D

CYCLING FACILITIES

D.1 General Design Guidance
D.2 Neighbourhood Bikeways
D.3 Protected Bicycle Lanes
D.4 Painted + Buffered Bicycle Lanes
D.5 Advisory Bicycle Lanes
D.6 Rural Cycling Design Considerations

Columbia Ave, Castlegar B.C.

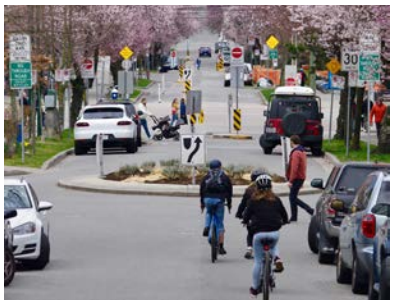
D.1

GENERAL DESIGN GUIDANCE

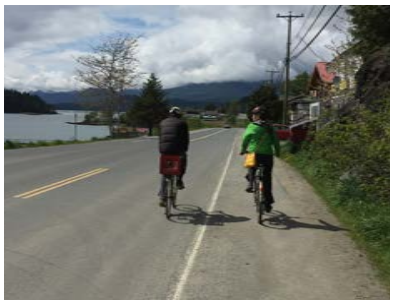
Level 2: This chapter provides general design guidance for on-street bicycle facilities, including the range of possible bicycle facility types and the approach to bicycle facility selection. The subsequent chapters provide detailed design guidance for each of the major bicycle facility types: Neighbourhood Bikeways (**Chapter D.2**), Protected Bicycle Lanes (**Chapter D.3**), Painted and Buffered Bicycle Lanes (**Chapter D.4**), Advisory Bicycle Lanes (**Chapter D.5**), and Rural Cycling Design Considerations (**Chapter D.6**). Design guidance for off-street facilities is provided in **Section E**.

BICYCLE FACILITY TYPES

There are a number of different types of bicycle facilities that can be applied in various contexts in communities throughout B.C. There are various terms used to describe each facility type. For the purposes of the Design Guide, a standardized nomenclature has been developed with the following types of bicycle facilities.

ON-STREET FACILITIES		
	**Neighbourhood Bikeways** Streets with low motor vehicle volumes and speeds that are suitable for motor vehicles and people cycling to share the road. Neighbourhood bikeways may include treatments such as signage, pavement markings, traffic calming, and traffic diversion to prioritize bicycles and make the facility comfortable for people of all ages and abilities.	**Chapter D.2**
	**Protected Bicycle Lanes** Separate travel lanes designated exclusively for bicycle use and other forms of active transportation (such as in-line skating, using kick scooters, and skateboarding, where permitted) that are physically separated from motor vehicles and pedestrians by vertical and/or horizontal elements.	**Chapter D.3**
	**Painted and Buffered Bicycle Lanes** Separate travel lanes designated exclusively for bicycle use that are delineated by a painted line and, in some cases, a painted buffer area.	**Chapter D.4**
	**Advisory Bicycle Lanes** Bicycle-priority travel lanes on a narrow road with a single, narrow centre travel lane for motor vehicles that accommodates two-way motor vehicle traffic but that may require one motorist to allow the other to pass. Motor vehicles may temporarily enter the advisory bicycle lane to pass on-coming motor vehicles.	**Chapter D.5**

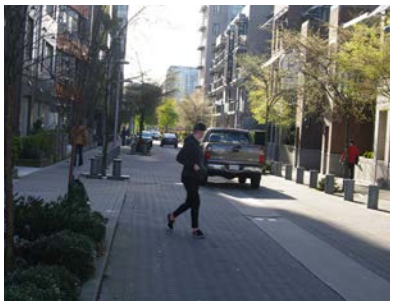
ON-STREET FACILITIES



Bicycle Accessible Shoulders

Paved spaces on the right side of a rural road or highway, and certain urban roads, that can be used by bicycle users. The shoulder may also be used by other road users for safety, operations, and maintenance purposes

Chapter D.6



Shared Street

A road with very low motor vehicle speeds and volumes in which the living environment dominates over the through movements. A shared street functions first as a meeting place, residence, playground, and pedestrian area. The road is shared among people walking, cycling, and driving.

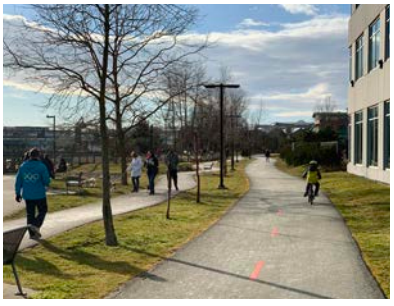
Chapter E.4

OFF-STREET FACILITIES

Multi-Use Pathways

Off-street facilities that are shared between people walking, cycling, and using other forms of active transportation such as skateboarders and in-line skaters.

Chapter E.2



Bicycle Pathways

Off-Street facilities that are designated exclusively for people cycling and using other active modes (such as in-line skating, using kick scooters, and skateboarding, where permitted), but are separated from pedestrians.

Chapter E.3

All Ages and Abilities Cycling Facilities

Each of the bicycle facility types included in the Design Guide can be considered part of a comprehensive bicycle network. However, many communities are increasingly focusing on 'all ages and abilities', or 'AAA', bicycle facilities that offer a greater degree of safety and comfort. An overview of all ages and abilities mobility considerations is provided in **Chapter B.1**.

The NACTO *Designing for All Ages & Abilities: Contextual Guidance for High-Comfort Bicycle Facilities* provides a cycling-specific overview of the all ages and abilities concept. NACTO emphasizes that all ages and abilities bicycle facilities that are safe, comfortable, and equitable have the following benefits:

- Help to achieve growth in cycling mode share by creating welcoming, low-stress cycling conditions.
- Bicycle facilities that eliminate stress will attract traditionally underrepresented cyclists, including women, children, and seniors.
- Investing in jurisdictions that have a distinct need for enhanced mobility can help ensure that people of all incomes and cultures have access to bicycle facilities. This helps to reduce barriers by providing a safe way to travel for daily needs.
- Better bicycle facilities are directly correlated with increased safety for people cycling, walking, and driving. Poor or inadequate infrastructure forces people cycling to choose between feeling safe and following the rules of the road. Where road design provides safe places to ride and manages motorist behaviour, unsafe cycling decisions tend to disappear, making it easier to ride in a safe and legal manner and resulting in more riders.

A number of bicycle facility types have the potential to be suitable for people of all ages and abilities, depending on the design and context. Other facilities, such as bicycle accessible shoulders, are never considered suitable for people of all ages and abilities but may serve as a supporting facility that enhances the overall active transportation network. The Design Guide does not limit guidance to all ages and abilities bicycle facilities. However, wherever possible, design professionals should strive to provide all ages and abilities facilities.

BICYCLE FACILITY SELECTION

Motor vehicle speeds and volumes are perhaps the most important considerations in selecting the appropriate bicycle facility type. Generally, higher motor vehicle speeds and volumes necessitate a greater degree of separation between motor vehicles and bicycles, as conceptually illustrated in **Figure D-28**.

Figures D-29 and **D-30** show the Bicycle Facility Selection Decision Support Tool, which outlines when each type of bicycle facility may be appropriate. The Bicycle Facility Selection Decision Support Tool may be used to narrow the range of possible facility types based on motor vehicle speed and average daily motor vehicle volume. There are, however, a range of other contextual and local conditions that should be understood and may impact the selection of the preferred bicycle facility type. Key facility selection criteria are outlined in **Chapter B.2**. The Bicycle Facility Selection Decision Support Tool is a guide that should be applied with professional judgement and careful consideration of the real-world context.

The Bicycle Facility Selection Decision Support Tool consists of two separate decision support tools: one for urban, suburban, and developed rural core contexts, and one for outer developed rural and basic rural contexts. Each decision support tool is based on motor vehicle speed and average daily motor vehicle volume.

For the purpose of facility selection, it is assumed that motor vehicle operating speed and the posted speed limit are approximately consistent. Where they differ, the operating speed should be used as the basis for motor vehicle speed. Additionally, it should be noted that the speed and volume thresholds listed in the Design Guide are not intended to be absolute. This process is inherently flexible and context-specific. In particular, there is flexibility in defining motor vehicle volume thresholds, and suggested values may be adjusted by +/- 500 to 1,000 vehicles per day based on professional judgement.

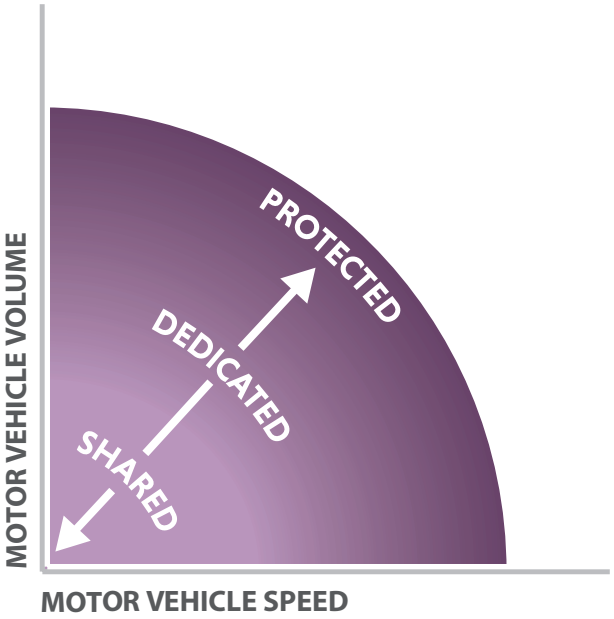


Figure D-28 // Conceptual Bicycle Facility Selection Diagram

The design decision support tools are provided to narrow the range of appropriate bicycle facility types and support a design professional's decision-making process. They do not replace the need for the decision on the appropriate bicycle facility type to be made by a qualified, experienced professional exercising sound judgement. Design professionals should also consult **Chapter B.2** to understand the contextual and local conditions that may influence the preferred bicycle facility1type.

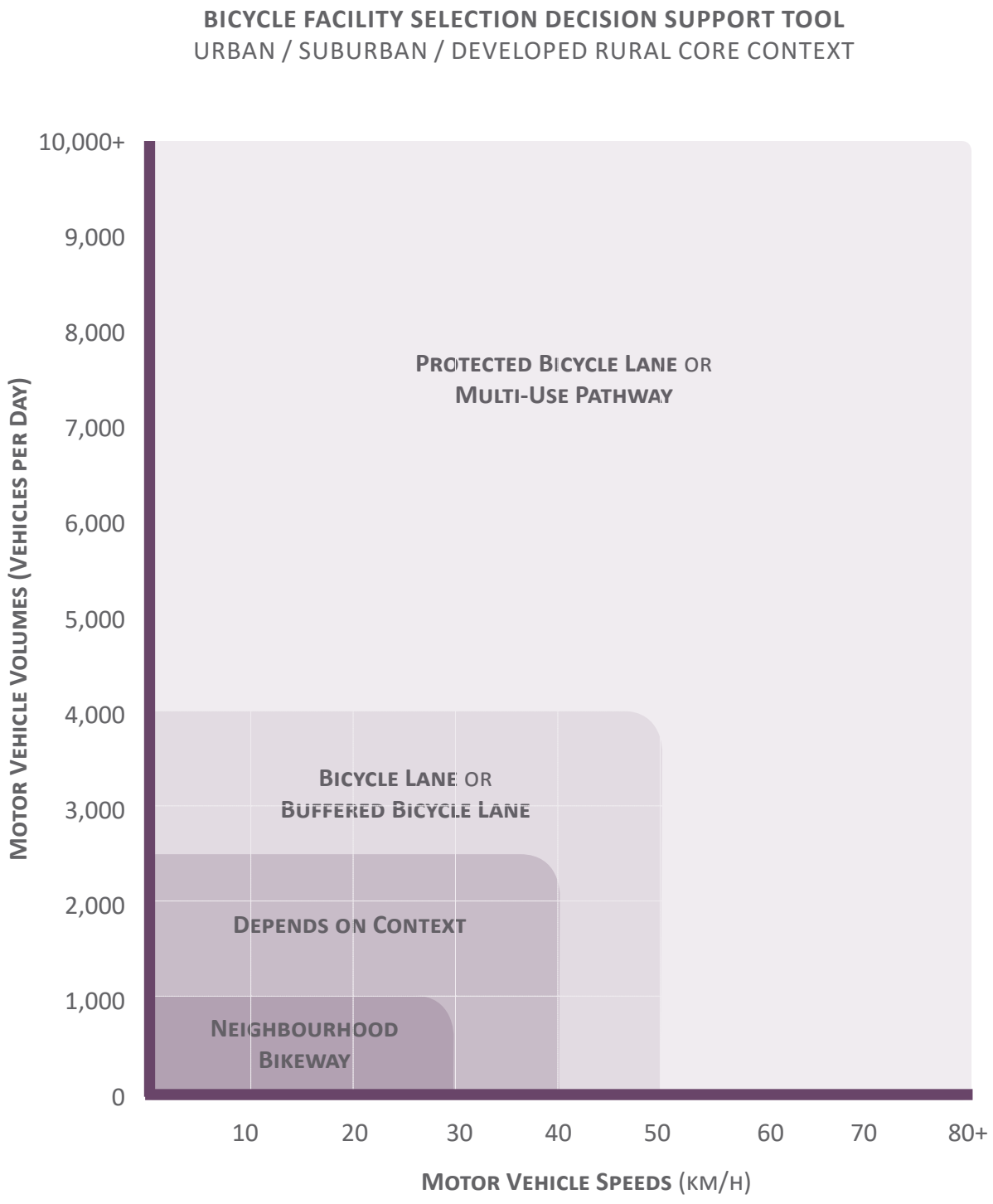


Figure D-29 // Bicycle Facility Selection Decision Support Tool - Urban / Suburban / Developed Urban Core Context

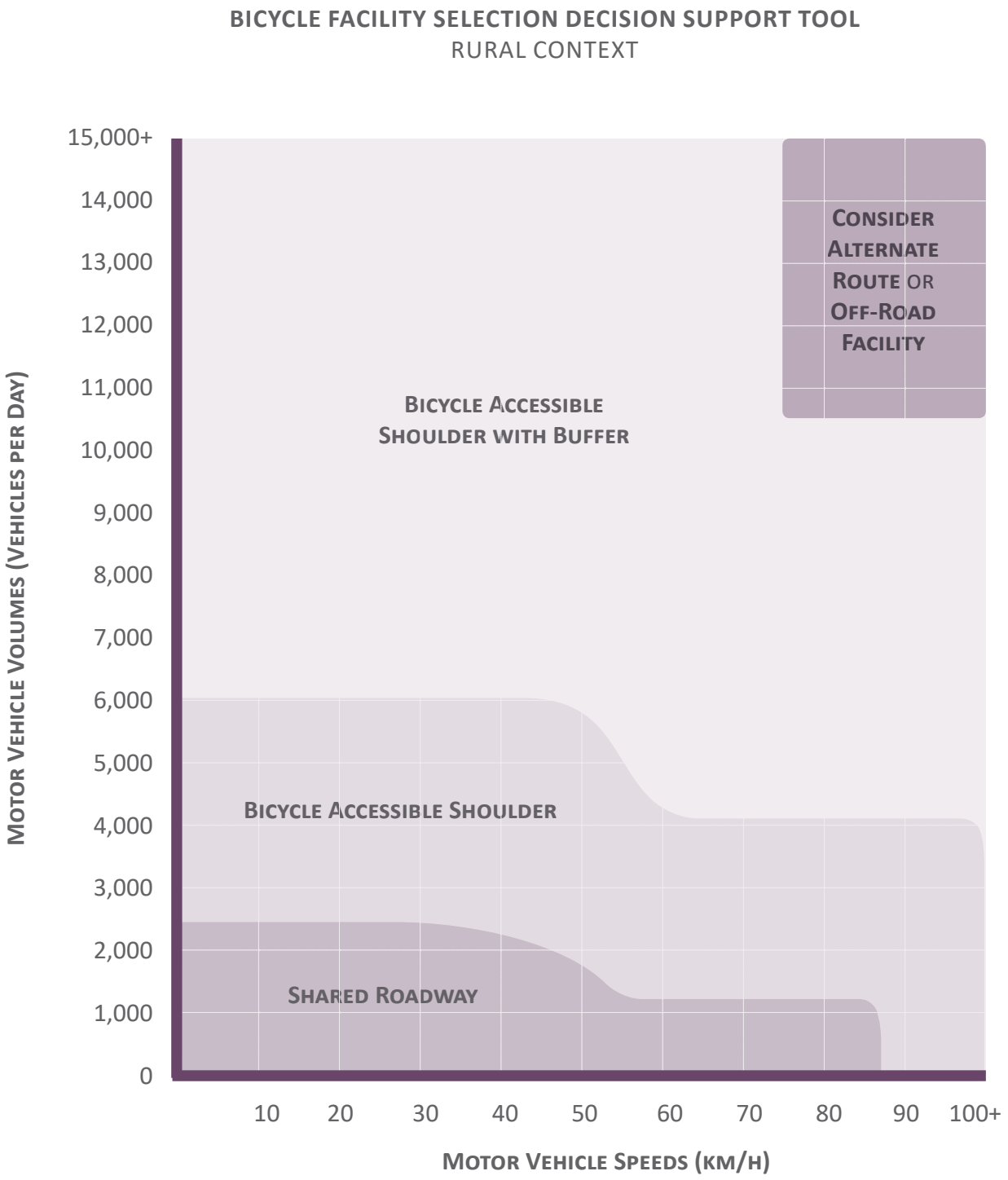


FIGURE D-30 // BICYCLE FACILITY SELECTION DECISION SUPPORT TOOL - RURAL CONTEXT

City of Vancouver, B.C.
Source: Modacity

D.2

NEIGHBOURHOOD BIKEWAYS

Neighbourhood bikeways (also often referred to as bicycle boulevards, local street bikeways, or bicycle priority streets) are streets with low motor vehicle volumes and speeds that have been enhanced to varying degrees to prioritize bicycle traffic. Because motor vehicle volumes and speeds are relatively low, neighbourhood bikeways can be comfortable facilities for people of all ages and abilities.

