designed and maintained to create a forgiving environment that limits crash forces to levels that are within human tolerance.

WA's Driving Change - Road Safety Strategy 2020-2030[15] supports the national strategy by also adopting Safe System principles and practices, including indicating a 30 km/h or less safe system speed threshold on road environments shared with vulnerable users.

Pedestrian crash severity (Figure 6) is also applicable to other vulnerable road users, including people riding bicycles, and indicates that as speeds increase (particularly above 30 km/h) the probability of serious vulnerable user injury or fatality increases dramatically and expotentially[16].

Figure 6: Crash severity risk based on speed



4. Network planning

4.1. Bicycle network planning principles

Effective bicycle networks encourage bike riding by creating widespread routes that are safe, efficient and easy to use. The LTCN for WA is made up of 12 strategies, including one for the Perth and Peel region and 11 strategies across regional areas.

These strategies propose ambitious, long-term plans that have been developed based on six bicycle network planning principles required to deliver a safe, integrated and comfortable cycle network (Figure 7).

Figure 7: Bicycle network planning principles

Safe

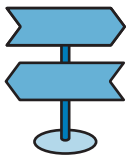
Everyone should be able to ride safely and confidently to the places they want to go with the appropriate level of protection from traffic provided.

Connected

Like a road network, all bike riding routes should connect to something along the way and at each end (whether that is a destination or another bike riding route).

Widespread

The network should be extensive enough for people to safely assume they can get to their destination without encountering hostile traffic or terrain conditions.



Legible

The network needs to be both intuitive and direct with coherent wayfinding and alignment of major routes parallel to natural land forms, such as rivers and coastlines, or within existing road and rail corridors.

Achievable

Network planning will consider tried-and-tested approaches while also embracing innovation and looking beyond existing levels of service and use towards a future where bike riding is a mainstream transport option.

Aspirational

The network proposed will demonstrate a long-term commitment to delivering a WA-wide network that supports bike riding as a viable form of mass transport for people of all ages and abilities.

4.2. A network classified by function

Routes in the LTCN are classified based on the WA Cycling Network Hierarchy[1], which designates the function of a route rather than its built form. Function considers the type of activities that take place along a route, and the level of demand for bike riding (existing and potential), while the built form – which is not prescribed by the LTCN – is determined based on user needs, community and strategic goals, the characteristics of the surrounding environment (such as traffic conditions, topography and land uses), and how to best respond to these to deliver a suitable facility that meets the all ages and abilities level of service.

The WA Cycling Network Hierarchy comprises of three core types of routes:

- Primary routes, which form the spine of the network, connect to key trips attractors and generally attract the highest demand for bike riding.
- Secondary routes, which provide connectivity between primary routes and major activity centres and attract moderate level of demand.
- Local routes, which are predominantly located in residential areas and support the beginning and ends of trips, providing critical access to higher order routes, local amenities and recreational space.

There are also two complementary route types – road cycling routes and transport trails – that are for recreation, sport and touring purposes and support more select user groups. As such, these route types are not generally required to meet the all ages and abilities standard for bike riding.

Routes are generally made up of off-road paths, on-road protected facilities and mixed traffic facilities, with facility selection and design dependent on a range of factors for each route and street, including local context (place, geographical), operating characteristics (kerbside activity, transit activity) and traffic characteristics (speeds, volumes, vehicle types). Guidance on the selection of these facilities based on basic road function and traffic conditions is outlined in Section 7.2, while detailed design guidance is provided in separate documents that are referenced throughout.

How the LTCN informs selection and design of facilities

The LTCN informs infrastructure selection by outlining how a proposed route or facility fits within the network and highlighting where higher order facilities are needed the most (i.e. on primary routes).

Regardless of route function, the entire long-term cycle network is intended to enable people of all ages and abilities to safely and conveniently get to where they need to go.

If any transport project is planned on a link in the LTCN, then providing appropriate all ages and abilities infrastructure should be prioritised as part of that project. If a project is planned on a road or corridor that is not part of the LTCN, practitioners still need to be mindful that bike riders have a right to travel on all public roads in WA, unless prohibited, whether or not the route is designated in the LTCN or has a bicycle facility present. The bicycle design outcomes should be considered in all scenarios where bike riders may be present.

By influencing bicycle facility selection in this way, the LTCN helps practitioners be more strategic about investment and implementation, while also balancing competing network needs, such as transit and freight.

Modifying the network

Routes in the LTCN can be modified as local circumstances change. For towns and areas not covered in one of the 12 LTCN strategies, the network can be identified and updated in a relevant local plan. The LTCN change management process[1] provides guidance on how amendments to the network can be made.

4.3. Integration with policy, planning and other model networks

The realisation of the LTCN as a low stress, high comfort network will ultimately depend on decisions made at all levels of policy, planning and delivery. A network-wide, end-to-end journey planning approach will ensure a high quality infrastructure is implemented, maximising the potential to unlock latent demand, and ensuring the integration of bicycle infrastructure with other modes and land uses.

If a facility is planned on a route that is an identified link in the LTCN, then the appropriate all ages and abilities infrastructure should be implemented. A lower level of service, such as a painted bicycle lane on a high-speed road, would not build out the high comfort network that serves a greater proportion of the population. The opportunity to provide a high quality connection may not occur again for some time and may become costly to retrofit. While this facility may be an improvement on having no bicycle facility at all, it may not be appealing to most people given the context.

Relevant network planning resources

- The LTCN for WA[1] outlines the aspirational blueprint for all ages and abilities cycling infrastructure, while the Active Transport Infrastructure Policy Statement[2] guides the provision of active transport infrastructure along State controlled roads and rail corridors.
- Local bike plans (or their equivalent) provide the vision for bike riding at the local level and are important for ensuring consistent implementation of the LTCN. Guidance for Local Bike Planning is available online[3].

5. Network design

5.1. Designing a suitable built form

The bicycle network takes on many forms based on bike rider needs, the geographical and physical context, traffic conditions and surrounding land uses.

Bike rider requirements are distinctive and bicycles are best planned for as vehicles within the road network, as well as vehicles operating on paths and in public places.

A fit-for-purpose form will deliver a highly rideable route that is safe and comfortable for bike riders of all ages and abilities and all designs should be able to clearly demonstrate that, at a minimum, the following five items have been considered.

Design considerations checklist:

- ☐ that the facilities provided are **appropriate for the context**, referring as required to the LTCN (Section 4);
- ☐ identification of the needs of different **bike rider types** and the target design profile (Sections 5.2, 5.3);
- ☐ achievement of the **bicycle design outcomes** and a suitable **level of service** (Sections 5.4, 5.5);
- ☐ responsiveness to the **comfort and geometric requirements** of bike riders (Sections 5.6, 5.7, 5.8); and
- ☐ appropriate selection of **facility types based on the level of traffic stress in various road contexts** as outlined in facility selection support tool (Section 7).

According to WA research, ***two thirds of people*** would either take up riding or ride more often if they had access to high comfort facilities.

5.2. Bike rider types

Understanding the different types of bike riders helps to inform bicycle infrastructure design by establishing a target comfort level for the network based on specific bike rider needs.

Characteristics commonly used to categorise bike riders include experience, age, skill and ability, trip purpose and confidence. People may not fit neatly into one bike rider type. Characteristics and preferences may also change based on factors such as the infrastructure available, time of day, where they are going, the volume and mix of other users, motor traffic conditions and if they are riding alone or with others.
For example, a commuter who is comfortable riding in traffic on their way to work may require a more protected facility to feel comfortable riding with a child.

Confidence, experience and trip purpose influence bike rider behaviours and requirements for different types of bicycle facilities in different contexts (Figure 8). WA research examining adults who have stated an interest in bike riding has identified three types of existing and potential bike riders based on confidence. These include:

- **Highly confident bike riders** – this is the smallest group identified in the research and is comprised of bike riders who have a high tolerance for traffic stress, typically prefer direct routes, and do not avoid operating in motorised traffic (even on roads with higher speeds and volumes). Many of these riders also enjoy routes separated from traffic, however they are likely to avoid facilities they perceive to be too crowded with other slower moving travellers or which deviate from their preferred alignment.
- **Somewhat confident bike riders** – this group, also known as the 'enthused and confident' segments, are the next smallest group. They have a lower level of tolerance for traffic stress than highly confident bike riders and generally prefer low-volume neighbourhood streets and demarcated or separated facilities on major/busier streets. This group may be willing to tolerate higher levels of traffic stress for short distances to complete trips to destinations or to avoid long detours.

- **Interested but concerned bike riders** – this is the largest group identified by the research and people who fit into this group are interested in taking up riding – or riding more often – but only where they have access to networks of separated facilities or very low volume, low speed streets with safe crossings. These bike riders have the lowest level of tolerance for traffic stress and are generally recommended as the target design profile as the resulting bicycle network will serve bike riders of all ages and abilities, including the more confident bike riders.

5.3. Target design profile – the interested but concerned bike rider

When used to inform the facility selection and design, bike rider types can be narrowed down into a target design profile, which establishes the intended comfort level for the bicycle network.

Defining the comfort level is a critical part of bicycle planning and design because when this step is overlooked the network typically defaults to servicing highly confident bike riders, rather than seeking to serve all ages and abilities by establishing a low stress network. A bicycle network that defaults to serving the most confident bike riders overlooks the needs of more vulnerable users and fails to maximise the potential for bike riding as a mainstream transport option for everyday use in WA.

The target design profile for facilities within the LTCN in WA is the interested but concerned bike rider.

The logic is that if the bicycle network is safe and comfortable for people that are keen and willing to ride if their concerns are addressed, then more people can and will use it. Importantly, the resulting bicycle network will still also serve more confident bike riders, while the opposite is not true.

As described in Figure 8, this group is the most risk-averse due to their fear of riding in traffic and concerns regarding their physical ability to manoeuvre a bicycle in traffic and on difficult terrain. Safety is the primary requirement for these bike riders and quiet, low speed streets and off-road facilities are essential for encouraging them to take up riding or to ride more often.

Understanding the interested but concerned bike rider requires a shift in thinking about bike riding from something done by the highly confident few for sport, fast-paced commuting or cycle tourism, to an everyday transport activity undertaken by new and less confident users, children, accompanied riders and bike riders with disability.

5.4. Bicycle design outcomes

The success of the bicycle network will be measured by the quality of the bike riding experience, which is impacted by how safe and comfortable it feels, how direct and attractive a journey is to ride, and whether the routes are connected and easy to follow.

The following six internationally recognised design outcomes (sometimes referred to as principles or requirements) describe what good design for bike riding should achieve (Table 1). They are transferable and can be applied to any design scenario to help practitioners assess the level of service provided by the infrastructure.

Figure 8: Bike rider types based on level of confidence

Interested but concerned

38% of the WA population

Will include novice bike riders, some accompanied riders and some bike riders with disability, and less confident bike riders who will only feel comfortable riding if high quality facilities are in place. Their common trip types will include learning to ride, riding to work or school on low stress routes, local trips for recreation or to visit family and friends, or riding on holiday in traffic spaces.

Safety and comfort are their primary requirements. These bike riders may trade-off speed for safety and amenity or may not ride at all if conditions are unsafe – or perceived to be unsafe – for bike riders.

Quiet, low speed streets and high quality facilities protected from higher speed bike riders or traffic are essential.

Somewhat confident

29% of the WA population

Will include intermediate and more regular bike riders, accompanied riders, or those returning to riding. They may be riding for recreation or to complete everyday trips, such as shopping, errands, caring and commuting.

While these bike riders generally prefer more separated facilities or quiet streets, they can be willing to ride in higher stress environments for short distances to complete trips or avoid lengthy detours.

Direct, legible routes with protection from traffic are likely to be most effective.

Highly confident

4% of the WA population

Includes those who ride frequently and have a high level of confidence mixing with motor traffic. Common trip purposes will be regular commuting or longer distance training, leisure and cycle tourism trips.

These bike riders typically choose the most direct route despite conditions.

Direct routes designed to be shared with other users, either on or off road, are preferred.

Low stress tolerance **High stress tolerance**

Notes:

- The percentages in Figure 8 reflect only adults who have stated an interest in bike riding and are sourced from the DoT People's Voice Survey May 2023[17].
- 29 per cent of people responded they were unable or unwilling to ride. It is important to note these people may be using the bicycle network for trips by foot, car or wheeled device, and that as the low stress network becomes denser and awareness of it grows, willingness to ride increases as more people begin to see riding as a viable, achievable transport mode rather than an activity done for sport or by people they perceive as highly confident bike riders.

Table 1: Bicycle design outcomes

Safe

Bike riders should feel safe at all times, including when stopping along the way or parking at their origin and destination. Speed, direction, mass and size must be balanced to provide users with the appropriate degree of protection, either through equalising these elements or by separation physically or in time (e.g. through signals). Consistency of design is also important for managing interactions between different modes and avoiding ambiguity on where people should ride.

Comfortable

Bike rider comfort is critical to the whole experience of bike riding and making it a viable, everyday choice. Routes should minimise level of traffic stress and other stress factors, including the physical effort required to ride. Regular and ongoing maintenance is essential to lasting comfort and appeal.

Coherent

Bicycle facilities and routes should form a low stress, high comfort network that gets people to where they need to go, linking to key destinations and integrating with other modes of travel. Routes should provide a continuous level of service from origin to destination and be easy to navigate, well signed and intuitive.

Direct

Bike riders should be offered the most direct route based on existing and latent trip desire lines, avoiding detours and delays. Directness should be considered in terms of time and distance, with delays at intersections and crossings, as well as physical detours, minimised.