KEY FEATURES

Neighbourhood bikeways are streets with low motor vehicle traffic volumes and speeds, which create conditions that are comfortable for people cycling to share the road with motor vehicles (see **Figure D-31**).

Neighbourhood bikeways should include **signage and pavement markings** to raise awareness to all road users that this is a shared facility between people cycling and driving (1). They can also include a range of traffic calming measures to reduce motor vehicle speeds (such as traffic circles, **curb extensions** (2), chicanes, and **speed humps** (3)) and a range of traffic diversion measures to reduce motor vehicle volumes (such as right-in/right-out islands and **median barriers across intersections** (4)). These traffic calming and diversion measures help to facilitate through movement by bicycles, while reducing motor vehicle volumes and speeds as necessary. Neighbourhood bikeways should also include treatments at major intersections to facilitate crossings for people walking and cycling, including either full signals or pedestrian and cycling activated **signals** (5) (see **Chapter G2**).

Figure D-31 // Key Features of Neighbourhood Bikeways

DESCRIPTION

Local motor vehicle traffic is permitted along neighbourhood bikeways, but short-cutting motor vehicle traffic should be discouraged. This helps to create a comfortable environment for people cycling and driving to share the road. In addition, the most critical design treatments for neighbourhood bikeways are crossings of major roads. Neighbourhood bikeways should include signalized and non-signalized crossing treatments at major intersections to facilitate bicycle crossings.

Neighbourhood bikeways are most effective in road networks with a strong, continuous grid pattern, although they can also be suitable in suburban contexts with curvilinear streets with appropriate wayfinding and connections between streets.

Neighbourhood bikeways can provide reasonable access within a short cycling distance to commercial destinations for people who do not feel comfortable riding on major streets. They can also provide a more pleasant cycling experience compared to major roads – with fewer motor vehicles, less pollution, and less noise.

However, neighbourhood bikeways can also sometimes be a less visible and less intuitive part of a bicycle network when compared to bicycle facilities on major roads. This results in bicycle users potentially being less visible to motorists, particularly at intersections. As such, an important goal of a neighbourhood bikeway is to make the bicycle facility as visible as possible at crossings of higher volume and higher speed roads to ensure motorists are expecting people cycling to be crossing. Because of their many benefits, neighbourhood bikeways are an effective type of bicycle facility to encourage cycling for people of all ages and abilities on streets with low motor vehicle volumes and speeds. However, because of their limitations in terms of lack of visibility and the fact they may not provide direct connections to destinations on major streets, they should be considered a complementary type of bicycle facility

Neighbourhood bikeway, Vancouver, B.C.

Adanac Street neighbourhood bikeway, Vancouver, B.C. (Source: Mike Zipf)

W 7th Avenue neighbourhood bikeway, Vancouver, B.C. (Source: Dylan Passmore)

Neighbourhood Bikeways are for People of All Ages and Abilities

Neighbourhood bikeways are considered an all ages and abilities bicycle facility as they increase the comfort of users by creating a safe and comfortable environment for people cycling and people driving motor vehicles to share the road. Research from the Cycling in Cities Program at the University of British Columbia found that neighbourhood bikeways are one of the safest and most preferred types of bicycle facilities. Neighbourhood bikeways, therefore, provide a broad level of appeal to a variety of people, including experienced bicycle users (who benefit from the lower motor vehicle volumes without significant increases in trip times), and less experienced bicycle users (who may not be comfortable cycling on higher volume roads). For less experienced bicycle users, neighbourhood bikeways can also serve as 'stepping stone' facilities that help increase their comfort level using on-street facilities.

and should not be considered a replacement for bicycle facilities on major streets.

Because neighbourhood bikeways are generally located on local roads, they are often not located on roads that have been identified as priority routes for winter maintenance. To ensure they are comfortable for people throughout all seasons, communities should review their snow and ice control programs and procedures to consider winter maintenance priorities and the impacts of traffic calming treatments on snow and ice control practices (see **Chapter I.3**).

BENEFITS + LIMITATIONS

Benefits

- Traffic calming and diversion measures can reduce motor vehicle volumes and speeds, which can improve compliance with traffic laws, and reduce the need for traffic enforcement.
- Traffic calming can be popular with neighbours near neighbourhood bikeways and can improve the aesthetics of the road.
- Treatments at major intersections facilitate safe crossings for people walking and cycling.
- Appealing to most types of bicycle users and particularly appealing to newer or less experienced bicycle users.
- Can be a 'stepping stone' for newer, or less experienced bicycle users.
- Can be a pleasant environment to cycle with less noise and pollution from motor vehicle traffic than bicycle facilities on busier roads.
- Often located parallel to arterial and collector roads, which can still provide adequate access to main street destinations with proper wayfinding.
- Can be cost-effective depending on the context and level of traffic calming and diversion treatments required.

Limitations

- People cycling must still share the road with motor vehicles.
- People cycling may be less visible or expected by motorists.
- Facilities with insufficient traffic calming and diversion treatments may increase short-cutting motor vehicle traffic.
- Treatments at major intersections and geometry changes can result in significant costs.

- Additionally added operating costs may be required to maintain pavement quality and clear snow and ice.
- Traffic calming and traffic diversion may present challenges for emergency services.

Level of Treatments

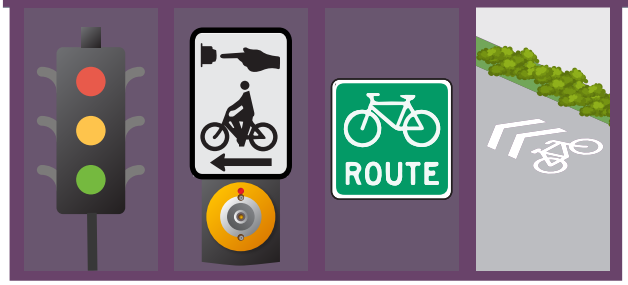
Neighbourhood bikeways are categorized based on the degree to which bicycles are prioritized through design treatments. A basic treatment level can be applied on roads that already have low motor vehicle volumes and speeds, where the only required measures consist of bicycle route signage and pavement markings, along with intersection treatments to aid bicycle users in crossing major roads. Where existing traffic speeds or volumes are higher, treatments may also include a range of traffic calming measures designed to reduce motor vehicle speeds, and traffic diversion measures designed to restrict motor vehicle access while maintaining full access for people walking and cycling. Each of these different treatments builds upon the last, adding to the level of prioritization for non-motorized modes (see **Figure D-32**).

Canadian Guide to Traffic Calming – 2nd Edition (2018)

Published by the TAC in 2018, the *Canadian Guide to Traffic Calming – 2nd Edition* provides information and guidance related to the planning, design, installation, operation, and maintenance of traffic calming measures on local, collector, and arterial roads within Canada. The document is intended to assist design professionals to better understand the principles of traffic calming and properly apply the processes, tools and techniques detailed in the guide. Application of traffic calming as part of a neighbourhood bikeway should be undertaken consistent with guidance provided in the TAC *Canadian Guide to Traffic Calming - Second Edition.*

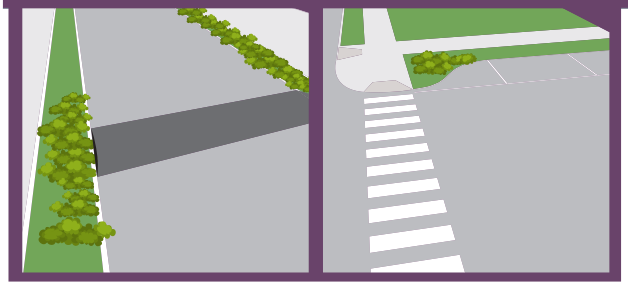
Neighbourhood bikeway connection sign, Vancouver, B.C.

LEVEL 1: REQUIRED TREATMENTS ((INTERSECTION TREATMENTS, SIGNAGE, PAVEMENT MARKINGS)



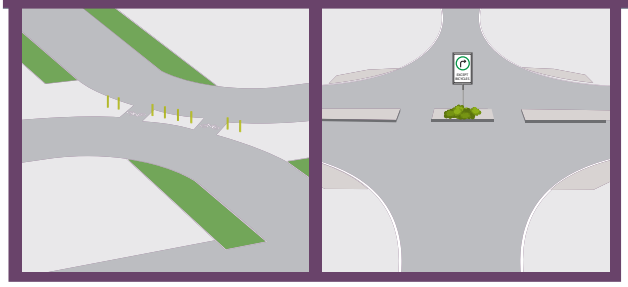
Intersection treatments such as signalization with bicycle detection should be used to help people cycling, walking, and using other forms of active transportation in crossing major roads and to minimize potential conflicts with motor vehicles. Signage and pavement markings can help to identify neighbourhood bikeways to both bicycle users and motorists and raise awareness to motorists. In cases where motor volumes and speeds are already sufficiently low, signage, pavement markings, and intersection treatments may be the only required treatments.

LEVEL 2: TRAFFIC CALMING (SPEED MANAGEMENT)



In addition to the Level 1 treatments, traffic calming measures can be provided to reduce motor vehicle speeds and bring them closer to those of people cycling. Reducing speeds along neighbourhood bikeways improves the cycling environment and is critical to creating a comfortable and effective cycling facility.

LEVEL 3: TRAFFIC DIVERSION (VOLUME REDUCTION)



In addition to the Level 1 and Level 2 treatments, traffic diversion measures can also be provided to reduce motor vehicle volumes and discourage through motor vehicular traffic, while maintaining through access for people cycling and walking.

Figure D-32 // Level of Treatments

Treatments may vary along a corridor as required, with distinct treatments at each intersection and along every block. As such, the design of neighbourhood bikeways is unique compared to other types of bicycle facilities, and includes a 'toolbox' of treatments that can be considered by design professionals based on the unique conditions along the corridor. Various traffic calming measures and traffic diversion measures can be considered. Note that vertical deflection measures such as speed humps and raised crosswalks are not permitted on roadways under provincial jurisdiction. This chapter introduces the 'toolbox' of treatments that can be considered along neighbourhood bikeways, but does not provide detailed guidance on traffic calming and diversion measures. More detailed guidance is provided in the TAC Canadian Guide to Traffic Calming – 2nd Edition. Additional guidance is also provided in **Appendix C**.

TYPICAL APPLICATIONS

Road Network Characteristics

Neighbourhood bikeways work best in road networks with a continuous grid pattern, which are found in many urban contexts and established neighbourhoods in communities throughout B.C. The logical and interconnected layout of these road networks are generally easy to navigate and provide numerous route options to destinations. Neighbourhood bikeways work best in grid networks on local roads that are spaced approximately up to 400 metres from major roads.

In some locations, a large city block, park, or other barrier may reduce connectivity in the grid road system, requiring people cycling to use higher speed roads. In these instances, design professionals should design treatments that will increase cycling comfort and safety when travelling along the segments of higher speed road, or should identify opportunities to develop connections for people walking and cycling. For example, while parks may sometimes be considered a barrier to connectivity, providing an off-street pathway through the park can improve network connectivity for people walking and cycling while providing access to community amenities and green space. Careful consideration should be given to the impact that an active transportation facility may have on the existing function of the park and should mitigate any negative impacts on park users and activities.

In suburban and rural contexts, development of effective neighbourhood bikeways can often be challenging due to a lack of alternate through roads and the concentration of motor vehicle traffic on arterial streets. The 'loop and lollipop' road patterns commonly found in many suburban developments may be reasonably good at keeping traffic speeds low and discouraging through traffic on residential roads, but limits connectivity between roads. In these contexts, the through roads are generally the major roads with higher volume and higher speed traffic with limited crossing opportunities — conditions that can be intimidating for less comfortable bicycle users. In these contexts, off-street pathway connections between subdivisions and through parks, for example, can provide critical opportunities to provide connections for people walking and cycling to create a continuous neighbourhood bikeway. Wayfinding signage is particularly important in these contexts to ensure the neighbourhood bikeway is easy to navigate (see **Chapter H.3**).

Traffic Speeds and Volumes

The desired average daily traffic on a neighbourhood bikeway is 500 motor vehicles per day or less. The maximum average daily traffic is 1,000 motor (vpd).

Neighbourhood bikeways should have posted speed limits and operating motor vehicle speeds of 30 km/h or less.

Neighbourhood bikeways can be considered if existing conditions are higher than these thresholds, only if sufficient traffic calming and diversion measures are provided to reduce traffic speeds and volumes to meet these thresholds. As shown in the Bicycle Facility Selection Decision Support Tool in **Chapter D.1**, neighbourhood bikeways can be considered if existing average daily traffic is 2,500 vpd or less, and if posted speed limits and operating motor vehicle speeds are 50 km/h or less, if the design treatments are anticipated to change traffic volumes and speeds to meet the recommended thresholds.

It should be noted that roadways under provincial jurisdiction typically cannot be posted at speeds lower than 50 km/h, except for in special circumstances such as school zones.

If the resulting motor vehicle volumes are above 1,000 vpd and/or posted or operating traffic speeds are over 30 km/h, the facility may not be considered comfortable for people of all ages and abilities. **Table D-9** identifies the level of treatment required depending on existing motor vehicle volumes and speeds.

An alternative motor vehicle volume measurement based on motor vehicles per hour (vph) may be used in lieu of (or in addition to) the vpd measurement. This can be particularly important if a road has unique travel patterns during peak periods or other times of day. In such cases, the target should be to design, build, and maintain for an average of 50 vph in the peak direction. A neighbourhood bikeway can operate at an average of 75 vph in the peak direction but should be improved or maintained to not exceed 100 vph in the peak direction.

Table D-9 // Neighbourhood bikeway treatments by motor vehicle speed and volume

Existing Motor Vehicle Volumes (VPD)	Existing Posted Motor Vehicle Speeds	Level of Treatments		
		Level 1: Required Treatments (Intersection Treatments, Signage, and Pavement Markings)	Level 2: Traffic Calming (Speed Management)	Level 3: Traffic Diversion (Volume Management)
<1,000	30 km/h or less	✓		
<1,000	30 to 50 km/h	✓	✓	
1,000 – 2,500	30 km/h or less	✓		✓
1,000 – 2,500	30 to 50 km/h	✓	✓	✓
>2,500	> 50 km/h	Consider alternate facility type		

Table D-10 // Neighbourhood Bikeway Desirable + Constrained Width

FACILITY	DESIRABLE (m)	CONSTRAINED LIMIT (m)
Parking lane	Refer to local bylaws	
Clear width (excluding parking lane)	5.5	4.0

Road Width

Clear width refers to the road's operating space, either between curbs (if there is no on-street motor vehicle parking) or between parked motor vehicles (if there is on-street motor vehicle parking). The clear width can impact both the speed at which motor vehicles travel and the comfort of people cycling. Roads with a wider clear width provide more comfortable passing and increased cycling capacity, but also encourage higher motor vehicle speeds. Conversely, roads with a narrower clear width may result in lower motor vehicle speeds but may not provide a comfortable space for people to ride abreast and/or for bicycles and motor vehicles to pass each other.

The desired clear width on a neighbourhood bikeway is between 4.0 metres and 5.5 metres (see **Table D-10** and **Figure D-33**). This provides the ideal width to allow motor vehicles and bicycles to comfortably share the road, while helping to ensure that bicycles and motor vehicles travel at similar speeds. A clear width of 4.0 metres will not allow two motor vehicles to pass one another. Instead, one motor vehicle may need to pull over to the side to allow the other to pass. The presence of driveways and/or vacant on-street parking spaces dictates the frequency of passing opportunities for motor vehicles and should be considered in the design of a neighbourhood bikeway.