Attractive

Facilities should be designed to integrate with their surroundings, enhancing sense of place and making the whole experience of riding more appealing. Routes should complement the areas through which they pass. Lighting, personal security, aesthetics, environmental quality and noise also impact the appeal of riding facilities.

Adaptable

Bicycle infrastructure should be able to improve and evolve as demands change. Meeting the preceding design outcomes in a way that allows infrastructure to adapt to changing user and environmental needs will form a critical component of building out an effective bicycle network. Trialling of potential measures using more flexible infrastructure will assist in meeting this aim.

5.5. Level of service

Level of service is a mechanism used to determine how well a transportation facility is performing from the perspective of the traveller.

The level of service provided by a facility can be assessed through all stages of project delivery, from planning to design and implementation. Level of service should be used to frame discussion about design options so that focus is placed on providing infrastructure that all bike riders feel comfortable using.

Level of service models generally assess elements of street design and traffic characteristics, using these to determine an average score for the street from critical through to basic, good and high. The Austroads Level of Service Metrics (for Network Operations Planning)[18] provides a framework that incorporates bike riders and their transport needs (focusing on mobility, safety, access, information and amenity needs).

Table 2 provides a summary of key level of service indicators against each of the bicycle design outcomes. These indicators are not exhaustive and are intended to provide a high-level picture of the service level required for most users, including the target design profile – the interested but concerned bike rider. This is the all ages and abilities level of service that designers should be providing on LTCN routes and is typically referred to as a 'high' service level that will be suitable for most people, including new and less confident bike riders.

Designers can consider the level of service provided with regard to the bike rider types for all projects delivered, regardless of whether they are designated LTCN routes or not. On-road facilities in high speed road environments, for example, may be intended for use by somewhat confident and highly confident bike riders and may not meet the all ages and abilities requirements described in Table 2, however these facilities should still be designed with the bicycle design outcomes in mind, especially safety. Facilities provided in retrofit scenarios should – at a minimum – not lower the level of service already provided.

The London Cycling Design Standards[19] guidance provides a comprehensive cycling level of service tool based on the attributes of six bicycle design outcomes.

This tool can be used at all stages of planning and design and provides a simple scoring system with factors (e.g. feeling of safety) and indicators (e.g. separation from heavy traffic).

Table 2: Bicycle design outcomes with all ages and abilities level of service indicators

Safe

- Facility provision is appropriate to the path, road and traffic characteristics. Exposure to conflict with other users is mitigated through design that consciously minimise differences in speed, direction, mass and size. Where necessary, modes are separated.
- Bike riders are always provided the required level of protection from motor traffic (Table 5).
- The level of service provided is continuous, including through intersections, and bike riders are safeguarded from kerbside and parking activities that present collision risks.
- Bicycle priority is clear to all users and maintained through signals at intersections and by visual priority across side roads.
- Facilities are designed to mitigate personal security issues for users.

Comfortable

- Bike riders can maintain a speed they are comfortable with and are not required to do challenging manoeuvres.
- The physical effort required to cycle is minimal and riding feels low stress with a suitable level of protection and smooth, well-maintained surfaces that enable flow.
- Desired minimum widths and gradients are achieved.

Coherent

- Routes are continuous and allow bike riders to maintain a reasonable speed.
- Bike riders can join/leave the facility easily and safely and have dedicated connections to other routes.
- Routes are easy to navigate with consistent signage and wayfinding to a range of routes and destinations provided at decision points.

Direct

- Routes are at least as direct as the equivalent motor traffic journey, with minimal requirement to stop or give-way, particularly on primary routes.
- Delay for bike riders at intersections is equal to or less than motor traffic.
- Signal timings are optimised for bike riders and designed to ensure that people on bikes can efficiently and safely cross intersections both when riding in traffic or on adjacent off-road facilities.
- Bike riders are permitted to make movements prohibited to motor vehicle traffic, with contraflow and filtered permeability used to enhance directness of routes.
- Parallel routes that are not along main streets and roads are genuinely comparable in distance, uninterrupted flow and legibility.

Attractive

- Routes and trip facilities are secure, well-maintained, well lit, and integrated into the local environment to support vibrancy, accessibility and visibility.
- The infrastructure adds to the sense of place in the area and is enjoyable to use, encouraging people to spend time there.
- Vibrancy and greenery are key considerations in network and route planning.
- Routes are planned, built and maintained to include facilities and vegetation to enhance the bike riding experience, reduce urban heat island effect and support biodiversity. This includes retention of existing vegetation and landscaping to add vegetation cover, including tree canopy.

Adaptable

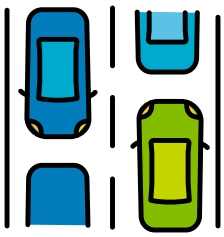
- Routes and trip facilities have the flexibility to expand, evolve and adapt to changing demands.
- Existing infrastructure is adapted to become more attractive and resilient through provision of additional wayfinding, greenery, amenity, shade, shelter and trip facilities (such as drinking stations, shaded bike parking, enhanced pavement coating, priority signalling, and so on).

5.6. Factors influencing bike rider comfort

A bike rider's sense of comfort is affected by their physical safety, which is influenced by various factors including interactions with motorised traffic and other people walking and wheeling, the design of intersections, terrain and the appeal of the route they are riding. It is also influenced by personal safety factors, such as how well lit the route is, how easy it is to find their way, presence of shelter, secure bike parking, rest stops and so on. The combination of these factors makes a route – and therefore bike riding – a feasible option.

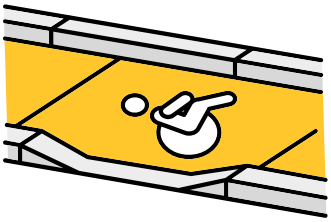
Figure 9 outlines some of the critical comfort factors for bike riders. Context-specific items on individual projects also need to be considered.

Figure 9: Common factors influencing comfort for bike

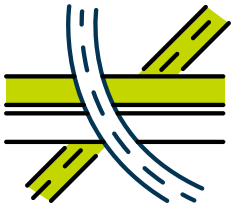


Traffic conditions (speed, volume and composition)

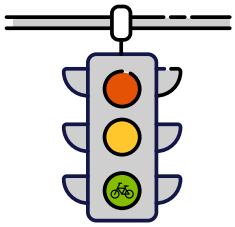
Presence and quality of bike facilities



Presence and quality of facilities for walking and wheeling

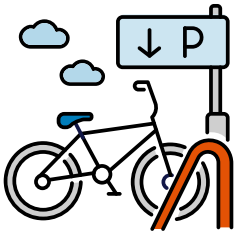


Street layout (lanes, median types, traffic calming, on-street parking)



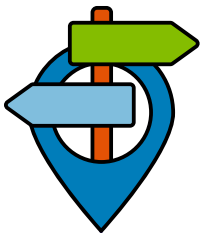
Level of protection and priority through intersections and crossings

Kerbside activity and geographic edge conditions



Presence of trip facilities, amenities and lighting

Volume and type of other active travellers in shared travel spaces



Ease, directness and rideability of routes

5.7. Bicycle vehicle requirements

An appreciation of the basic geometric parameters applicable to bicycles and consideration of the operating envelope a bike rider requires assists in delivering suitable bike riding facilities.