The following may be considered where a neighbourhood bikeway has a clear width less than 4.0 metres:

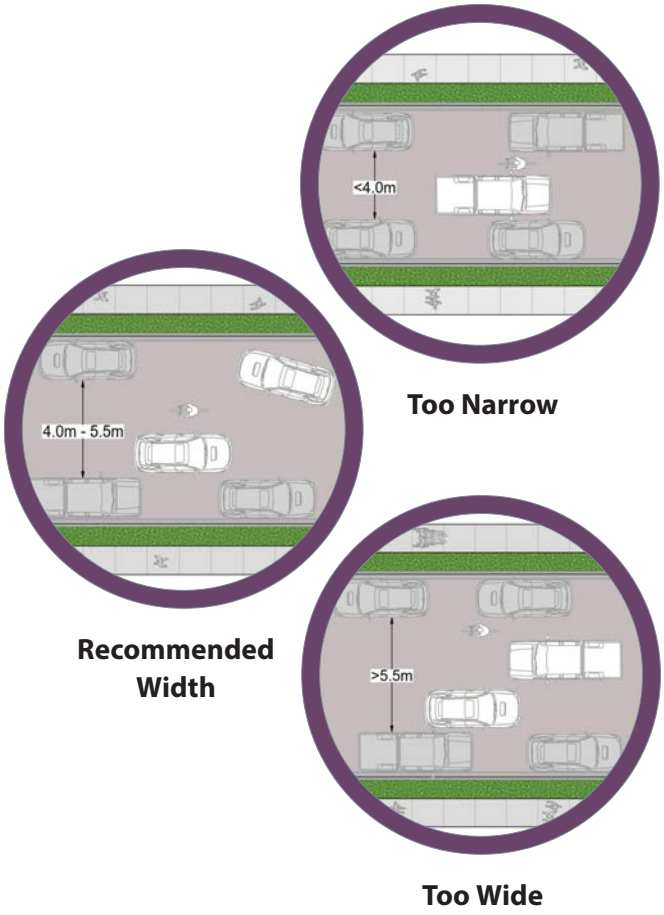
- Remove on-street parking on one or both sides of the road (if present);
- Widen the road;
- Convert the road to one-way operation for motor vehicles and add a contraflow bicycle lane; or
- Choose another corridor.

The following may be considered where a neighbourhood bikeway has a clear width greater than 5.5 metres:

- Add on-street parking (if not present); or
- Consider traffic calming options to visually narrow the road such as curb extensions or chicanes.

It should also be noted that neighbourhood bikeways should not include a directional dividing line and as such, the entire clear width is intended to be used for both directions of traffic.

Figure D-33 // Neighbourhood Bikeway Clear Widths



DESIGN GUIDANCE

Level 1: Intersection Treatments

Intersections with major roads are the most critical locations in the design of neighbourhood bikeways. Crossing treatments should be used to assist people cycling in crossing major roads and to minimize potential conflicts with motor vehicles. The range of standard crossing treatments considered where a neighbourhood bikeway intersects a road are discussed below.

- **Minimize Stops at Local Road Crossings:** Stop signs increase cycling trip length and energy expenditure due to frequent starting and stopping. This can lead to non-compliance by people cycling and/or the use of alternate routes. The frequency of interruptions to people cycling should be minimized on neighbourhood bikeways by re-orienting stop signs so that they do not face the direction of the neighbourhood bikeway and instead control cross traffic. Any increase in motor vehicle speeds on the neighbourhood bikeway facilitated by the change in traffic control may be mitigated by installing traffic calming (see below).

  This treatment only applies where a neighbourhood bikeway crosses a local road and should not be applied when crossing a busier road of a higher classification.

- **Signalized Crossings:** Signalized crossings are used where the number of people crossing the road is higher. Traffic signals should be *required treatments* when crossing arterial roads, multi-lane roads, and/or roads with high traffic volumes. Traffic signals are *recommended treatments* when crossing collector roads depending on the context and traffic volumes. It should be noted that many factors go into the decision around the orientation of traffic controls, including relative volumes on the intersecting roads, road patterns, and other factors. Refer to **Chapter G.2** for more More information regarding traffic signals.

- **Bicycle Detection:** Detection should be provided where people cycling on a neighbourhood bikeway approach a traffic signal. The following are the most common methods of detection:
  1. Loop detectors (marked so that people cycling know where to position their bicycle);
  2. Bicycle push buttons; and
  3. Video detection.

  In many cases, the same detector that is used for motor vehicles can be used for bicycles; however, these should have bicycle detection marking symbols applied denoting stopping locations for people cycling.

- **Crossing at Off-Set Intersections:** Off-set intersections are created when the legs of an intersection do not line up directly across from one another. There are a number of options for transitioning a neighbourhood bikeway through an off-set intersection, as follows:
  1. The preferred design treatment is to provide a bi-directional bicycle pathway on one side of the road to facilitate the connection, as shown in **Figure D-34**.
  2. An alternative option is to install traffic signals to provide breaks in through motor vehicle traffic to allow people cycling to navigate through the intersection, as shown in **Figure D-35**.
  3. Another alternative option is to create two bicycle centre left turn lanes on the through road allowing people cycling to make a two-stage left turn, as shown in **Figure D-36**. This is the least desirable option and is not considered comfortable for people of all ages and abilities.

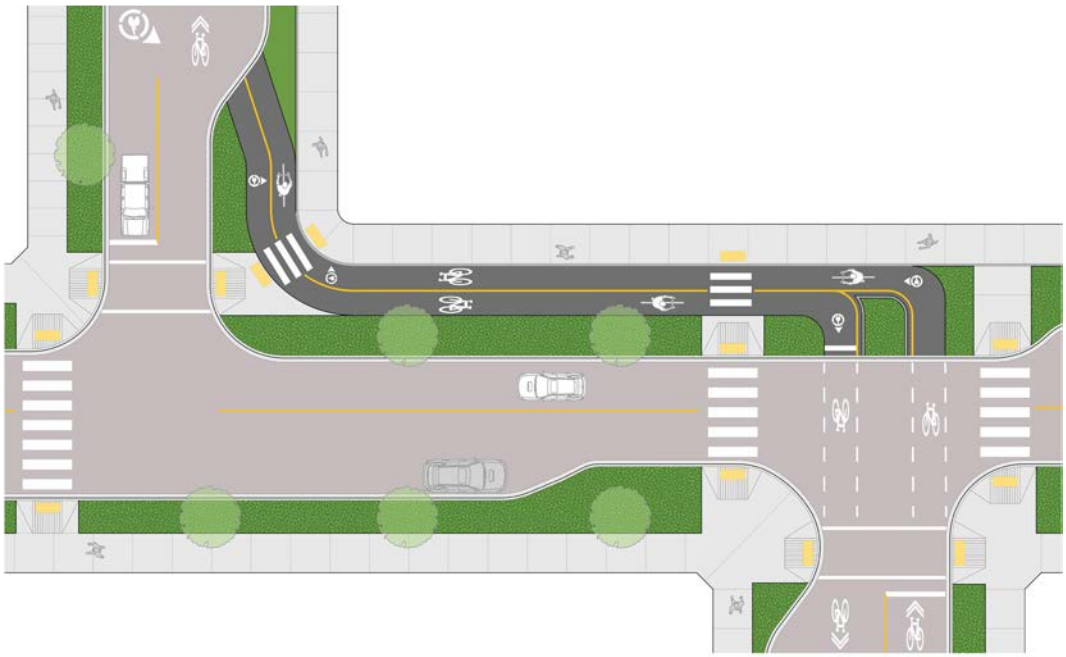


Figure D-34 // Neighbourhood Bikeway Crossing at Off-Set Intersection Using Bicycle Pathway

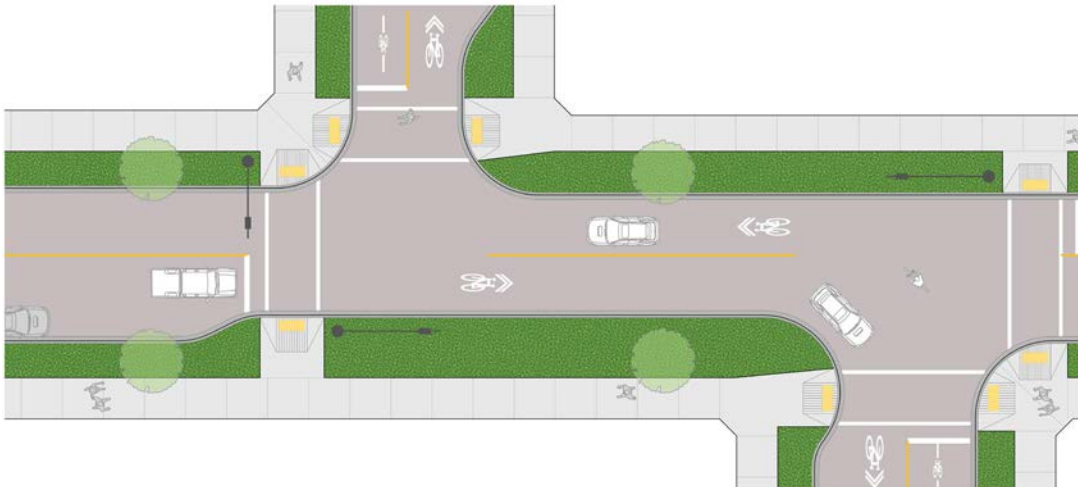


Figure D-35 // Neighbourhood Bikeway Crossing at Off-Set Intersection Using Traffic Signal

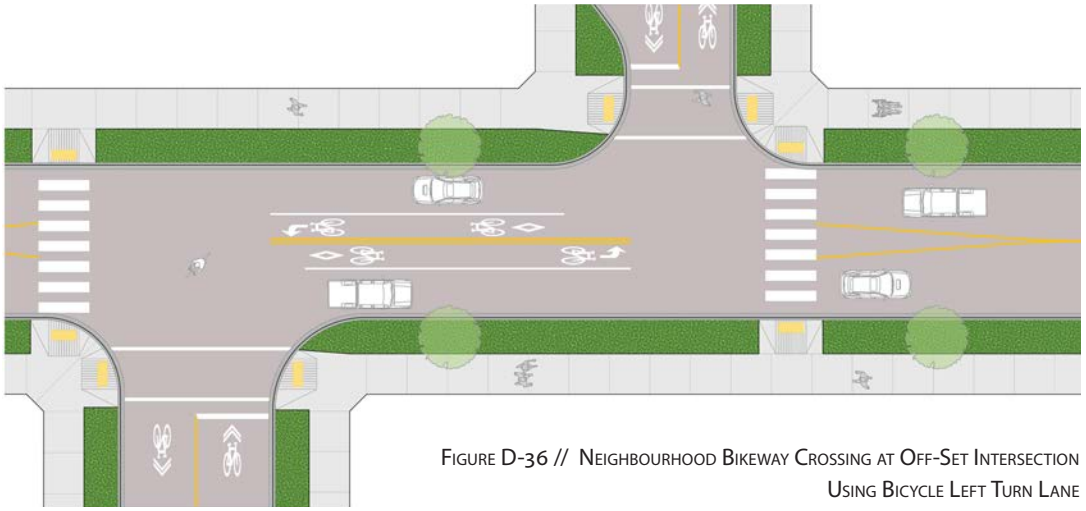


Figure D-36 // Neighbourhood Bikeway Crossing at Off-Set Intersection Using Bicycle Left Turn Lane

Level 1: Signage and Pavement Markings

Signage and pavement markings alone do not necessarily create the conditions necessary for a neighbourhood bikeway. However, if motor vehicle volumes and speeds are already low (less than 1,000 vpd) and posted and operating motor vehicle speeds of 30 km/h or less, and if existing intersection treatments facilitate bicycle travel, then signage and pavement markings may be all that is required to create a neighbourhood bikeway.

The following is recommended for signage on a neighbourhood bikeway (see **Appendix B** for more details):

- The Bicycle Route sign (MUTCDC IB-23; B.C. B-G-001) should be used. Sign location and spacing should be consistent with guidance in Section A. 4.3.3 of the MUTCDC or the *B.C. Manual of Standard Traffic Signs & Pavement Markings* (for roadways under provincial jurisdiction).
- Wayfinding signs should be used to provide information regarding direction, distance, and/or estimated travel time to destinations (further guidance on wayfinding is provided in **Chapter H.3**).
- Shared use lane pavement markings should be used to indicate the desired positioning of bicycle users within the road.
- Custom directional pavement markings (also known as 'breadcrumbs') may be used to reinforce to people cycling that they are on a neighbourhood bikeway and/or to indicate where a change in direction is required to continue to navigate along the neighbourhood bikeway.
- Road sign plates may include a bicycle symbol to enhance bicycle wayfinding and route visibility.

Level 2: Traffic Calming (Speed Management)

Traffic calming measures consist of devices that reduce motor vehicle speeds closer to cycling speeds, and/or reduce motor vehicle volumes, thereby making the neighbourhood bikeway a safer, more pleasant bicycle route. The types of traffic calming devices suitable for a neighbourhood bikeway can generally be categorized as *vertical deflections* and *horizontal deflections*, both of which are described below. These measures are distinct from those that restrict motor vehicle access, which are described in detail under Level 3 – Traffic Diversion (Volume Management).

The TAC *Canadian Guide to Traffic Calming* provides design guidance on various traffic calming treatments, some of which may be appropriate to reduce motor vehicle speeds along a neighbourhood bikeway as described below. Refer to the TAC *Canadian Guide to Traffic Calming* for further information and detailed design guidance.

Vertical Deflection

Vertical deflection measures cause a vertical upward movement of the motor vehicle, thereby lowering motor vehicle speeds as motorists slow to avoid an unpleasant sensation as they traverse the traffic

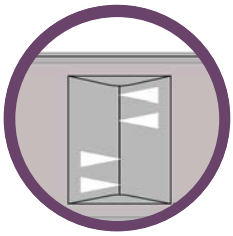
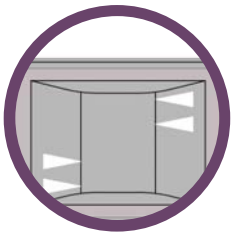
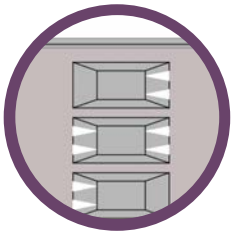
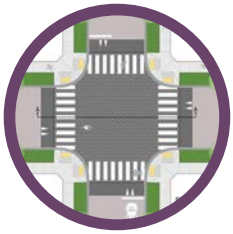
A Note on Speed Limits

The maximum speed limit on a neighbourhood bikeway should be no more than 30 km/h if it is to be considered an all ages and abilities cycling facility. Simply changing the speed limit, however, is unlikely to reduce motor vehicle speeds. As such, posted speed limit changes should be implemented in conjunction with the vertical and horizontal deflection measures described below that create physical change in the road and effectively reduce motor vehicle speeds. Note that speed limits below 50 km/h are not typically appropriate on roadways under provincial jurisdiction.

calming measure. Vertical deflections have the secondary benefits of reducing motor vehicle volumes and deterring neighbourhood short-cutting traffic.

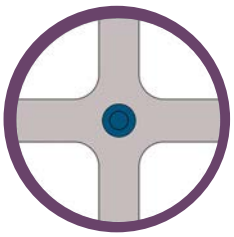
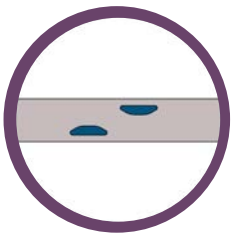
It should be noted that vertical deflection measures are not permitted on roadways under provincial jurisdiction. However, other traffic calming and diversion methods, in addition to intersection treatments, may be considered.

Examples of vertical deflection measures that can be considered along neighbourhood bikeways are provided below. Further details are provided in **Appendix C**.

VERTICAL DEFLECTION		
 **Speed Hump**	A speed hump is a raised area of a road that causes the vertical upward movement of a traversing motor vehicle, intended to create discomfort for motorists travelling at higher speeds and to reduce motor vehicle speeds. Speed humps should be used on local roads only where transit vehicles, buses, emergency vehicles and other large vehicles are not anticipated at high volumes. It should be noted that speed humps may reduce appeal to people cycling if they also have to travel over them. People cycling at greater than 20 km/h can be destabilized riding over a speed hump.	▪ Speed humps should be located no less than 75 metres from a traffic signal and spaced between 80 and 150 metres apart from one another to maintain desired motor vehicle speeds.
 **Speed Table**	A speed table is an elongated raised speed hump with a flat-topped section that is long enough to raise the entire wheelbase of a motor vehicle. Speed tables may be used on public transit and emergency response routes.	▪ Speed tables should be located no less than 75 metres from a traffic signal and spaced between 80 and 150 metres apart from one another to maintain desired motor vehicle speeds.
 **Speed Cushion**	A speed cushion is a raised area on a street similar to a speed hump, but which does not cover the entire width of the street. The width is designed to allow a large motor vehicle, such as a bus, to 'straddle' the cushion, while light motor vehicles will have at least one side of the motor vehicle deflected upward. Speed cushions are intended to produce sufficient discomfort to limit motor vehicle travel speeds, yet allow the motorist to maintain motor vehicle control and allowing larger motor vehicles such as buses and emergency vehicles to pass without difficulty.	▪ The optimal width of a speed cushion is 1.8 metres.
 **Raised Intersection**	A raised intersection is constructed at a higher elevation than the approach roads, resulting in a vertical change upon entry to the intersection. The purpose of a raised intersection is to reduce motor vehicle speeds and reduce conflicts, as they often are provided in conjunction with a stop control on one or both intersecting roads	▪ Raised intersections should be raised to the same level as the adjacent sidewalk (typically 80 millimetres)

Horizontal Deflection

Horizontal defection measures include a lateral shift in the travel pattern of motor vehicles and cause motorists to slow down in response to either a visually narrower road or a need to navigate a curving travel lane. Various horizontal deflection measures are described below.

HORIZONTAL DEFLECTION	
 **Curb Extension**	A curb extension (also referred to as a neckdown, choker, curb bulb, or bulb-out) is a horizontal intrusion of the curb into the road, resulting in a narrower section of the road. When placed on a neighbourhood bikeway, they both visually and effectively narrow the road width. This reduces motor vehicle speeds, reduces pedestrian crossing distances, prevents parking close to an intersection, and increases motorist and cycling sightlines. In some cases, people cycling may feel forced into the path of motor vehicles if the curb extensions do not provide adequate spacing for people cycling. The design of the curb extension should ensure that it does not create pinch points for people cycling.
 **Traffic Circle**	A traffic circle is an island located at the centre of an intersection that requires motor vehicles to travel through the intersection in a counter-clockwise direction around the island. A traffic circle is applied on lower road classifications and acts as a traffic calming measure. A traffic circle is distinct from a roundabout in that its primary objective is to calm traffic rather than intersection traffic control. Traffic circles typically replace either uncontrolled intersections or intersections controlled by stop signs. Traffic circles are effective in reducing motor vehicle speeds, and also eliminate the need for people cycling to stop as is the case where stop signs are provided. Traffic circles also provide opportunities for landscaping to improve the aesthetics of the bicycle route. Design professionals should consider the potential safety risks of traffic circles before installing them along a neighbourhood bikeway (see Research Note on page D26).
 **Chicanes**	Chicanes are a series of curb extensions on alternating sides of a street, which narrow the street and require motorists to steer from one side of the street to the other to travel through the chicane. Chicanes are not considered a 'typical' treatment and should be used with caution along with appropriate lighting and signage. Chicanes are effective at reducing motor vehicle speeds by forcing a lateral shift of the pathway of motor vehicles travelling past chicanes.

Level 3: Traffic Diversion (Volume Reduction)

Traffic diversion measures refer to devices that restrict motor vehicle movements at intersections, while allowing unrestricted movements for people walking and cycling. These devices are effective in reducing motor vehicle volumes on neighbourhood bikeways. Since emergency vehicle access can be an issue with traffic diversion devices, municipalities should work with emergency service providers prior to implementing these devices. In addition, municipalities should consult with the community to ensure that impacts to traffic ingress and egress are understood and managed.

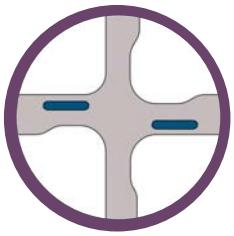
Research Note

Some studies have found that traffic circles have an increased safety risk compared to other intersection controls. Research from the Cycling in Cities Program at the University of British Columbia has found that traffic circles can present a challenge if used on hills where people cycling can travel through an intersection at high speeds, and if used where a high volume of turning movements are expected.[1]

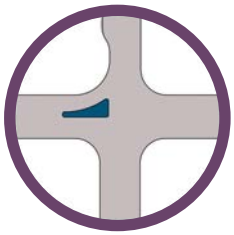
In addition, some people cycling and motorists may make incorrect 'wrong way' left turns around traffic circles, which can present additional safety issues. Good visibility across the traffic circle and to cross-street traffic is critical as people cycling may turn left in front of them, increasing the crash risk with motorists. The NACTO Urban Bikeway Design Guide also notes that people on bicycles often complain that motorists overtake them when approaching the circles, creating a hazardous condition. Although traffic circles can be effective in reducing motor vehicle speeds and volumes, design professionals should apply caution in the use of traffic circles.

1 Kay Teschke et al., 'Route Infrastructure and the Risk of Injuries to Bicyclists: A Case-Crossover Study' (2018).

The following traffic diversion measures can be considered to restrict motor vehicle access and reduce motor vehicle volumes while retaining bicycle route continuity as part of a neighbourhood bikeway. Details are provided in **Appendix C**.

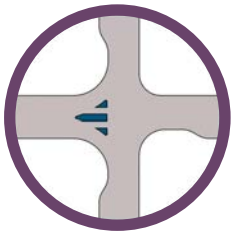
TRAFFIC DIVERSION / VOLUME MANAGEMENT	
 **Directional Closure**	A directional closure consists of curb extensions or vertical barriers extending to approximately the directional dividing line of a road, effectively prohibiting one direction of motor vehicle traffic. Bicycles are permitted to travel through a directional closure in both directions, including the direction in which motor vehicle traffic is obstructed.
 **Diverter**	A diverter is a raised barrier placed diagonally across an intersection that forces motor vehicle traffic to turn and prevents through movements. Diverters should incorporate gaps for people walking and cycling, and may be mountable by emergency vehicles.

TRAFFIC DIVERSION / VOLUME MANAGEMENT



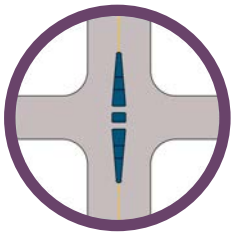
Intersection Channelization

Intersection channelization is the use of raised islands or bollards in an intersection to obstruct traffic movements and physically direct motor vehicle traffic through an intersection. People cycling are typically permitted to make all movements, including those which motor vehicles are prevented from making. Gaps in channelizing islands should be provided to accommodate bicycles.



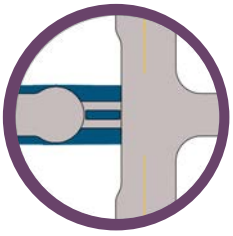
Right-In / Right-Out Island

A right-in/right-out islands is a raised triangular island at an intersection approach which obstructs left turns and through movements by motor vehicles to and from the intersecting street or driveway. People cycling are typically permitted to make left turns and through movements from the side street, either through gaps or depressions in the island.



Raised Median

A raised median through an intersection is a concrete or asphalt island located on the directional dividing line of a two-way road through an intersection that prevents left turns and through movements for motor vehicles to and from the intersecting roads. This can create a refuge for people walking and cycling, enabling them to cross one direction of travel at a time, thereby reducing waiting time for gaps when crossing the road.



Full Closure

A full closure consists of a barrier extending the entire width of the road that obstructs all motor vehicle traffic movements from continuing along the road. A closure can change a four-way intersection to a three-way intersection, or a three-way intersection to a non-intersection. Gaps should be provided for people walking and cycling and to allow for emergency vehicle access.

Other Considerations

Green Roads / Stormwater Treatments

Traffic calming and traffic diversion measures on neighbourhood bikeways (as well as on other roads) provide an important opportunity to achieve other important benefits, such as reducing the impact of stormwater runoff by using stormwater collection swales and pervious asphalt or concrete. These design features capture excess stormwater runoff, filter stormwater impurities, increase groundwater recharging, and reduce the load of excess stormwater on existing drainage systems. They can be applied to a variety of measures such as curb extensions, traffic circles, and medians. In addition to stormwater benefits, these techniques can also help improve environmental sustainability, beautify the landscape, and create a more attractive and livable environment.

Public Art

Public art can define the space along a neighbourhood bikeway and is also a great way to increase public involvement. The art can even be functional, such as decorative bicycle parking. Ideas for public art along neighbourhood bikeways include:

- Public competitions for artistic bicycle parking or intersection mural designs;
- Commissioned sculptures that identify the terminus of a neighbourhood bikeway;
- Vinyl wraps of utility boxes that have art or educational information; and
- Themed artwork or logos that identify a particular neighbourhood bikeway route.

The inclusion of public art along neighbourhood bikeways should ensure that clear sightlines are maintained along the length of the corridor.

Pedestrian Amenities

The design features that make neighbourhood bikeways comfortable places to cycle can also make them great places to walk. These features can be further enhanced through the installation of pedestrian amenities such as park benches, water fountains, and pedestrian-oriented road lighting that create an inviting and comfortable pedestrian environment. Additionally, pedestrian safety and accessibility improvements are a key consideration when upgrading neighbourhood bikeways. The addition of pedestrian amenities improves safety and accessibility while advancing the notion that the benefits of neighbourhood bikeways extend beyond people cycling.

Landscape and Street Trees

Corridors landscaped with street trees and landscaping beautify the streetscape and can help to slow motor vehicle traffic by providing visual friction at the roadside. Funding for landscaping can come through partnerships with parks and recreation and environmental services departments, as well as private funding sources.

Ideally, plants used for landscaping are native and low maintenance. Cooperative agreements may be formed with nearby residents and business owners to provide for minor maintenance activities such as watering and pruning. Pruning and maintenance is important to ensure that street trees do not block signage or reduce sightlines, and to ensure they continue to perform as intended.

Hornby Street protected bicycle lane, Vancouver, B.C.
Source: Paul Krueger

D.3

PROTECTED BICYCLE LANES

Protected bicycle lanes are dedicated facilities for the exclusive use of people cycling and using other active modes (such as in-line skating, using kick scooters, and skateboarding, where permitted through local and regional government bylaws). Protected bicycle lanes are physically separated from motor vehicles and pedestrians by vertical and/or horizontal elements. Protected bicycle lanes are distinct from painted or buffered bicycle lanes (**Chapter D.4**) as they provide physical separation between bicycle users and motor vehicles.

DESCRIPTION

Protected bicycle lanes combine the user comfort benefits of off-street pathway with the route directness and access to destination benefits of on-street infrastructure. Protected bicycle lanes have different forms and go by different names (such as cycle tracks, separated bicycle lanes, or on-street bicycle pathways) but all share common elements – they provide space that is intended to be exclusively for people cycling (and other active modes where permitted) and they are physically separated from motor vehicle travel lanes, parking lanes, and sidewalks.

Protected bicycle lanes can be designed for either one-way or two-way operation and can be constructed at sidewalk level, street level, or an intermediate level in between. They can be physically separated from motor vehicles and pedestrians using a variety of possible treatments, including flexible delineators, curbs, medians, concrete barriers, planters, parked motor vehicles, or a combination of these elements.

Protected bicycle lanes are typically positioned directly next to a curb and separated from general purpose travel lanes or parking by a type of separation that is appropriate for the speed and volume of the adjacent motor vehicle traffic.

Protected bicycle lanes are considered an all ages and abilities bicycle facility, as they increase the comfort of users by providing a clear physical separation between people cycling and motor vehicles. Protected bicycle lanes can minimize conflicts between bicycles and parked motor vehicles, and they can reduce the frequency and likelihood of 'dooring'. This increased comfort can play a significant role in increasing bicycle use, particularly among less experienced bicycle users and among women, children, and seniors.

TYPICAL APPLICATIONS

Protected bicycle lanes are most appropriate on roads with higher motor vehicle volumes and speeds, multiple motor vehicle lanes, relatively high bicycle volumes, and relatively few laneways and driveways. Protected bicycle lanes should be considered the preferred design treatment under the following conditions:

- Where motor vehicle speeds are posted at 50 km/h and motor vehicle volumes are greater than 4,000 vpd.
- Where motor vehicle speeds are posted at 60 to 80 km/h, at any motor vehicle volume.
- Locations with high curbside activity, regardless of posted motor vehicle speeds or motor vehicle volumes.

Research Note

Research has found that protected bicycle lanes are the safest type of bicycle facility. The Cycling in Cities Program at the University of British Columbia found that protected bicycle lanes were the safest type of bicycle facility, with a 90% decrease in safety risk compared to a major street with no cycling infrastructure.[1]

Another recent study examined thirteen years of data from twelve large U.S. cities, including 17,000 fatalities and 77,000 severe injuries. The study found that cities with protected bicycle lanes had 44% fewer deaths and 50% fewer serious injuries than the average city. Furthermore, the study found that painted bicycle lanes provided no road safety improvements, and that shared use lanes were actually less safe than having no pavement markings at all.[2]

1 Kay Teschke et al., 'Route Infrastructure and the Risk of Injuries to Bicyclists: A Case-Crossover Study' (2018).

2 Marshall and Ferenchak, 'Why Cities with High Bicycling Rates are Safe for All Road Users' (2019).

PROTECTED BICYCLE LANE CONSIDERATIONS

Protected Bicycle Lane Zones

Protected bicycle lanes are typically characterized by three separate zones (**Figure D-37**):

- **Bicycle Through Zone:** The space in which people cycling operate. It is located between the Street Buffer Zone and the Furnishing Zone.
- **Furnishing Zone:** The area that provides physical separation between the protected bicycle lane and the sidewalk.
- **Street Buffer Zone:** The area that provides physical separation between the protected bicycle lane and the motor vehicle lane.

The design choices made for each of these zones affect one another and can result in the need for trade-offs based on the available right-of-way. The following general design principles should be considered with respect to the design of the various zones:

- Changes in the Bicycle Through Zone elevation and horizontal alignment should be minimized, and where present, changes should be gradual;
- The Bicycle Through Zone should be wide enough to accommodate existing and anticipated bicycle volumes, facilitate passing of slower bicycle users and allow side-by-side travel where feasible;
- The Bicycle Through Zone should be free from pedal and handlebar hazards;
- The Street Buffer Zone should provide adequate horizontal and vertical separation from motor vehicles, including curbside activities such as parking, loading, and transit;
- The Furnishing Zone should discourage pedestrians from walking in the protected bicycle lane;
- The Sidewalk Buffer and Street Buffer Zones can provide space for signage; and
- Pedestrian travel should be accommodated within the sidewalk and without impeding on the Furnishing Zone.

A description of the width and characteristics of the Bicycle Through Zone, Furnishing Zone, and Street Buffer Zone are provided in the Design Guidance subsection later in this chapter.

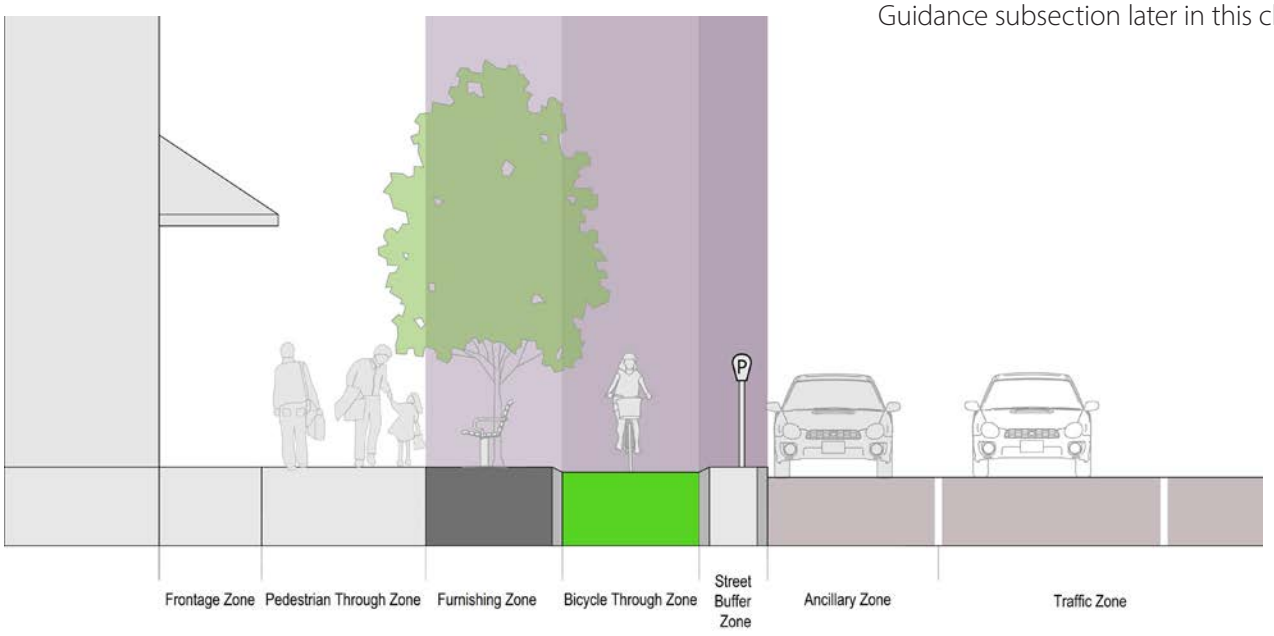


Figure D-37 // Protected Bicycle Lane Zones

Additional Considerations

Maintenance and snow removal equipment are important considerations, as the facilities need to be wide enough to accommodate standard equipment sizes. Local jurisdictions should consider the suitability of existing maintenance and slow clearing equipment versus purchasing new equipment in determining protected bicycle lane widths. Snow clearing should be heightened in priority in the design of protected bicycle lanes in B.C. communities with frequent snow fall and colder winter weather. Additional information regarding maintenance is provided in **Chapter I.3**.