There are a range of bicycle types that people use and examples of these – and their dimensions – are provided in Table 3. A standard eRideable device has also been included.

The operating envelope (Figure 10) is an example of an Austroads envelope that shows the minimum space required to accommodate a two-wheeled bicycle of 1.75 m length.

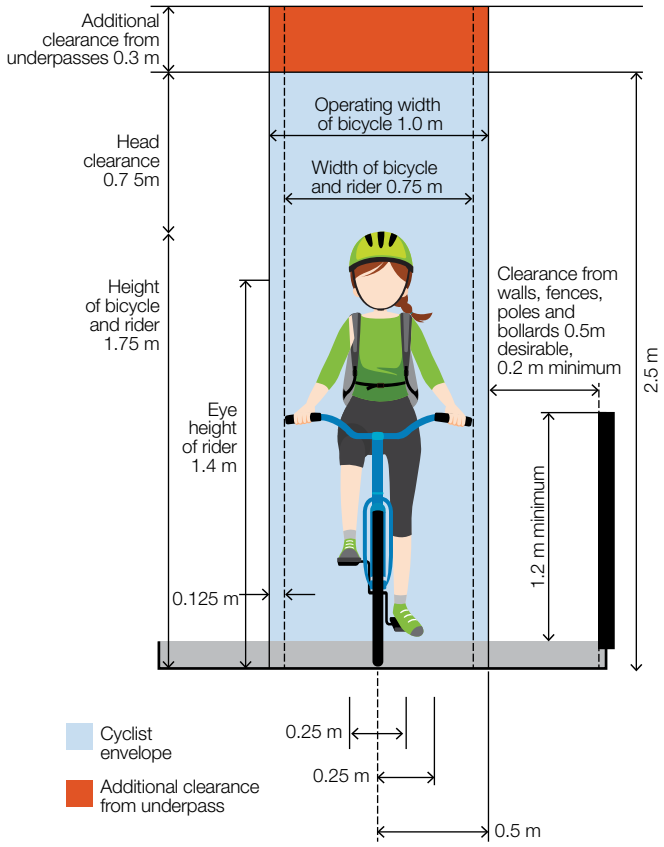
The static width allocated for the bike rider is 0.75 m (elbow to elbow) and an additional 0.25 m dynamic width to accommodate for a small deviation in the bike rider's stability when travelling in a straight line. Not all bike riders can maintain a straight line however, and when riding uphill more experienced bike riders often work the bicycle from side to side, while less experienced bike riders may wobble. To allow for these characteristics, Austroads has suggested that the 1.0 m envelope width should be increased to 1.5 m to accommodate a greater dynamic width of 0.50 m. Additionally, due to the introduction of new devices, some jurisdictions are now considering a design vehicle standard length of 2.8 m (especially through corners and bends).

Designers need to ensure that in any given design scenario, the dynamic width can accommodate:

- the essential manoeuvring space bike riders need for the balancing and weaving required to keep a bicycle upright and moving.
- comfortable lateral clearances to provide a buffer from parked cars, overtaking motor vehicles, barriers, kerbs, posts and other obstacles.
- the vertical 'pedal strike zone' – an additional clearance factor required to protect bike riders from striking their pedals on kerbs or separators.

Designers also need to consider these dimensions when installing treatments such as bollards or holding rails, as well as trip facilities (especially bike parking).

Figure 10: Operating envelope for a standard bike rider

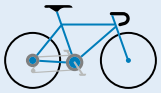
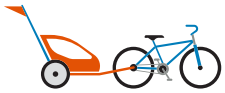


5.8. The physical effort required to ride

Bike riding requires physical effort to build and maintain momentum, retain stability and manoeuvre. Minimising the effort required to ride a bike is a key part of delivering the bicycle design outcomes and is central to making bike riding attractive and comfortable, regardless of age or ability. Key factors impacting the physical effort required to ride are outlined in Table 4.

Depending on their ability, preferences, vehicle or device, and whether they have electric assistance, bike riders may average speeds between 15 km/h and 25 km/h. This can vary from under 10 km/h on a steep incline, to over 50 km/h on a prolonged downhill section.

Table 3: Approximate dimensions of different types of bicycle vehicles and eRideables

Type	Diagram	Typical dimensions (mm)			Special Features
		Length	Width	Height	
Standard bicycle		1,800	600	1,200	
Road bicycle		1,800	600	1,200	Narrow tyres, often with clipless pedal systems (cleats)
Electric bicycle		1,800	600	1,200	Heavier, faster acceleration
Child's bicycle		1,500	500	600-900	Small size, lower top tube
Folding bicycle		1,500	600	1,200	Small size, lower top tube (at or below 500mm)
Tandem		2,750	600	1,200	Length, reduced manoeuvrability
Adult tricycle		1,800	800	1,200	Width, reduced manoeuvrability
Recumbent bicycle/tricycle		2,000	750-1,000	1,300	Length, width, reduced manoeuvrability
Hand cycle		1,800	800	1,000	Length, width, height, reduced manoeuvrability
Cargo bicycle		2,550	650	1,300	Length, height, reduced manoeuvrability
Cargo tricycle		2,100	870	1,300	Length, width, height, reduced manoeuvrability, weight
Bicycle tagalong		2,900	600	1,200	Length, height, reduced manoeuvrability, weight
Bicycle and child trailer		3,000	800	1,200	Length, width, height, reduced manoeuvrability, weight
Bicycle and child seat		1,800	600	1,400	Height
Trishaw		2,250	1220	1,600	Length, width, height, reduced manoeuvrability, weight
eRideable		1,250	700	1,350	Faster acceleration, weight limited to 25 kg or less, smaller wheels*

***Information on eRideables is available from the Road Safety Commission.**

Commercial hire operators of eScooters are currently permitted (by way of Ministerial exemption) to have larger devices (weight up to 35 kgs and length to 1300 mm). These dimensions may need to be factored in where local governments have permanent hire schemes set up in their locality.