Other factors that should be given due consideration to ensure a successful protected bicycle lane design include the following:

- Stormwater management;
- Lighting;
- Underground utilities;
- Curbside activities and co-ordination with the pedestrian zones (see **Section C**); and
- Landscape and street trees.

DESIGN GUIDANCE

Bicycle Through Zone

The key design consideration for the Bicycle Through Zone is the width of the protected bicycle lane itself. There are a number of factors that influence the functional and perceived width of the protected bicycle lane that should be considered in determining the width of the Bicycle Through Zone, as follows:

- **User Volumes:** Protected bicycle lanes have the potential to attract greater number of bicycle users and introduce a need to facilitate more frequent passing.
- **Speed Differential:** Protected bicycle lanes have the potential to attract bicycle users of a variety of abilities and introduce greater variance in travel speeds.
- **Grade:** The requirement for a bicycle user to climb due to topography / slope may introduce greater speed differential between bicycle users of differing abilities and cause many people cycling to 'wobble' as they climb.
- **Elevation:** The presence of vertical barriers due to the protected bicycle lane elevation narrows the perceived width of the bicycle lane.
- **Orientation:** A bi-directional configuration allows for passing in the opposing lane, whereas a uni-directional configuration is limited to only the width of the single lane, as described on pages D34 and D36.

Table D-11 shows the desirable and constrained limit widths for each protected bicycle lane component. The widths for uni-directional and bi-directional protected bicycle lanes are described in more detail on pages D34 and D36.

Table D-11 // Protected Bicycle Lane Width Guidance

FACILITY	DESIRABLE (M)	CONSTRAINED LIMIT (M)
Bicycle Through Zone (Uni-Directional)	2.5*	1.8
Bicycle Through Zone (Bi-Directional)	4.0	3.0
Street Buffer Zone	0.9*	0.6
Furnishing Zone**	2.0	0.25

* If Street Buffer Zone is not adjacent to on-street motor vehicle parking, the desirable width is ≥0.9 metres, with a wider buffer creating additional cycling comfort.

** Furnishing Zone in this context refers to the buffer between the Bicycle Through Zone and Pedestrian Through Zone. This is especially relevant for sidewalk level protected bicycle lanes, where there is no grade difference between people cycling and people walking. For full details on Furnishing Zone width in a pedestrian context, refer to **Chapter C.3**.

Uni-Directional Protected Bicycle Lane

As shown in **Table D-11,** the desirable width of the Bicycle Through Zone is 2.5 metres on a uni-directional protected bicycle lane to accommodate passing and side-by-side travel. If bicycle volumes are expected to be less than 150 bicycles per hour, then a width of 2.0 metres is more appropriate. The constrained limit width of the bicycle lane portion of a uni-directional protected bicycle lane is 1.8 metres.

The absolute minimum width of the bicycle lane portion of a uni-directional protected bicycle lane is 1.5 metres. This width does not facilitate people cycling passing within the lane. The absolute minimum should only be used for short distances (under 100 metres), when reasonable consideration has been given to local context, and after confirming that maintenance equipment can navigate this reduced width. **Figures D-38** and **D-39** show uni-directional protected bicycle lane configuration with no parking and with parallel on-street parking.

10th Avenue Bikeway, Vancouver, B.C.

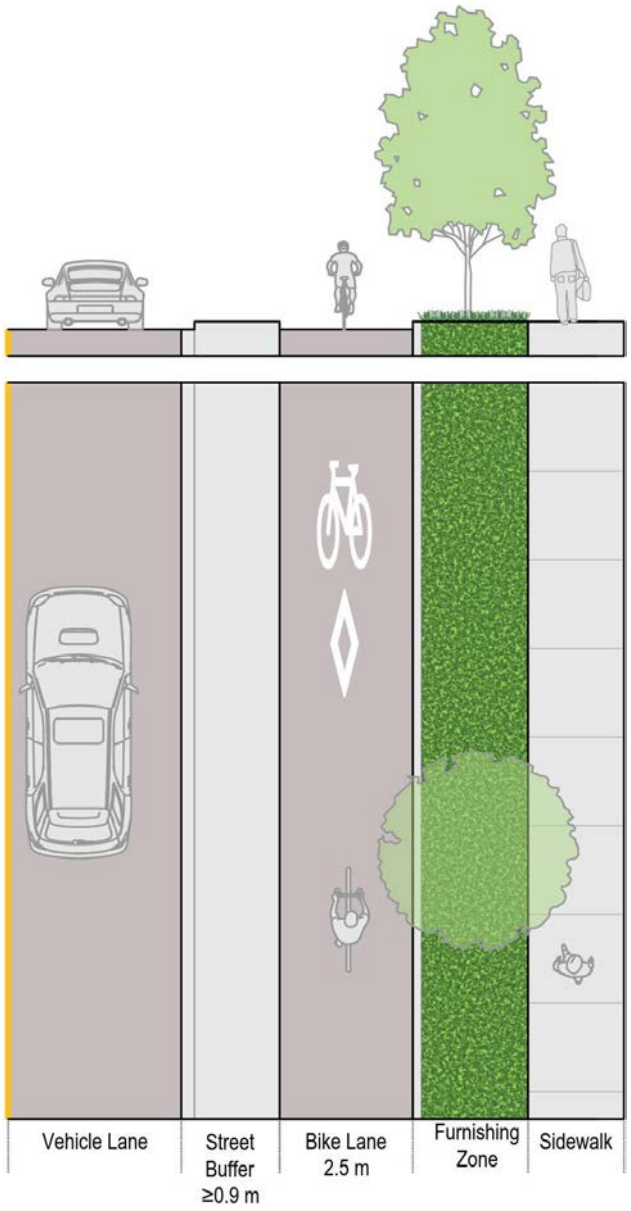


Figure D-38 // Uni-Directional Protected Bicycle Lane Cross-Section -No On-Street Parking (Desired Width)

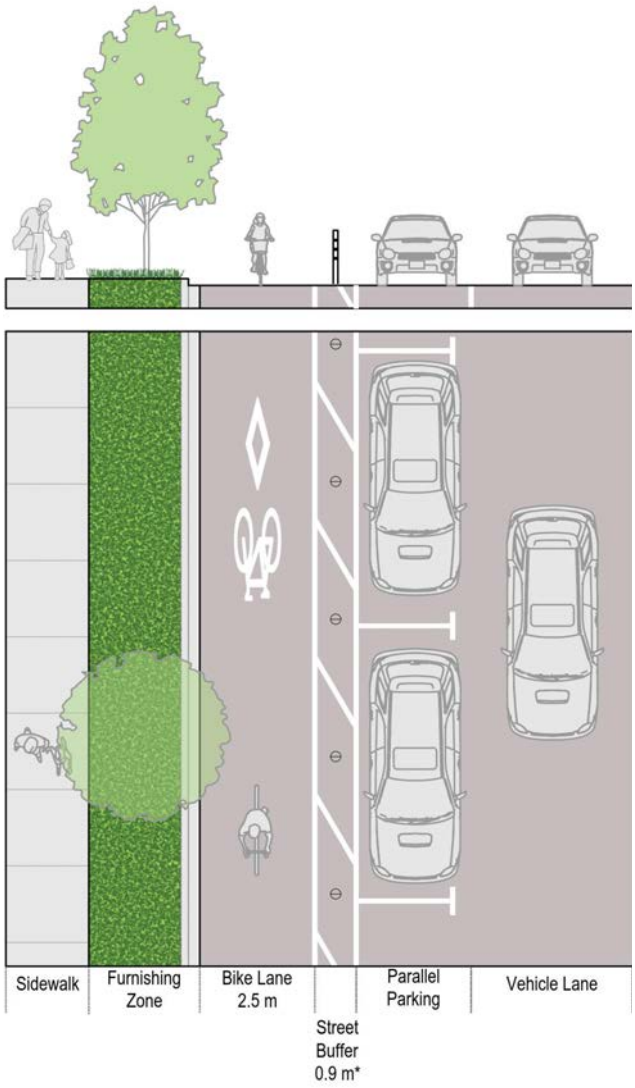


Figure D-39 // Uni-Directional Protected Bicycle Lane Cross-Section - With On-Street Parking (Desired Width)

Bi-Directional Protected Bicycle Lane

As shown in **Table D-11**, the desirable width of the Bicycle Through Zone is 4.0 metres on a bi-directional protected bicycle lane facility (2.0 metres in either direction). If bicycle volumes are expected to exceed 350 bicycles per hour, then a width of 4.5 metres is more appropriate to accommodate passing and side-by-side travel. The constrained limit width of the Bicycle Through Zone on a bi-directional protected bicycle lane is 3.0 metres. The absolute minimum width of the bicycle lane portion of a bi-directional protected bicycle lane is 2.4 metres. This would require people passing to cross into the oncoming lane. The absolute minimum should only be used for short distances (under 100 metres), and when reasonable consideration has been given to local context and confirming that maintenance equipment can navigate this reduced width.

If using the upper limits of the proposed widths, there is concern that motor vehicle drivers may confuse the bicycle lane for a motor vehicle lane. To help mitigate against motor vehicle drivers mistaking a protected bicycle lane for a motor vehicle lane, the installation of a flexible delineator can be added to the centre of the bi-directional protected bicycle lane near intersections to raise awareness of the facility. The use of the facility can then be monitored and the flexible delineator can be removed at any time, including in the winter for maintenance.

Figure D-40 shows bi-directional protected bicycle lane configurations with no on-street parking. **Figure D-41** shows bi-directional protected bicycle lane configuration with parallel on-street parking.

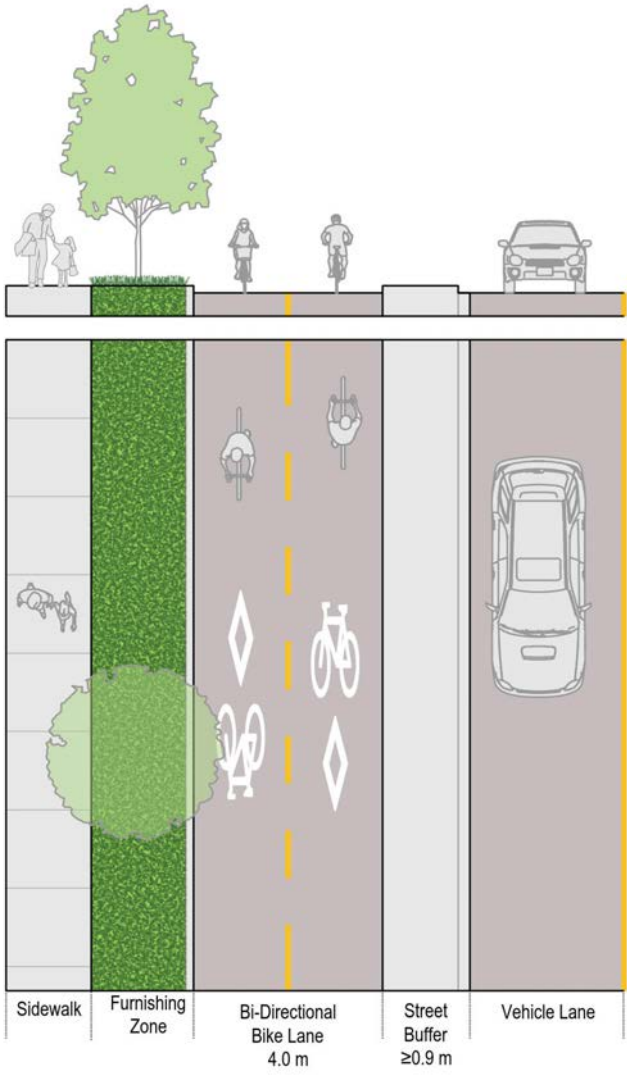


Figure D-40 // Bi-Directional Protected Bicycle Lane Cross-Section - No On-Street Parking (Desired Width)

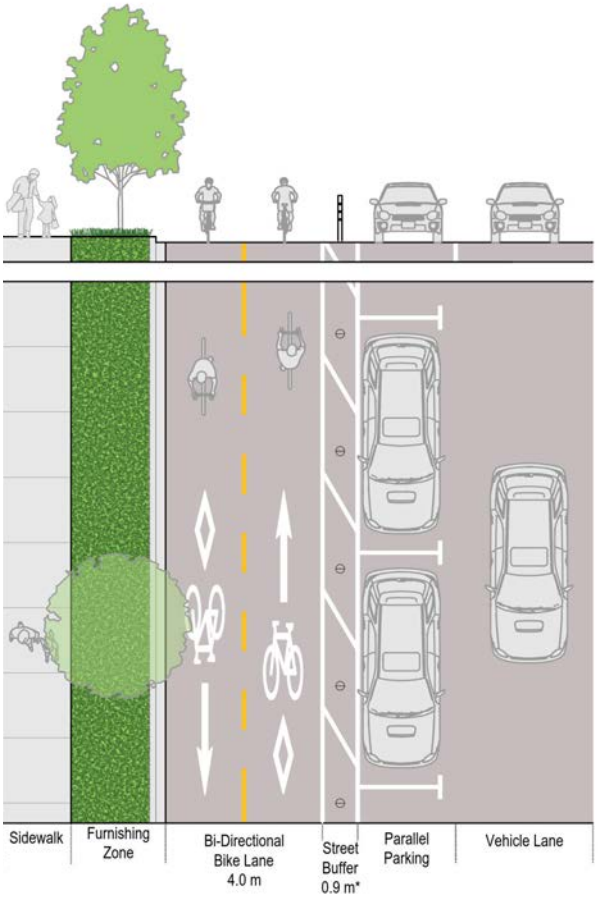


Figure D-41 // Bi-Directional Protected Bicycle Lane Cross-Section with On-street Parking (Desired Width)

Furnishing Zone

In the context of a protected bicycle lane, the goal of the Furnishing Zone is to provide separation between people cycling in the Bicycle Through Zone and people cycling in the Pedestrian Through Zone. For full details on the Furnishing Zone in a pedestrian context, including appropriate widths, surface treatments, and amenities, refer to **Chapter C.3**.

As shown in **Table D-11**, the desirable width of buffer space between the Pedestrian Through Zone and the Bicycle Through Zone is 2.0 metres. The constrained limit width is 0.25 metres.

The Furnishing Zone also helps to distinguish between the bicycle and pedestrian facilities. Providing visual separation reduces encroachment of users, enhancing safety and comfort for all users. Separation can include placing objects in the buffer space (such as grass, trees, planters, or benches), with the use of curbs, or by using different surface materials or colours.

Providing separation between the two zones is especially relevant for universal accessibility when installing intermediate level or sidewalk level protected bicycle lanes. Specific guidance pertaining to these types of protected bicycle lanes is provided later in this chapter. TWSIs or other detectable surfaces may be installed to alert pedestrians of the protected bicycle lane's presence and guide them to a safe crossing point. See **Chapter B.3** for more details regarding TWSIs.

Street Buffer Zone

The goal of the Street Buffer Zone (between the protected bicycle lane and the road) is to provide physical separation with vertical objects between people cycling and moving, or parked motor vehicles. The width of the buffer is impacted by the use of the adjacent motor vehicle lane and whether it is a parking lane or a travel lane. Other factors that need to be considered when determining the width and materials to use for the buffer include:

- The number of travel lanes;
- Motor vehicle volumes and speeds;
- The elevation of the bicycle lane;
- Maintenance;
- Drainage;
- Existing right-of-way;
- Whether or not to include signage;
- Durability;
- Access (for emergency and service vehicles, access to parked cars);
- Cost;
- Aesthetics; and.
- Available space.

As shown **Table D-11** in the desired width of the Street Buffer Zone is 0.9 metres when it is adjacent to an on-street motor vehicle parking lane. This allows for adequate separation from parked motor vehicles and may facilitate snow storage where not adjacent to on-street parking. If the Street Buffer Zone is not adjacent to on-street motor vehicle parking, the desirable width is ≥0.9 metres. Wider buffers up to 1.8 metres improve cycling comfort, especially along multi-lane and/or higher speed roads. The wider Street Buffer Zone allows for the creation of a motor vehicle yield zone at intersections, driveways, and laneway crossings.

The constrained limit width of a Street Buffer Zone is 0.6 metres. The absolute minimum width of a Street Buffer Zone located between the protected bicycle lane and motor vehicle travel lane is 0.5 metres – the minimum necessary to accommodate standard signage on a buffer.

In addition to providing increased physical separation mid-block, the Street Buffer Zone affects cycling safety at intersections, driveways, and laneway crossings. Design guidance at intersections and crossings is provided in more detail in **Chapter G.4**.

It is important to ensure that protected bicycle lane drainage is maintained when using the Street Buffer Zone for snow storage. This can be achieved by providing gaps in snow piles at low areas. Refer to **Chapter I.3** for more detail on maintenance.

Types of Separation

The types of separation that may be used in the Street Buffer Zone are shown in **Figure D-42.** A combination of these treatments may be used along a corridor to achieve the full benefits of each separation type. The benefits of each are compared in **Table D-13**.

A raised or landscaped median provides vertical physical separation. If a raised or landscaped median is not used, then some type of vertical object within a painted buffer area is needed to provide separation. The placement of the vertical objects within the buffer should consider the need for shy distance to the protected bicycle lane and the motor vehicle lane. When placing vertical objects, preference should be given to maximizing the width of the protected bicycle lane. Additionally, sightlines should be considered when placing and choosing types of separation, especially near intersections and conflict zones.

The preferred type of protection and spacing is principally based on the posted motor vehicle speed of the adjacent roadway, as shown in **Table D-12**.

Motor Vehicle Speed and Physical Separation

Refer to the TAC *Geometric Design Guide for Canadian Roads*, Section 5.7.5 for detailed guidance on the recommended type of separation, dimensions, and spacing for the Street Buffer Zone based on the posted speed limit of the adjacent motor vehicle lane.

Table D-12 // Preferred Separation Element based on Motor Vehicle Speed

POSTED SPEED LIMIT	PREFERRED SPACING TYPE
50 km/h or greater	Continuous barriers offering physical protection such as a raised median
50 km/h	Intermittent vertical elements, such as flexible posts and planters are acceptable. Continuous barriers may also be considered.
Less than 50 km/h	Ability to include less physical protection due to lower adjacent motor vehicle speeds.

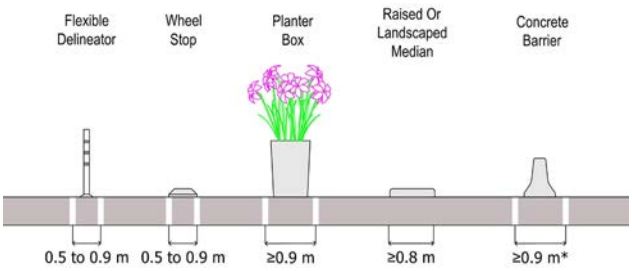


Figure D-42 // Types of Separation Used in the Street Buffer Zone

Table D-13 // Comparison of Separation Types For Street Buffer Zone

	FLEXIBLE DELINEATOR POST	WHEEL STOP	PLANTER BOX
APPROPRIATE CONTEXT	■ Lower-speed environments; may not be appropriate for roads with posted speeds that exceed 50 km/h. ■ Recommended treatment adjacent to motor vehicle parking to allow access.	■ Lower-speed environments; may not be appropriate for roads with posted speeds that exceed 50 km/h.	■ Lower-speed environments; planter boxes with periodic or intermittent spacing are not appropriate on roads with posted speeds of 50 km/h or greater. ■ If planter boxes are used on roads with posted speeds of 50 km/h or greater, they should be constructed of a durable material and should not be periodic or intermittently spaced unless they are placed on top of a concrete median or adjacent to a median or curb to provide continuous physical protection. ■ If they are used on roads where operating speeds are different from posted speeds, the design should be adjusted accordingly.
COST	■ Lowest initial capital cost but may need routine replacement, resulting in higher long-term costs.	■ Low cost.	■ High cost, including ongoing maintenance for re-positioning and possible seasonal removal.
DESIGN FLEXIBILITY	■ Easily removed and relocated.	■ Easily removed and relocated.	■ Easily removed and relocated. ■ Can be used on a seasonal basis (removed in the winter). ■ If they are used on roads with posted speeds of 50 km/h or less, there is more flexibility in their design.
DESIGN NOTES	■ Small footprint compatible with a range of buffer designs. ■ Should be combined with buffered bicycle lane pavement markings. ■ Allows drainage and snow storage. ■ Appearance is less 'permanent' than other forms, and may be less aesthetically pleasing.	■ Can be used in narrower buffers than other types of separation. ■ Must be pinned down. ■ Consider use of end treatments such as mini-barrier noses. ■ Must have vertical element at least at the start when adjacent to traffic; may need additional vertical elements to enhance visibility, particularly during winter months.	■ Can add to the aesthetics and enjoyment of the facility. ■ Planters with intermittent spacing that are not separated from adjacent motor vehicle lanes should consider clear zone . ■ Should have reflective markings or be signed.
DURABILITY	■ Low durability.	■ High durability.	■ Relatively high durability; depends on material used.

	FLEXIBLE DELINEATOR POST	WHEEL STOP	PLANTER BOX
PROTECTION	■ May increase user comfort, but does not offer physical protection.	■ Can be used to provide continuous protection, but low height provides less protection than other types of separation.	■ Moderate to high degree of protection, depending on spacing and material used. ■ The face of the planter exposed to traffic may be rounded to better absorb the energy of an impact. The planter should not be anchored to the pavement and should have sufficient mass to absorb the energy of an impact without significant deflection.
MAINTENANCE	■ Can be impacted if buffer space is used for snow storage. ■ Susceptible to damage and may need to be frequently replaced.	■ Low maintenance requirements.	■ High maintenance requirements; likely to require ongoing care and landscaping.
SIGHTLINES	■ Minimal impacts.	■ Minimal impacts.	■ Need to ensure they do not restrict clear zone requirements and sightlines, particularly on roads with higher motor vehicle speeds.
SPACING	■ Spaced 3.0 to 6.0 metres apart. ■ Spacing may be dependent on factors such as parking and loading encroachment. ■ Generally placed in the middle of the buffer area but may be positioned to one side or the other as site conditions dictate.	■ May be spaced closer to create a continuous barrier. ■ If spaced apart, spacing should be even along the corridor. Spaced 2.5 metres to 3.5 metres apart.	■ May be spaced closer to create a continuous barrier. ■ If spaced apart, spacing should be even along the corridor.

	CONCRETE BARRIER	RAISED OR LANDSCAPED MEDIAN	PARKING LANE
APPROPRIATE CONTEXT	■ Recommended for locations where more physical protection from motor vehicles is needed, such as on bridges with high-speed traffic. ■ Should not be used with on-street parking.	■ Recommended for locations where more physical protection from motor vehicles is needed; for example, on bridges with high-speed traffic.	■ Where on-street parking exists, the protected bicycle lane can be placed between the parking and the sidewalk.
COST	■ Relatively low initial capital cost compared to other types of separation.	■ Higher initial capital cost, but requires less long-term maintenance than other types of separation.	■ Low cost, plus the cost of any additional separation elements.

	CONCRETE BARRIER	RAISED OR LANDSCAPED MEDIAN	PARKING LANE
DESIGN FLEXIBILITY	■ Relatively low flexibility.	■ Relatively low flexibility.	■ Relatively low flexibility.
DESIGN NOTES	■ Intended to provide continuous vertical separation. ■ On higher speed roads, crash cushions should be included at barrier ends. ■ Less aesthetically pleasing than other types of separation.	■ Intended to provide continuous vertical separation. ■ On higher speed roads, crash cushions should be included at barrier ends. ■ Less aesthetically pleasing than other types of separation.	■ Intended to provide continuous vertical separation
DURABILITY	■ High durability.	■ High durability.	■ Depends on type of additional separation used.
PROTECTION	■ Provide a high degree of separation and physical protection from motor vehicles.	■ Can provide a continuous curb separation from motor vehicles, though may include gaps or inlets for channelizing stormwater towards existing catch basins in retrofit facilities.	■ Parked motor vehicles provide a vertical separation that adds protection only when present. Risk of dooring if insufficient buffer is not included. When parking spots are not in use, a horizontal separation is present. Additional vertical separation elements should be used to provide protection when parking spots are not in use and allow visibility of curbs for winter maintenance.
MAINTENANCE	■ Low maintenance requirements.	■ Low maintenance requirements.	■ Low maintenance requirements; and is the same as normal on-street parking conditions.
SIGHTLINES	■ Minimal impacts	■ Need to ensure they do not restrict clear zone requirements and sightlines, particularly on roads with higher motor vehicle speeds.	■ Parking should be discontinued before intersection and driveways to provide adequate sightlines.
SPACING	■ Continuous, with breaks for emergency access as needed.	■ Continuous, with breaks for emergency access as needed.	■ N/A

PROTECTED BICYCLE LANE COMPONENTS

There are several possible configurations of protected bicycle lanes that can be implemented based on the characteristics of the road. The four components to be considered when determining the potential configuration of a protected bicycle lane are as follows:

- Travel Direction: Will the protected bicycle lane be one-way in the direction of motorized travel, one-way in a contraflow direction to motorized travel, or two-way?
- Placement: Will the protected bicycle lane be placed on the left and/or right side of the road?
- Elevation: Is the protected bicycle lane going to be placed at street level, sidewalk level, or an intermediate level in between the two?
- Type of Separation: The type, dimensions, and spacing of separating elements such as flexible delineators, raised medians, and other forms of separation.

These four main components are discussed in detail on the following pages. Travel direction, location, and elevation are independent subsections, while the various types of separation were discussed in the Design Guidance subsection above.

Travel Direction

Protected bicycle lanes can be either uni-directional (one-way) or bi-directional (two-way) and can be located on one-way or two-way roads for motor vehicle traffic. The decision to build a uni-directional or bi-directional protected bicycle lane should be influenced by the following:

- The direction of motor vehicle travel;
- Whether motor vehicle turning movements are permitted at intersections;
- The number of driveways and other potential interruptions or conflicts; and
- Connectivity to the rest of the bicycle network.

The following subsections describe the key considerations behind uni-directional and bi-directional protected bicycle lanes.

Uni-Directional

Uni-directional protected bicycle lanes provide a protected bicycle lane on one or both sides of the road in the direction of motorized vehicle travel. Uni-directional protected bicycle lanes in the direction of motorized travel are generally the preferred option to integrate bicycle facilities into the existing operation of the road. This configuration can simplify movements at intersections and provides intuitive and direct connections with the surrounding transportation network, including similar transitions to existing bicycle lanes and shared travel lanes.

Some of the key considerations with uni-directional protected bicycle lanes include:

- Uni-directional protected bicycle lanes provide access to both sides of the road. However, this can result in incidents of people cycling in the wrong direction on a one-way road along uni-directional bicycle lanes.
- Conflict points along corridors with uni-directional protected bicycle lanes can be more predictable when compared to bi-directional facilities. This is because when people are cycling in the same direction as motor vehicles, it is easier for motorists to anticipate their movements. Bi-directional facilities have sometimes been found to have higher collision rates than uni-directional facilities when comparing collisions between motorists and people cycling travelling in a contraflow direction.

- With uni-directional protected bicycle lanes, there may be less need for dedicated bicycle signals or adjusting signal phasing, depending on the number of turning motor vehicles.

Bi-Directional

In some situations, uni-directional protected bicycle lanes may not be practical or desirable. Bi-directional protected bicycle lanes may be considered on constrained corridors where there is insufficient space for a pair of uni-directional protected bicycle lanes, or on one-way roads. Some of the key considerations associated with bi-directional protected bicycle lanes include:

- Limited access to destinations on the other side of the road may result in sidewalk cycling and potential conflicts with people walking.
- Contraflow movements for people cycling through traffic signals may be less efficient (waiting for red lights at most intersections). This can lead to user frustration, red light running, and/or people concentrating on making the light and not focusing on potential safety issues. There may be increased delay for other road users as well.
- People walking and motor vehicle drivers who are turning may not expect to see people cycling in the contraflow direction. This can increase collision risk, particularly at intersections, laneways, and driveways where drivers and pedestrians fail to look for people cycling approaching from the contraflow direction.
- Contraflow movements require special attention at intersections, driveways, and other conflict points, as pedestrians and motorists may not anticipate contraflow bicycle movements. Providing a bi-directional protected bicycle lane on a two-way road introduces contraflow movement which can be challenging to accommodate. The same challenge can occur when providing a bi-directional protected bicycle lane on a one-way road.
- Challenges when bicycle facilities terminate and ensuring that people cycling in the contraflow direction re-enter traffic in the correct direction.

When choosing between uni-directional and bi-directional protected bicycle lanes, the challenges associated with travel direction need to be weighed against the connectivity benefits. A bi-directional protected bicycle lane on a road with two-way motor vehicle traffic introduces additional conflict points at intersections. Section 5.3.1.2 of the TAC *Geometric Design Guide for Canadian Roads* notes that, along wide roads with long block lengths and intensive land use, bi-directional protected bicycle lanes can provide people cycling with more direct route choices by eliminating the need to cross the road in order to travel in the opposing direction. However, this would only be applicable if there were bi-directional lanes on both sides of the road, or if only one side of the road had land uses with destinations.

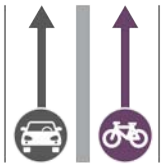
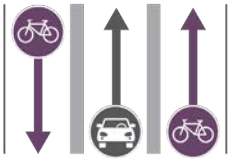
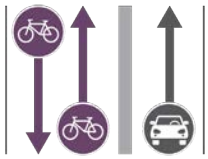
When implementing bi-directional bicycle facilities on two-way roads, additional measures to protect the bicycle movements at intersections, such as signal phasing and geometric treatments, need to be addressed to mitigate the additional conflict with motor vehicles turning. Refer to **Chapter G.4** for details on intersection treatments.

One-Way vs Two-Way Roads

Protected bicycle lanes can be installed on one- and two-way roads. **Table D-14** and **D-15** will provide an overview of the typical configurations of uni-directional and bi-directional protected bicycle lanes on one- and two-way roads, along with a summary of associated considerations.

Table D-14 // Protected Bicycle Lane Configurations on One-Way Roads

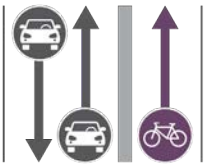
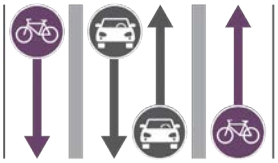
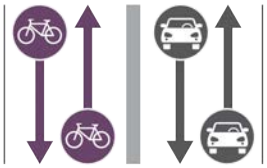
Source: Adapted from MassDot Separated Bike Lane Planning & Design Guide

	ONE-WAY PROTECTED BICYCLE LANE*	ONE-WAY PROTECTED BICYCLE LANE PLUS CONTRAFLOW PROTECTED BICYCLE LANE	TWO-WAY PROTECTED BICYCLE LANE*
			
ACCESS TO DESTINATIONS	Provides bicycle access to only one side of the road.	Provides full access for people cycling to both sides of the road.	Provides bicycle access to only one side of the road.
NETWORK CONNECTIVITY	Does not address contraflow travel and may result in wrong way cycling.	Accommodates two-way bicycle travel, though contraflow travel through signals may be impacted by signal timing.	Accommodates two-way bicycle travel, though contraflow travel through signals may be impacted by signal timing.
CONFLICT POINTS	Has fewer conflict points when compared to other configurations, as people will be cycling the same direction as motor vehicle traffic.	Other road users may not anticipate people cycling in the contraflow direction.	Other road users may not anticipate people cycling in the contraflow direction.
INTERSECTION OPERATIONS	Can often make use of existing signals and phasing, although separate bicycle signals may be required depending on motor vehicle volumes and conflicts.	Will require additional signal equipment for the contraflow bicycle lane.	Will require additional signal equipment for the contraflow bicycle lane.
IMPACT	Requires less width when compared to the other configurations.	Requires more width and impacts both sides of the road.	Requires more width when compared to the uni-directional configuration on one side.

*An additional consideration for this configuration is the choice of which side of the road to place the protected bicycle lane. See page D49 for more information.

Table D-15 // Protected Bicycle Lane Configurations on Two-Way Roads

Source: Adapted from MassDot Separated Bike Lane Planning & Design Guide

	ONE-WAY PROTECTED BICYCLE LANE ON ONE SIDE OF THE ROAD	ONE-WAY PROTECTED BICYCLE LANE ON EACH SIDE OF THE ROAD	TWO-WAY PROTECTED BICYCLE LANE
			
ACCESS TO DESTINATIONS	Provides bicycle access to only one side of the road.	Provides full access to both sides of the road.	Provides bicycle access to only one side of the road.
NETWORK CONNECTIVITY	Does not address contraflow travel and may result in wrong way cycling.	Accommodates two-way bicycle travel.	Accommodates two-way bicycle travel, though contraflow travel through signals may be impacted by signal timing.
CONFLICT POINTS	If bicycles and motor vehicles are travelling in the same direction directly adjacent to each other, the number of conflicts may be reduced as travel behaviour is more predictable; however, turning movements yielding to bicycles remains the primary conflict; as a result, parking should be restricted close to intersections to ensure sightlines are unobstructed.	As bicycles and motor vehicles are travelling in the same direction, the number of conflicts may be reduced as travel behaviour is more predictable; however, turning movements yielding to bicycles remains the primary conflict, as a result, parking should be restricted close to intersections to ensure sightlines are unobstructed.	There is significant potential for conflict between turning motor vehicles and bicycles. Traffic signalization is recommended to mitigate this risk. Conflicting movements should be prohibited by providing separate signal phases for bicycle users and turning motor vehicles. If this is not possible, conflicts should be mitigated with clear signage and pavement markings indicating right-of-way. This should only be considered for short segments or where there is limited to no access or driveways
INTERSECTION OPERATIONS	Can likely make use of existing signals and phasing.	Can likely make use of existing signals and phasing.	Typically requires additional signal equipment for the contraflow bicycle lane.
IMPACT	Requires less width when compared to the other configurations.	Requires more width and impacts both sides of the road	Requires more width when compared to the uni-directional configuration on one side.