Table 4: Factors influencing the physical effort required for bike riding

Factor	Influencing:
Rider speed and manoeuvring	• Physical effort is required to start riding and maintain speed. • Direct routes allow bike riders to maintain momentum at their preferred speed. • Designers should minimise the need for bike riders to stop, slow, deviate unnecessarily from their desired route, or make tight manoeuvres.
Surface quality and materials	• Rough, uneven and resistant surfaces reduce stability and can be difficult and dangerous for bike riders, especially inexperienced bike riders and small-wheeled devices. • Smooth, comfortable surfaces made of high-quality materials (appropriate to local weather conditions) make riding more appealing. • Route maintenance is critical to retaining surface quality
Gradients	• Both uphill and downhill gradients influence a bike rider's level of comfort. Steeper downhill gradients result in higher speeds, which may cause path conflicts or make bends and turns more hazardous. • Directness of routes needs to be balanced with avoiding steep gradients and alternative routes should be considered where practical. • Separation of users should be considered where gradients differ from desired standards.
Exposure to the elements	• Weather elements, such as wind and sun, can discourage people from riding. • Elements such as greenery and shade increase the attractiveness of a route and are an important design consideration. • Landscaping and other features should be used to break headwinds and reduce air resistance.

6. Bicycle facility types

6.1. General facility types included in this guide

The following facility types can be considered all ages and abilities when used in appropriate contexts.

Facilities have been grouped under four categories:

- Off-road paths (shared or separated)
- Physically separated bicycle lanes
- On-road bicycle lanes (painted or buffered)
- Mixed traffic facilities (shared zones and safe active streets).

Routes may require a combination of these facilities to respond to the local context and to ensure the infrastructure adds to the sense of place and character of the area.

Consistent infrastructure provision is likely to result in a more legible route to ride, however consistency in level of service should be the key focus for designers. Regardless of the facility type used, bicycle routes should achieve the six bicycle design outcomes – safe, direct, comfortable, coherent, attractive and adaptable – including through transitions and intersections.

When used in the appropriate context, these facilities should be low stress and high comfort for the target design profile – the interested but concerned bike rider – and promote bike riding as an everyday option for most people, not just for highly confident bike riders.

Level of protection

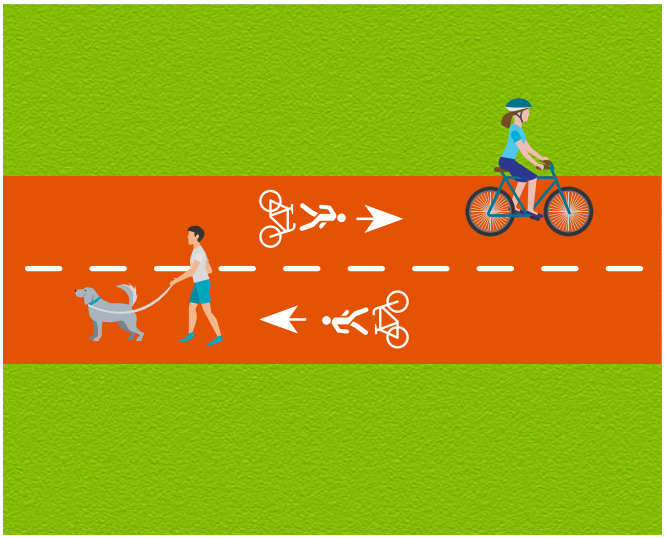
The types of bicycle facilities vary in terms of the level of protection they provide, both between bike riders and motorised traffic and between bike riders and people walking and wheeling. Protection can be provided through the demarcation of space for bike riding (designated lines, signs and rights-of-way), distance (horizontal buffering space), minimised differences (in speed, direction, mass and size), time (separating movements in time through signals), or separation (physical barriers and dedicated facilities). The degree and efficacy of various protective measures will depend on where and how the facility is implemented.

Off-road paths and physically separated bicycle lanes provide a high level of protection by separating bike riders from motor traffic, while on-road bicycle lanes and mixed traffic streets offer less protection and should only be used in low speed, low volume traffic conditions. In many instances, if there is space for an on-road bicycle lane, there is potential for a physically-separated lane. Designers should consider that where existing space is allocated to motor traffic, there should not be a presumption that all this space must be retained for motor traffic. Similarly, existing traffic speeds, volumes and lane numbers or widths may not need to be maintained and could be reduced to create safer operating environments.

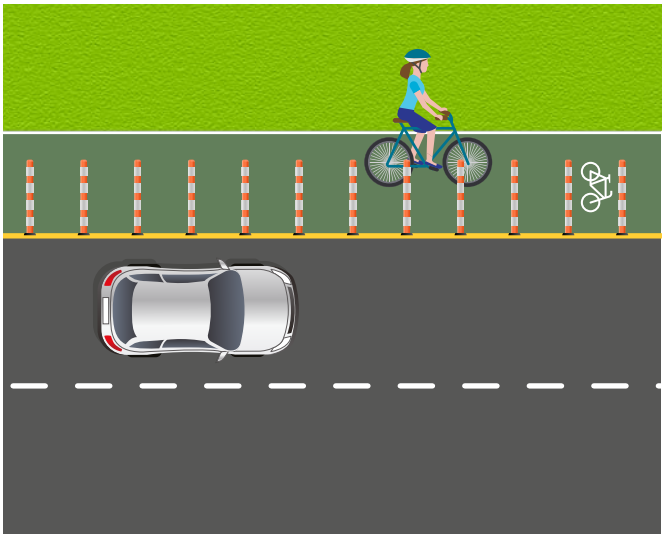
6.2. All ages and abilities bicycle facilities

Off-road paths – this includes shared paths where bike riders share the space with other travellers, and separated paths where the path for bike riders is separated from the path for people walking and wheeling by a median, line, barrier or visually by pavement material and colour (can also be known as a bicycle path). Bike riders are legally permitted to ride on any path in WA (unless signposted otherwise), including footpaths, and no compulsory signs or pavement markings are required to formally designate a shared path, however shared paths are specifically designed to accommodate the safe and efficient movement of people walking, wheeling and riding concurrently.

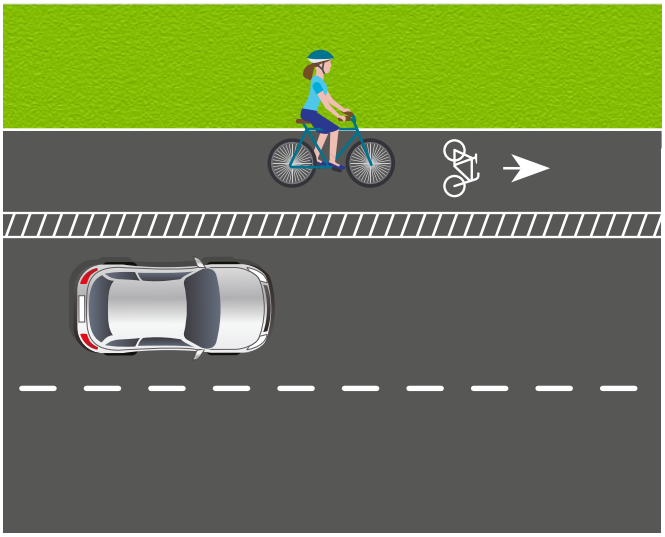
Design guidance: Shared and Separated Paths guidance[3]



Physically separated bicycle lanes – these lanes – also known as cycle tracks – position bike riders between the parking or traffic lane and the footpath, with physical separation to provide bike riders with the experience of an off-road path with the functionality of an on-road lane. Protection can be provided for the full route or at key conflict and activity areas, depending on locations and traffic conditions. The physical barrier restricts the encroachment of motor vehicles and other users through permanent or temporary features such as planting/vegetation, planter boxes, frangible bollards, temporary road barriers, parking with dooring buffer and raised curbs. These lanes can be one-way or bi-directional and at the level of the carriageway verge or an intermediate level.