Placement

On one-way roads with bi-directional protected bicycle lanes or uni-directional protected bicycle lanes only on one side of the road, placement is an important consideration. Protected bicycle lanes on the right or left side of the road can be considered. There is ongoing research regarding which side of the road uni-directional and bi-directional protected bicycle lanes should be located on.

The following includes some of the considerations for the placement of protected bicycle lanes on the right or left side of the road.

Left Side of the Road

- Bicycles and motor vehicles that are directly adjacent to one another are moving in the same direction;
- Avoids conflicts with transit vehicles and bus stops;
- Directional dividing line is to the left of all motor vehicle traffic;
- Bicycles are located on the motorist side of the motor vehicle, which may make them more visible to the motorist; and
- Additional treatments to increase awareness and visibility should be considered.

Right Side of the Road

- Road users are more familiar with slower road users, including bicycles, being located on their right side;
- Motor vehicle is directly adjacent to oncoming bicycle traffic, which may help increase visibility of bicycle users in the opposing direction; and
- When travelling in the same direction, at an intersection, there is greater lateral distance between the person cycling in the protected bicycle lane and a motorist. This may reduce awareness of bicycles travelling in the same direction as motor vehicles. However, this can also give the motorist more time to become aware of people cycling and can improve the sightline angle.

Elevation

A protected bicycle lane may be configured with a height difference between the protected bicycle lane and the motor vehicle lane, and/or between the protected bicycle lane and the sidewalk. The elevation of the protected bicycle lane may vary along a corridor and can incorporate design features such as bicycle transition ramps and raising the bicycle lane as needed at pedestrian crossings, bus stops, and intersections. The number of elevation changes is important to consider along a corridor, as too many ups and downs can result in an uncomfortable cycling experience. In most cases, the decision regarding elevation is based on physical constraints and feasibility.

There are three general protected bicycle lane elevation options, each with their own factors to consider. In each option, a catch basin is required at the low point and an inlet or cut out may be required in the median to facilitate drainage.

Bi-directional protected bicycle lane, Victoria, B.C.

Sidewalk Level Protected Bicycle Lanes

Sidewalk level protected bicycle lanes are typically separated from the road by a standard vertical curb and buffer in the Street Buffer Zone (see **Figure D-43**). In constrained circumstances, the Street Buffer Zone may not be provided (see **Figure D-44**). This facility type may be considered when the road right-of-way is constrained and there is limited space for a buffer. In an urban environment, a sidewalk level protected bicycle lane is commonly located alongside a parallel pedestrian facility. This type of protected bicycle lane and sidewalk together may be considered similar to a multi-use pathway segregated by user type, depending on intersection treatments. This facility may offer maintenance benefits if pathways and sidewalks are cleared by the local jurisdiction, particularly for snow clearing requirements and improved accessibility.

Figure D-43 // Sidewalk Level Protected Bicycle Lanes (with Street Buffer Zone)

Figure D-44 // Sidewalk Level Protected Bicycle Lanes (without Street Buffer Zone)

Intermediate Level Protected Bicycle Lanes

Intermediate level protected bicycle lanes can be built at any elevation between the sidewalk and the road (see **Figure D-45**). Similar to sidewalk level protected bicycle lanes, they are typically separated from the road by a standard vertical curb. The bicycle lane is typically raised between one-half and the full height of the curb. More details about the width of the buffer between the road and the bicycle lane and the type of treatment we discussed previously in this chapter. Providing vertical separation between people walking and cycling is the primary consideration for separated bicycle lane elevation. A separated bicycle lane flush with the sidewalk may encourage encroachment by people walking and cycling unless discouraged with a continuous sidewalk buffer. A change in elevation provides a detectable edge for the visually impaired. The change in elevation should be a minimum of 50 millimetres between the sidewalk and the protected bicycle lane.

Intermediate level protected bicycle lanes may present snow clearing challenges in B.C. communities with a winter climate, as this configuration does not allow the protected bicycle lane to be cleared as part of the sidewalk or the road and may result in additional operational resources and costs. However, there may be specific circumstances where they are still worth considering, including urban areas near transit stops and areas frequently accessed by people with visual disabilities.

Figure D-45 // Intermediate Level Protected Bicycle Lanes

Street Level Protected Bicycle Lanes

Street level protected bicycle lanes are built at the same level as the road (see **Figure D-46**). These commonly occur in retrofit scenarios where protected buffers are added to the existing road, creating a protected bicycle lane. They can be separated from the motor vehicle lane by a range of vertical separation measures, as described on page D39). Street level protected bicycle lanes also offer effective separation between people walking and cycling. As with intermediate level protected bicycle lanes, maintenance may be more difficult because the protected bicycle lane is not at the same level as the sidewalk and they are separated from adjacent travel lanes (and hence road maintenance equipment) by a vertical barrier. However, the relative ease with which protected bicycle lanes can be added to roads using this method makes road level protected bicycle lanes an important facility type for retrofit situations.

Figure D-46 // Street Level Protected Bicycle Lanes

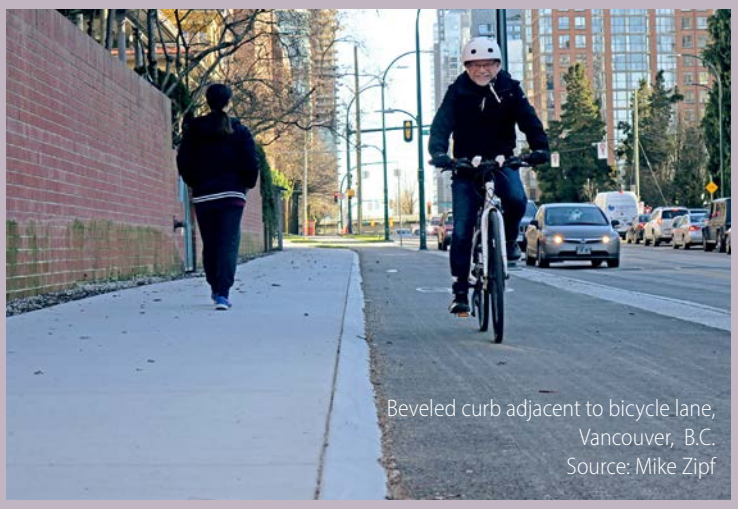
Intermediate Level Protected Bicycle Lane Accessibility Considerations

Protected bicycle lanes introduce a new path of travel alongside the sidewalk. For people with vision impairments, it may be difficult or impossible to detect the presence of a protected bicycle lane, particularly when the protected bicycle lane is at sidewalk level or intermediate level (between the sidewalk and road). Pedestrians may inadvertently step into and walk along the protected bicycle lane without realizing they have done so, creating a risk of collisions between people cycling and people walking.

Sidewalk level and intermediate level protected bicycle lanes should include a detectable edge so people with limited vision can distinguish between the protected bicycle lane and the sidewalk. Where sufficient space is available, a strip of grass (e.g., softscape) provides a clear differentiation between the two facilities. However, in constrained environments, there may not be enough space to provide this strip of softscape, so a detectable edge or curb should be used.

One advantage of an intermediate level protected bicycle lane is that the vertical delineation between the sidewalk and bicycle lane provides a detectable edge between the two facilities. This scenario applies when no horizontal separation exists between the sidewalk and the bicycle facility. This configuration may present challenges for snow clearing but it has great advantages for accessibility.

The City of Vancouver has worked with the accessibility community to test out different types of separation and it was found that a curb ratio of 1V:3H (50 millimetres tall by 150 millimetres wide) is both detectable by people with visual impairments using a cane and is also safe for wheelchair users, allowing them to enter and exit the bicycle lane when needed. This is the preferred treatment when designing intermediate level protected bicycle lanes



Beveled curb adjacent to bicycle lane, Vancouver, B.C.
Source: Mike Zipf

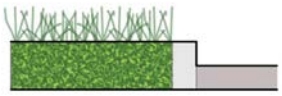
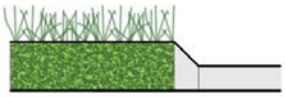
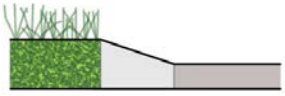
Curbs

The angle of the curb has an impact on the ease of encroachment of users and on potential pedal hazards. Three common curb types are presented below.

The curb height also impacts the safety and comfort of the bicycle facility. Curbs can be constructed at heights between 50 millimetres and 150 millimetres. Shorter curbs (50 millimetres to 75 millimetres) eliminate the risk of pedal strike, which increases the usable bicycle lane width by permitting people to safely ride closer to the edge of the protected bicycle lane. They are recommended at curbs adjacent to the protected bicycle lane and are also recommended at locations where bicycles are encouraged to exit the protected bicycle lane, such as along commercial roads to ease access onto the sidewalk. Mountable curb designs have generally been found to be detectable by people who are visually impaired.

Where taller curbs are required for drainage purposes, a beveled curb is recommended. Taller curbs help to discourage encroachment by motor vehicles and are recommended adjacent to motor vehicle travel lanes and on roads with on-street parking.

Further discussion on the maintenance considerations of different types of curbs is included in **Chapter I.3**.

CURBS		
Vertical Curb	Vertical curbs are designed to prohibit encroachment by motor vehicles or bicycles; however, they can create a hazard for pedals, particularly where the bicycle lane width is closer to the lower limit.	
Beveled Curb (1V:1H)	A beveled curb (1V:1H) is angled to reduce pedal strike hazards and is most often used at locations where the bicycle lane is narrow. Consideration should be taken when used to separate the bicycle lane with the sidewalk and/or sidewalk buffer; while easier for pedestrians to navigate than vertical curbs, beveled curbs may present a tripping hazard for people who are mobility or visually impaired.	
Mountable Curb (1V:3H)	Mountable curbs (1V:3H) are designed to be encroached on by motor vehicles and bicycles. Compared to the curb types above, they are more forgiving for bicycles that are travelling over them and provide a slight change in elevation to inform pedestrians they are entering the bicycle lane, but are gentle enough to avoid being a tripping hazard. They do, however, consume more cross-section width.	

SIGNAGE

The Reserved Bicycle Lane sign (MUTCDC RB-90, RB-91) should be installed along protected bicycle lanes. The Reserved Bicycle Lane Ends sign (MUTCDC RB-92) should be installed at the end of the reserved lane denoting the end of the protected bicycle lane.

For uni-directional protected bicycle lanes, additional signage at each entry to the protected bicycle lane can be installed to deter wrong way travel. The signage should be facing the wrong way travel, and can include Entry Prohibited signs(MUTCDC RB-23; B.C. R-009-1 Series or B.C. R-009-2 Series) or Wrong Way signs (MUTCDC RB-22; B.C. R-009-3 Series) signs. Installation of these signs should only be used if wrong way riding has been observed or if there is a likelihood that the facility would be used incorrectly; otherwise this could lead to unnecessary sign clutter.

More information on the placement and spacing of the Reserved Bicycle Lane sign and supplementary signs is provided in **Appendix B.**

PAVEMENT MARKINGS

Protected bicycle lanes should include the Bicycle symbol and Reserved Use diamond symbol. The Bicycle symbol should point in the direction of travel with the diamond below it, and should be placed at each approach to all crossings. These symbols may be supplemented by directional arrow markings to denote the protected bicycle lane movement and to deter wrong way riding.

Green pavement markings should be reserved for conflict points, including driveways and intersections, as well as bike boxes and two-stage turn boxes (see **Chapter G.4**). For bi-directional facilities, additional pavement marking is recommended to enhance awareness for motorists that there is two-way travel on the facility.

Bi-directional protected bicycle lanes should have directional dividing lines that are dashed to indicate where passing is permitted, and solid to indicate where passing is undesirable.

Additional guidance on pavement markings at intersections and crossings is provided in **Chapter G.4**.

Additional guidance on pavement marking details such as dimensions, placement, and spacing is provided in **Appendix B**. Guidance regarding pavement marking maintenance is provided in **Chapter I.3**.

Uni-Directional protected bicycle lane, Vancouver, B.C.
Source: Victor Wang

Buffered bicycle lane, District of Saanich, B.C.

D.4

PAINTED + BUFFERED BICYCLE LANES

Painted and buffered bicycle lanes are separate travel lanes designated for the exclusive use of people cycling. Other active users such as skateboarders and in-line skaters may also be permitted to use bicycle lanes depending on local bylaws. In most cases, bicycle lanes are located on the right side of the road adjacent to the curb or a parking lane.

Bicycle lanes define the road space for bicycle users and motorists, which helps to facilitate predictable behaviours and orderly movements between road users. As a result, bicycle lanes encourage motorists to stay out of the cyclists' path and discourage cyclists from riding on the sidewalk.

Bicycle lanes are different from protected bicycle lanes (described in **Chapter D.3**) as they do not provide physical separation between bicycle users and motor vehicles. A bicycle lane is also different from bicycle accessible shoulder (described in **Chapter D.6**) because bicycle lanes are reserved for the exclusive use of people cycling.

DESCRIPTION

Bicycle traffic in a bicycle lane is typically one way with bicycle users travelling in the same direction as the adjacent motor vehicle lane. In some cases, bicycle lanes can be configured in a contraflow direction on one-way roads to improve connectivity for bicycle users. Contraflow bicycle lanes are generally used on urban roads with moderate motor vehicle volumes and speeds.

Bicycle lanes are identified by signage and pavement markings, including solid longitudinal lines and bicycle and reserved lane diamond symbol pavement markings, placed at regular intervals. A dashed longitudinal line is used at locations where motor vehicle traffic can cross the bicycle lane, typically to accommodate motor vehicle turning movements.

There are several possible bicycle lane configurations that are generally categorized based on their placement across the width of road and whether they have buffers with the adjacent lanes. The configurations discussed in this chapter include:

- Curbside bicycle lanes;
- Parking adjacent bicycle lanes;
- Left side bicycle lanes; and
- Contraflow bicycle lanes.

Buffered vs. Unbuffered Bicycle Lanes

Bicycle lanes can be unbuffered or buffered:

- An **Unbuffered Bicycle Lane** includes only a white longitudinal line running parallel to the alignment of the road to visually separate the bicycle lane from the motor vehicle and/or parking lanes.
- A **Buffered Bicycle Lane** provides additional separation between the bicycle lane and the motor vehicle travel lane and/or parking lane by way of an additional white longitudinal line that runs parallel to the bicycle lane. Depending on the width of the buffer space, the buffer space can be defined with additional markings such as hatched striping. A buffer may be used to visually narrow the bicycle lane width to reduce the perception that a wider bicycle lane may be used as a motor vehicle parking or travel lane.

Bicycle Lanes Adjacent to On-Street Parking

In many North American communities, bicycle lanes have been provided between motor vehicle lanes and on-street parking lanes (referred to as parking adjacent bicycle lanes). Research has shown that parking adjacent bicycle lanes are one of the least comfortable, least preferred, and least safe types of bicycle facilities among all users. In fact, research from the Cycling in Cities Program at the University of British Columbia has found that parking adjacent bicycle lanes are not safer than no cycling infrastructure.[1][2] Parking adjacent bicycle lanes present the following issues:

- They present additional conflict points for bicycle users;
- They have a greater risk of 'dooring' as all vehicles have a driver, but many do not have a passenger;
- Should a person cycling get 'doored' or have to enter the travel lane to avoid 'dooring,' they risk serious injury in a collision with a moving motor vehicle; and
- They are often blocked by delivery vehicles, taxis, and other private vehicles.

Design professionals are reminded that the provision of on-street parking should not be prioritized over cycling safety.

The recommended practice is to avoid the use of parking adjacent bicycle lanes. If bicycle facilities are recommended on a street with on-street parking, the following mitigation measures should be considered (in order of priority):

1. Remove on-street parking.
2. If on-street parking cannot be removed, provide a parking protected bicycle lane (see **Chapter D.3**);
3. If a parking protected bicycle lane cannot be provided, provide a buffered bicycle lane, with a sufficient buffer width between parked motor vehicles and the bicycle lane; or
4. If a buffered bicycle lane cannot be provided, consider another corridor or facility type.

The use of parking adjacent bicycle lanes without a buffer is not recommended in the Design Guide.

1. Meghan Winters and Kay Teschke, Route Preferences among Adults in the Near Market for Bicycling: Findings of the Cycling in Cities Study (American Journal of Health Promotion, 2010).