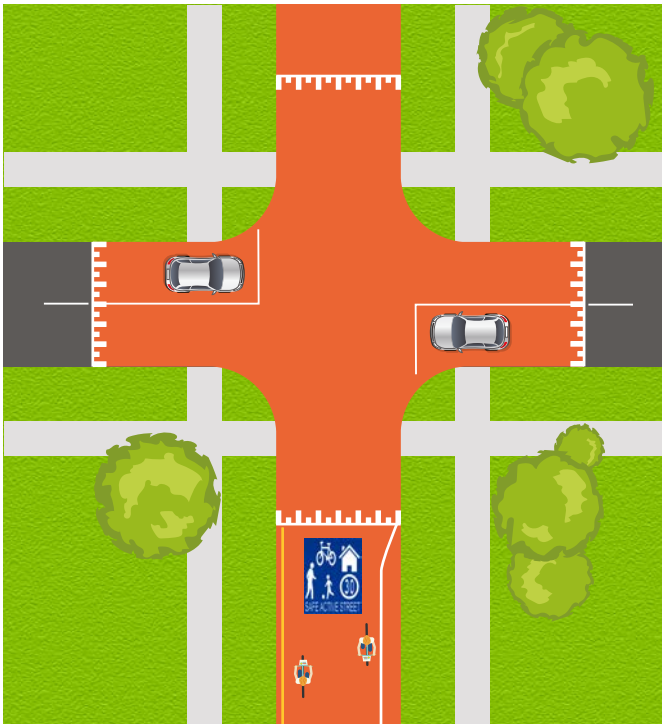


On-road bicycle lanes – this includes painted and buffered uni-directional lanes providing designated space for bike riding on the carriageway. They are generally located on the left side of the road and demarcated by signs, lines and pavement markings. Buffered lanes are painted lanes paired with designated buffer space separating the lane from the adjacent traffic or parking lane. The level of service provided by these lanes depends on the road context, the level of protection provided, and their continuation through intersections and crossings. Consideration should be given to how these facilities can be improved to increase the level of service provided over time, through increased protection and/or changes to traffic conditions and composition.



Mixed traffic facilities – this includes safe active streets and shared zones. Safe active streets are located on quiet local streets (1,500 or less vehicles per day) where the speed has been reduced to 30 km/h to provide a high-comfort riding space for all ages and abilities, while keeping the street accessible for motor traffic. These facilities differ from traffic calming measures, have regulatory speed limits and distinctive blue patches, and maintain priority for bike riders over all intersecting roads. Shared zones are lengths of carriageway or networks of roads in an area in which traffic must give way to people walking or wheeling, and where the road environment has been adapted for low vehicle speeds of 10 km/h or 20 km/h. The use of the term 'shared zone' in this guidance reflects the definitions given by Main Roads WA and Design WA.

Design guidance: Main Roads WA Speed Zones[20], Design WA State Planning Policy 7.2 – Precinct Design[6]



7. Bicycle facility selection

7.1. Factors to be considered in the facility selection process

Bicycle facility selection is a context-sensitive decision that needs to account for a range of factors. The quality of the bicycle infrastructure selected will impact the level of comfort provided and by extension, the amount of people who will use and benefit from it. Documenting and accounting for these contextual factors is an essential part of the planning and design process.

Factors that can inform bicycle facility selection and design:

- **Project functionality criteria and boundaries** – the selection process should address how the proposed facility fits within the LTCN. For example, if a facility is part of a primary route it will need to cater for higher volumes of bike riders. Connection to other LTCN routes also needs to be considered, with logical project boundaries established to meet the desired network connectivity and with transitions to other routes that are logical and intuitive for bike riders, as well as other road users and people walking and wheeling who may interact with the facility.
- **Type of bike rider the facility is intended to serve** – understanding the target bike rider type is essential for setting a strategic level of service for the infrastructure being delivered. As outlined in Section 5.3, the intended target design profile for the LTCN is the interested but concerned bike rider who needs low stress, high comfort facilities in order to feel safe riding for transport.
- **Project type** – infrastructure selection will be impacted by whether the project is a new construction, reconstruction on an existing alignment with basic changes to the road or path, or construction on an existing road that retains the alignment and road type. For new and reconstruction projects, there may be fewer constraints and the preferred bicycle facility can be implemented. Projects on existing roads or minor reconstruction projects may have more constraints that will impact facility selection and design. The inability to provide the preferred all ages and abilities facility should not result in the immediate dismissal of the project and designers may consider an alternative route or look at options to modify the road to make another facility feasible (such as by reducing traffic volumes and speeds).
- **Land use context** – differences in land use across urban, rural and city/town centre areas will impact density, activity level, setbacks, space available, number of crossover, the distances between destinations, the expected volume and type of bike riders, availability of trip facilities, and various other factors that will influence what infrastructure is appropriate and achievable. Future proposed land uses can also be checked to determine if a higher-order facility may be realised before or during development.
- **Road context and traffic composition** – the function of a road and the associated motor traffic speeds, volumes and vehicle mix heavily influence which types of facilities will be safe and comfortable. Generally, the higher the level of traffic stress, the more protective the required bicycle facility.

The selection of bicycle facilities will not only respond to the listed factors, but more importantly, will be considered as part of a design process that requires collaboration from a range of experts, including professionals from transport planning, urban design, landscape architecture, road and traffic engineering, as well as meaningful engagement with the community to ensure the resulting infrastructure meets their needs.

7.2. Level of traffic stress

Level of traffic stress is a method of classifying roads and paths based on how comfortable bike riders with different levels of confidence would feel using them (using the bike rider types).

This method can help identify location-specific stress factors and ensure the facilities selected are appropriate for the context that surrounds them.

As shown in Figure 11, there are four rated levels of traffic stress (1-4), ranging from low through to extreme traffic stress environments based on characteristics including traffic speeds, traffic volumes, number of lanes, parked cars, ease of intersection crossing and whether bike riders are separated or mixed in traffic.

A bicycle facility that is Stress Level 1 is considered to be appropriate and comfortable for all bike rider types and is known as an all ages and abilities bicycle route.

While there is no one-size-fits-all infrastructure response, contexts with moderate or high levels of stress (Levels 3 and 4) generally require bicycle facilities that provide a higher level of protection, or practitioners can reduce traffic lanes, speeds and volumes.

Figure 11: Level of traffic stress ratings with bike rider types

Stress Level 4	Stress Level 3	Stress Level 2	Stress Level 1
Extreme traffic stress bike route that is uncomfortable for most bike riders, generally only used by highly confident bike riders where no alternative is available.	High traffic stress bike route that is comfortable for highly confident bike riders. Somewhat confident bike riders may be willing to ride these routes for short parts of their journey.	Moderate traffic stress bike route comfortable for somewhat confident bike riders. Some adults who are interested but concerned may feel safe riding	Low traffic stress bike route comfortable for interested but concerned bike riders and suitable for all ages and abilities.

7.3. All ages and abilities bicycle facility selection support tool

The selection of one all ages and abilities bicycle facility over another, in particular, an on-road facility versus a separated facility, needs to respond to the set of site characteristics that will exist for each design scenario. The final selection cannot be fully determined through the use of guidance alone, and the choice of a specific bicycle facility – or combination of facilities – will need to be appropriate to the local context. No guideline, warrant, or other selection tool can fully substitute the judgement of experienced and qualified practitioners.

Within this context, the following selection support tool has been developed to enable initial determination of a bicycle facility type that considers the road function, target traffic speed and traffic volume. The tool applies to urban contexts and is intended as a design aid during the planning process to establish a consistent basis for making decisions about appropriate facility selection.

Designers will need to consider other contextual factors and site-specific characteristics, including volume of bike riders using a route (or likely to be attracted to it), parking configuration and turnover, road geometry and gradients, conflict between bike riders and turning vehicles, vehicle composition (particularly the presence of freight vehicles) and presence of public transport.

In all cases where there are complex operational considerations or high volumes, speeds or large vehicles in the mix, the first preference is to achieve a physically separated facility, either as an on-road physically separated bicycle lane or an off-road path. Importantly, while lower protection on-road bicycle lanes have been included, their implementation is only supported in limited contexts.

It is important to recognise there is no single pathway to a good design outcome for an all ages and abilities facility and the facility selection support tool is intended to be used as part of a flexible design process that takes into account the broader considerations outlined throughout this document.

Table 5: All ages and abilities bicycle facility selection support tool

Road function	Target motor vehicle speed [T]	Target motor vehicle volume (per day)	Indicative range for selection of all ages and abilities bicycle facility by road function					
			Shared zone	Safe active street	Painted bicycle lane	Buffered bicycle lane	Physically separated bicycle lane	Off-road path
Any road with complex or conflicting operational factors [P]	Any	Any						
Access function, e.g. local access streets (with or without parking)	Up to 30 km/h	≤1,500						
Access or collector function, e.g. local streets accessing residential properties or neighbourhood/town centres	Up to 40 km/h	≤3,000						
		≤6,000						
Through traffic function, e.g. arterial roads linking significant destinations	Greater than 41 km/h [Y]	Any						
Regional through traffic function, e.g. major arterials moving high capacity or commercial traffic (including freight)	Greater than 70 km/h	Any						

Notes:

T While posted or 85th percentile motor vehicle speed are commonly used design speed targets, 95th percentile speed captures high-end speeding, which causes greater stress to people riding and more frequent passing events. Setting target speed based on this threshold results in a higher level of riding comfort for the full range of bike riders.

Y 40 km/h has been set as the motor vehicle speed threshold for providing separated facilities. This is consistent with the road safety and 'vision zero' policies of many jurisdictions and with providing level of traffic stress level 1, which is considered all ages and abilities. Some jurisdictions use a 50 km/h posted speed as a threshold for separated facilities, consistent with providing level of traffic stress level 2 that can effectively reduce stress and accommodate more types of bike riders.

P Operational factors that can lead to bicycle facility conflicts are reasons to provide separated bicycle facilities regardless of motor vehicle speed and volume. These factors may include high kerbside activity, transit, traffic composition (e.g. high volumes of heavy vehicles), congestion, turning conflicts, high pedestrian volumes and so on.

- A mixed traffic facility may be appropriate on roads with a collector function if the speed is reduced and depending on motor vehicle volumes. Shared zones should only be considered where conditions meet the appropriate speed zone requirements (according to Main Roads WA Speed Zones) and where predicted demand for bike riding is low.
- The volume thresholds for on-road lanes are indicative only. Where volumes exceed these ranges or operational factors reduce safety (such as on-street parking creating door zone conflicts) then a higher level of protection should be used.

7.4. Assessing and refining preferred bicycle facility type

Once a preferred all ages and abilities bicycle facility type has been identified, the selection needs to be assessed and refined based on the various site specific factors and considerations. Beyond the factors outlined in Section 7.1, there are a variety of other considerations that may arise in the selection and design process. Some key considerations in refining the facility type include:

- **Unusual motor vehicle peak hour volumes** – on roads or streets that regularly experience unusually high peak hour volumes, a higher level of protection than indicated in Table 5 may be necessary, particularly when the peak hour also coincides with peak volumes of bike riders.
- **Traffic composition** – higher volumes or percentages of heavy vehicles and buses increase risks and discomfort for bike riders due to the vehicle size and mass. The blind spots of these vehicles can also be a concern and exacerbate potential turning conflicts. Designated emergency vehicle routes may also influence bicycle facility selection and design. Higher levels of protection, additional buffering widths, or other treatments to increase visibility and safety in these locations may be required.
- **Vulnerable populations** – the presence of high concentrations of vulnerable populations, such as children or older adults, should also be considered during facility selection and design. These groups may only feel comfortable on separated facilities, regardless of the traffic speeds and volumes. These groups may be less experienced, less confident and less visible to motorists.
- **Environmental impact and amenity** – decisions on the type, location, design and delivery of infrastructure can have profound implications for the environment. Therefore, the preferred facility type may need to be refined, or a different selection should be made to prevent biodiversity loss and ensure the facility supports an attractive riding experience through the natural landscape (including shade, shelter, and amenity).
- **Crossover and intersection frequency** – this is particularly important for bicycle lanes and shared paths as it may impact the rideability of a route, especially if the bicycle facilities do not have clear right-of-way or motorists do not have adequate sight lines or space to yield to bike riders. Bicycle lanes may need to be realigned or raised to ensure visibility.
- **Parking turnover and kerbside activity** – conflicts with parked or temporarily stopped vehicles present significant risks to bike riders due to increased exposure to dooring, people walking in their riding path, passengers being unloaded in the bicycle facility area, or vehicles pulling out onto them. In locations with high parking turnover, complicated parking configurations, or kerbside loading needs, bicycle facility width and separation may need to change.
- **Transit considerations** – bike riding offers a valuable first and last mile connection to transit systems, effectively expanding the transit shed around a station or stop. Accessibility of transit boarding areas, pedestrian crossings and parking all need to be integrated with bicycle facilities.

7.5. Downgrading a preferred facility

In design scenarios where the preferred all ages and abilities bicycle facility type is not feasible and the level of protection is downgraded, achievement of the bicycle design outcomes – especially safety – will likely be reduced and bike riding participation may be supressed. Where this occurs, efforts should be made to identify potential solutions that will help achieve improved outcomes and contribute to the realisation of an all ages and abilities network.

7.6. Other facilities and measures

There are numerous other facilities and measures that can be implemented to improve environments for bike riding, and while these may not meet all ages and abilities requirements, they are still important tools for enhancing various streets and roads for bike riding, reducing the level of traffic stress experienced, and contributing to improvements in the level of service (if potentially only for somewhat confident or highly confident bike rider types).

The following facilities and measures are some of the more common used in WA:

- **Bicycle signage and pavement markings** – this encompasses any treatment of infrastructure that indicates the presence of a bicycle facility or distinguishes that facility for people riding, walking, wheeling or driving. Bicycle signage can include wayfinding and route signage, regulatory signage, warning signage and any other specific signage that provides information and instruction to path and road users. Pavement markings are applied onto pavement surfaces (path or road) to designate specific rights-of-way, direction, conflict zones or route options. These facilities can help to guide bike riders and visually remind people travelling via other modes that they should expect to see people on bicycles. Research has shown that the presence of bike stencils on the road pavement can increase peoples' levels of comfort, however only in very low traffic, low speed roads with no centreline and alongside speed reduction treatments.
- **Traffic calming measures** – changing the design and operations of a street through strategies such as reducing lane widths, removing lanes, or other traffic calming measures can change demand for access and movement and increase the safety and comfort levels for bike riders. Traffic calming can be used to reduce speeds and volumes, particularly on local streets where motor vehicle speeds can be brought closer to the speed of bike riders and within safer thresholds and volumes can be reduced to lower the frequency of passing events (Section 3.4). DoT's Local Area Traffic Management (LATM) guidelines provide advice on incorporating the safe and efficient movement of people riding bikes into the planning and design of LATM schemes. Importantly, LATM schemes are not considered all ages and abilities bicycle facilities like safe active streets are, as they are not required to be on designated LTCN routes or meet the same criteria.
- **Network reconfiguration** – changing the network by diverting motorised traffic, changing the travel directions, consolidating parking, altering kerbside access or activity, and making other changes to how a street is used can improve conditions for bike riders and enhance the level of service of various bicycle facilities. Safe active streets and other mixed traffic environments can rely on these types of network changes to create the low speed, low volume conditions necessary for bike riders to feel safe and comfortable. Filtered permeability or prohibiting through-traffic can create more comfortable bike riding environments without requiring dedicated, separated or off-road space.

8. Appendices

Appendix 1. Glossary

Accompanied rider	A rider who is accompanied by another person while riding, generally due to age or ability characteristics.
Active travel	Refers to being physically active to make a journey, which can be for a variety of purposes such as transport, exercise, fun or recreation. Walking and bike riding are the most common modes, but using a wheelchair, scootering, skating, running, paddling or using other assisted devices (such as an eBike) are also included.
All ages and abilities	Refers to the design philosophy about creating places and facilities that are safe, comfortable and accessible for anyone to ride.
Bicycle	As per the Road Traffic Code 2000, refers to a vehicle with 2 or more wheels that is built to be propelled by human power through a belt, chain or gears (whether or not it has an auxiliary motor), and includes a pedicab, penny-farthing, tricycle and power assisted pedal cycle; but does not a wheelchair, wheeled recreational device, wheeled toy, any vehicle (other than a power assisted pedal cycle) with an auxiliary motor capable of generating a power output over 200 watts (whether or not the motor is operating), or an electric rideable device.
Bicycle facility	Generic term covering paths, lanes and end-of-trip provisions for bike riders.
Bicycle path	An off road path set aside for the exclusive use of bicycle riders, sometimes referred to as a separated or bicycle-only path.
Bike rider	Refers to the driver of, or person riding, a bicycle.
Bike rider operating envelope	Refers to the typical space a person takes up while bike riding, taking into account the static width of a rider and their bicycle, as well as the dynamic width required to accommodate for a small deviation in the rider's stability when travelling in a straight line. Also referred to as a design envelope.
Bike rider types	Profiles or typologies used to classify the general population into different types of bike riders based on characteristics such as comfort level, skill and experience, trip purpose, age and ability. This guidance has grouped adults who have stated an interest in bike riding into three types of potential and existing riders: highly confident, somewhat confident, and interested but concerned.
Bicycle design outcomes	Refers to the six internationally-recognised requirements that need to be achieved and balanced in the design of bike riding infrastructure: safe, comfortable, coherent, direct, attractive and adaptable. Also referred to as design principles.

Bicycle network planning principles	Refers to the six planning principles applied when planning long-term cycle networks: safe, connected, legible, widespread, aspirational and achievable. Also referred to as guiding principles.
Level of service	A mechanism used to determine how well a transportation facility is performing from the perspective of the traveller.
Level of traffic stress	A method of classifying roads and paths based on how comfortable riders with different levels of confidence would feel using them.
Long Term Cycle Network	Identifies the aspirational blueprint for all ages and abilities cycling infrastructure in WA.
Local Area Traffic Management	Refers to the use of physical devices, streetscaping treatments and other measures (including regulations and other non-physical measures) to influence vehicle operation, in order to create safer and more pleasant streets in local areas.
Micromobility	Refers to a broad range of small, lightweight devices operating at speeds of around 25 km/h or less. This includes bikes, eBikes, eRideables, scooters and skateboards.
Mode	Refers to the way in which people or goods are transported. For people, this is typically: walking, riding, public transport or private car.
Path	Any route intended for use by people walking or riding which is not part of a road and which may or may not be adjacent to a road.
Rider	As per the Road Traffic Code 2000, rider means the driver of, or person riding, a motor cycle, bicycle, electric personal transporter, animal or animal-drawn vehicle, but does not include a passenger, or a person walking beside and wheeling a bicycle.
Walk, wheel, ride	These terms are used to consider everyone that uses, or could use, the active transport network of paths, trails and local streets to get around. This includes people travelling for transport, as well as people walking, wheeling or riding for recreation, tourism, informal exercise, or to deliver goods and services.
WA Cycling Network Hierarchy	Refers to the functional hierarchy of routes applied to cycle networks in WA.
Separated path	A path signed for separated use on which bicycle riders and pedestrians are required to use separate designated areas.
Shared path	An area that is open to the public that is designated for use by both bicycle riders and pedestrians.
Target design profile	Refers to the bike rider types selected as the target profile for the network and any facility within it. The target design profile for the LTCN is the interested but concerned bike rider.
85th percentile speed	Refers to the speed at or below which 85 per cent of all vehicles are observed to travel under free-flowing conditions past a monitored point. Can be applied as 95th percentile as well.

Appendix 2. List of Figures

Appendix 3. List of Tables

Appendix 4. Key reference documents

These key reference documents and articles provided information and insights used in the development of this guidance.

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