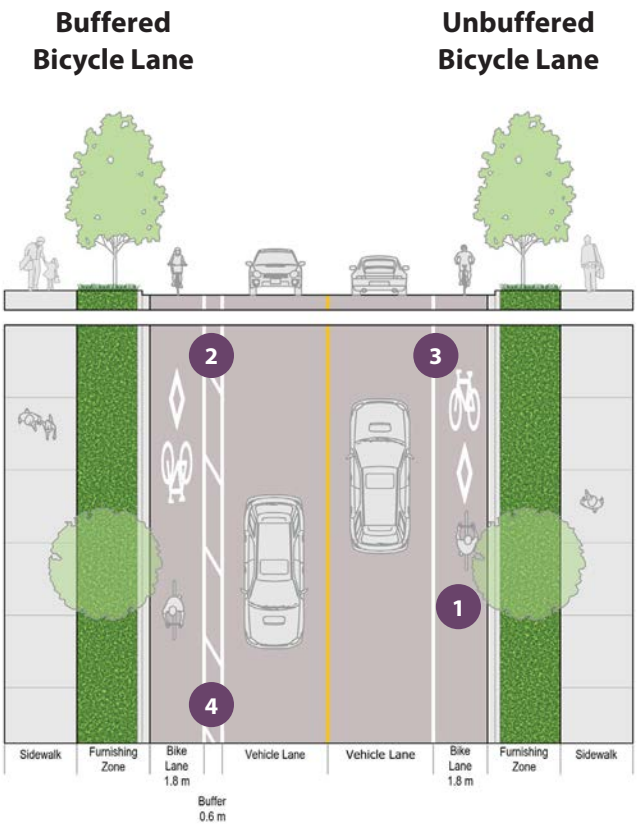
2. Kay Teschke et al., Route Infrastructure and the Risk of Injuries to Bicyclists: A Case-Crossover Study (American Journal of Public Health, 2012).

DESIGN GUIDANCE

This section provides geometric design guidance for the different types of bicycle lanes. More detailed design guidance on bicycle lane treatment at intersections, transitions, and crossings is provided in **Chapter G.4**.

Curbside Bicycle Lanes

Figure D-47 and **Table D-16** provide design guidance for unbuffered and buffered curbside bicycle lanes. Detailed guidance is provided on page D60.



1. *Desirable width of 1.8 metres*
2. *For widths greater than 1.8 metres, provide buffer between motor vehicle travel lane and bicycle lane.*
3. *100-200 mm solid white longitudinal line*
4. *If buffer space is provided, diagonal hatch markings can be provided for buffers of at least 0.6 metres*

Figure D-47 // Curbside Bicycle Lane Cross-Section - Desired Widths and Key Features

Table D-16 // Curbside Bicycle Lane Width Guidance

FACILITY	DESIRABLE (M)	CONSTRAINED LIMIT (M)
Curbside bicycle lane	1.8*	1.5**
***Buffer** (between bicycle lane & motor vehicle lane)	0.6	0.3

*For any width greater than 1.8 metres, a buffer should be provided to avoid the bicycle lane being mistaken or used for other purposes, such as parking or motor vehicle travel.

**The absolute minimum width of an unbuffered curbside bicycle lane is 1.2 metres. A bicycle lane width between 1.2 metres and 1.5 metres should only be considered for short distances (less than 100 metres), in constrained areas, and when reasonable consideration has been given to an alternate design.

*** Where motor vehicles speeds are 50 km/h or greater, adding a buffer is strongly recommended.

Unbuffered Curbside Bicycle Lanes

In this application, the bicycle lane is located on the right side of the road between the curb and an adjacent vehicle travel lane, where bicycle users and motorists are travelling in the same direction, and where on-street parking is not provided. The bicycle lane is visually separated from adjacent motor vehicle lanes with a solid white longitudinal line running parallel to the alignment of the road .

The desirable width of an unbuffered curbside bicycle lane is 1.8 metres. This provides sufficient width for single file bicycle traffic with some visual separation from motor vehicle lanes and to avoid any obstacles in the roadway. This width also accommodates a wider variety of bicycle types such as those pulling trailers and cargo bikes. The maximum recommended width of an unbuffered curbside bicycle lane is 1.8 metres; if the bicycle lane is wider than this, it may encourage motor vehicle drivers to use the lane by mistakenly considering it as another motor vehicle lane or a parking lane. A buffered bicycle lane should be provided where more than 1.8 metres width is available.

The constrained limit width of an unbuffered curbside bicycle lane is 1.5 metres. If the bicycle lane is narrower than 1.5 metres, it loses much of its capability to provide separation between bicycles and adjacent motor vehicles.

Widths of less than 1.5 metres should only be provided in exceptional circumstances and require justification through a design exception in accordance with the TAC *Geometric Design Guide for Canadian Roads*. The absolute minimum width of an unbuffered curbside bicycle lane is 1.2 metres based on the horizontal operating envelope of a person cycling. This minimum reflects the additional width provided by the gutter pan with curbside bicycle lanes. Further, a bicycle lane width between 1.2 metres and 1.5 metres should only be considered for short distances, in constrained areas, and when reasonable consideration has been given.

Buffered Curbside Bicycle Lanes

The additional width provided by a buffered curbside bicycle lane is desirable to accommodate bicycle passing movements and to provide additional space between bicycles and moving motor vehicles. A curbside bicycle lane should include a buffer where motor vehicle speeds are 50 km/h or greater and bicycle volumes are greater than 1,500 bicycles per day, or where space is available.

A buffer can also be added to provide additional separation between people cycling and motor vehicles. The desired buffer width is 0.6 metres. In constrained situations, the buffer can be 0.3 metres wide. The maximum width of a buffer is 0.9 metres; if at least 0.9 metres of additional space is available, a protected bicycle lane should be considered instead. Wider buffers (greater than 0.6 metres) may be enhanced with additional hatch markings.

Additional information on bicycle lane pavement markings including hatching dimensions is provided in **Appendix B**.

A *Consider adding a buffer next to the vehicle lane or implementing a protected bicycle lane if extra space is available.*

Figure D-48 // Buffer Space Options for Bicycle Lane Adjacent to Parallel Parking

Parking Adjacent Bicycle Lanes

Design professionals should carefully consider user comfort and safety risks prior to designing a bicycle lane adjacent to motor vehicle parking (see Research Note). In the event that this facility type is chosen, the design guidance below should be considered.

A buffer is strongly recommended between the parked motor vehicles and the bicycle lane where a bicycle lane is provided adjacent to motor vehicles. The buffer provides space for motor vehicle doors to open without presenting a hazard to adjacent bicycle users. Bicycle lanes adjacent to on-street parking without a buffer are not recommended in the Design Guide. **Figure D-46** shows various buffer configurations, including the constrained limit width, desirable width, and an additional buffer space where space is available.

Assigning Extra Buffer Width

Buffers can be located on one or both sides of the bicycle lane, either between moving and/or parked motor vehicles (see **Figure D-48**). Where the total width available is greater than 2.1 metres, space should be allocated first to the bicycle lane to achieve the desirable width of 1.8 metres, and the balance of the width should go towards increasing the buffer. Where the parking turnover frequency is less than 10 motor vehicles per hour and/or the motor vehicle volumes are greater than 5,000 motor vehicles per day, increasing the buffer width between the bicycle lane and motor vehicle lane is recommended. However, along corridors with higher parking turnover and/or motor vehicle volumes less than 5,000 motor vehicles per day, additional width should instead be allocated to the buffer between the bicycle lane and the parking lane to mitigate the risk of 'dooring.'

Where the total width available for the bicycle lane and buffer is 2.4 metres or greater, a protected bicycle lane should be considered rather than a buffered bicycle lane. Refer to **Chapter D.3** for more information on protected bicycle lanes. If a protected bicycle lane is not desired or applicable and more than 2.7 metres of space is available, additional buffer space may be provided between the bicycle lane and the motor vehicle lane, as outlined in **Table D-16**, or between the bicycle lane and the curb. The extra width should be marked differently so that the bicycle lane is not confused with a motor vehicle lane.

The desired width of a bicycle lane adjacent to on-street parking is 2.4 metres, including a 1.8 metre bicycle lane and a 0.6 metre buffer between the parking lane and the bicycle lane. Refer to **Figure D-48**. The constrained limit width of a bicycle lane adjacent to parallel parking is 2.1 metres, including a 1.5 metre bicycle lane and 0.6 metre buffer.

The parking lane width is generally dictated by local bylaws and/or design standards, but should generally accommodate the width of the parallel parked vehicle and leave some additional space if parked sub-optimally. Consideration may also be given to added space for snow storage where no buffer is provided.

Bicycle Lane Adjacent to Angled Parking

Angled parking is often used where a road has sufficient width to increase the available parking supply. However, in general, angled parking is not preferred adjacent to a bicycle lane. If angled parking is already provided, protected bicycle lanes located adjacent to the curb are recommended (see **Chapter D.3**). Where protected bicycle lanes are not feasible, bicycle lanes may be a suitable type of facility. However, note that many of the same challenges associated with bicycle lanes next to parallel parking exist for bicycle lanes adjacent to angled parking. Design professionals should carefully consider user comfort and safety risks prior to designing a bicycle lane adjacent to angled motor vehicle parking (see Research Note in the previous subsection).

There is currently little design guidance in other documents for installing a bicycle lane adjacent to angled parking and whether front-in or back-in is the preferred configuration. Design professionals should consider a variety of factors when deciding whether to implement back-in or front-in angled parking such as: safety, motor vehicle access, pedestrian realm impacts, and ease of maneuver. Angled parking treatments should only be considered in retrofit projects where the angled parking already exists and bicycle facilities are being added to the roads.

The main concern with front-in angled parking is the lack of sightlines for drivers backing out. Conversion of the angled parking to back-in angled parking can increase motorist's sightlines and reduce the risk of drivers blindly backing out of the parking stall into the bicycle lane. However, for many drivers, driving front-in is a more familiar and common action than backing into an angled parking stall.

If space allows, it is recommended that the bicycle lane is protected and located between the sidewalk curb and the angled parking (refer to **Chapter D.3** for more information).

Where a bicycle lane is located adjacent to angled parking on the road side, the desirable width of the bicycle lane is 1.8 metres (see **Figure D-49**). Additionally, when designing a bicycle lane adjacent to angled parking, a buffer should be provided between the bicycle lane and the edge of the angled parking lane. This provides space for people riding bicycles to maneuver around a motor vehicle coming into the travel lane, for people to load their motor vehicles, and for longer motor vehicles to park without impeding the bicycle lane. The constrained limit width of the buffer is 0.9 metres for front in angled parking and 0.6 metres for back in angled parking, with a maximum width of 1.4 metres.

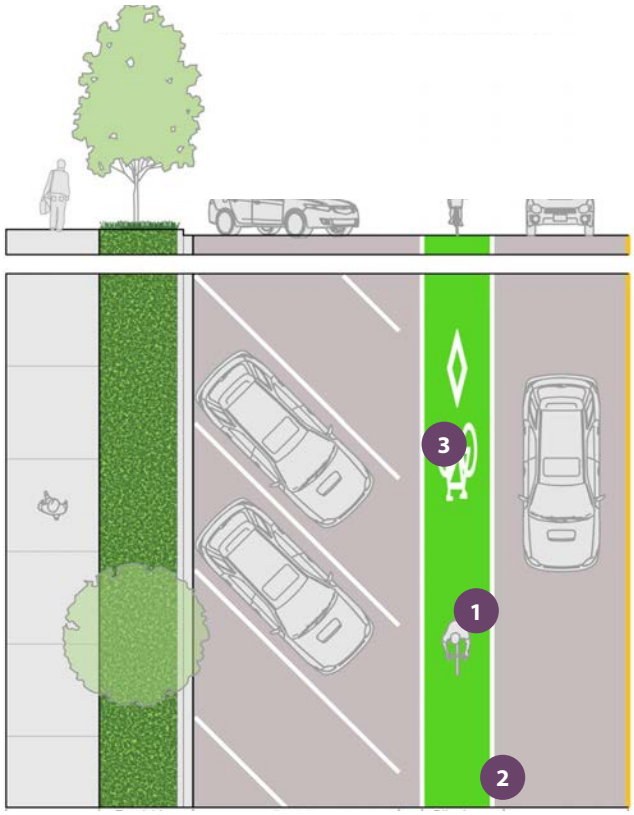


Figure D-49 // Bicycle Lane Adjacent to Back-In Angled Parking - Desired Widths and Key Features

1. *Desirable width of 1.8 metres*
2. *Green conflict zone markings can enhance visibility*
3. *Buffer area between angled parking and bicycle lane. Buffer area can be enhanced with different surface materials (such as textured surface)*

When implementing a treatment that shifts users' expectations, such as back-in angled parking, an educational campaign is imperative and should be implemented in advance of implementing the measure.

Similar to bicycle lanes adjacent to parallel parking, space should be allocated to the bicycle lane first, followed by the buffer adjacent with the parking lane, then with the motor vehicle lane. If further additional space exists, buffer space may be provided between the bicycle lane and the motor vehicle lane. If there is insufficient width available to provide an adequate bicycle lane width and buffer width, other design options should be considered, including converting the angled parking to parallel parking.

Left Side Bicycle Lanes

Left side bicycle lanes are on the left side of a one-way road. Refer to **Figure D-50**. Some of the circumstances where left side bicycle lanes may be considered include locations where:

- There are a significant number of left turning bicycle users;
- There are conflicts with right side transit stops, loading and delivery activity, and/or on-street parking; and
- There are more destinations are on the left side of the road, particularly destinations that attract people cycling.

Some of the benefits of left side bicycle lanes include:

- Avoids potential right side bicycle lane conflicts on roads;
- May improve bicycle visibility for motor vehicle drivers as the bicycle lane is located on the motorist's side, although drivers may not typically expect to see people cycling on the left side;
- Parking lane is typically located on the right side;
- If there is left side parking, left side bicycle lanes minimizes door zone conflicts because of fewer doors openings on the passenger side; however, there is more impact to the sightline of approaching bicycle users for motorists pulling out of the parking lane; and
- No transit conflicts as bus stops are on the right side of the road.

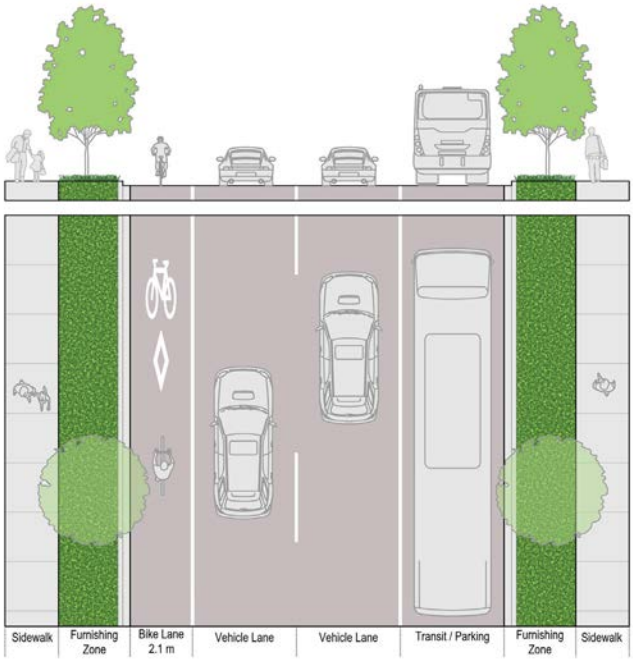


Figure D-50 // Left Side Bicycle Lane Cross-Section - Desired Width

The desirable width of a left side bicycle lane is 2.1 metres. For any width greater than 1.8 metres, a buffer should be provided to avoid the lane being mistaken or used for other purposes, such as parking or motor vehicle travel. Recommendations for the bicycle lane width and buffer are consistent with the above sections on curbside and parking adjacent bicycle lanes. Design professionals should give careful consideration to ensure safe, intuitive transitions are provided at either end of a left side bicycle lane as this facility type is less familiar to bicycle users and motorists, and has the potential to lead to confusion.

Additional signage and pavement markings should be provided when installing left side bicycle lanes to clearly demarcate the bicycle lane for motor vehicle drivers and reduce wrong way cycling. However, design professionals should use caution when installing signage to ensure to not result in reduced effectiveness of existing signage.

Contraflow Bicycle Lanes

A contraflow bicycle lane is a painted bicycle lane with bicycle users travelling against the flow of motor vehicle travel. A contraflow bicycle lane is used to facilitate two-way bicycle movement on a road that is one-way for motor vehicles. The bicycle lane and the motor vehicle lane should be separated by a directional dividing line (see **Figure D-51**).

A contraflow bicycle lane may be considered in the following scenarios:

- On roads where a large number of people cycling are already riding the wrong way;
- On corridors where alternate routes require excessive out-of-direction travel;
- On corridors where alternative routes include unsafe or uncomfortable roads with high motor vehicle volumes and/or no bicycle facilities;
- On corridors where the contraflow lane provides direct access to destinations on the road under consideration; and
- Where two-way connections between bicycle facilities are needed along one-way roads.

The desirable width of a contraflow bicycle lane is 2.4 metres, including a 1.8 metre bicycle lane and a 0.6 metre buffer (see **Table D-17**).

It is preferable to have lower volumes and speeds where contraflow lanes are used without protection to reduce cycling workload. Additionally, they work well on roads with few intersections or accesses. These measures help to mitigate potential conflicts stemming from bicycles approaching from the opposite direction than expected for motor vehicle traffic.

As a part of implementation, design professionals need to determine an effective signage plan to accompany this facility, and can include the Contraflow Bicycle Lane Crossing sign (MUTCDC WC-43). Additional details on signage are provided in **Appendix B**.

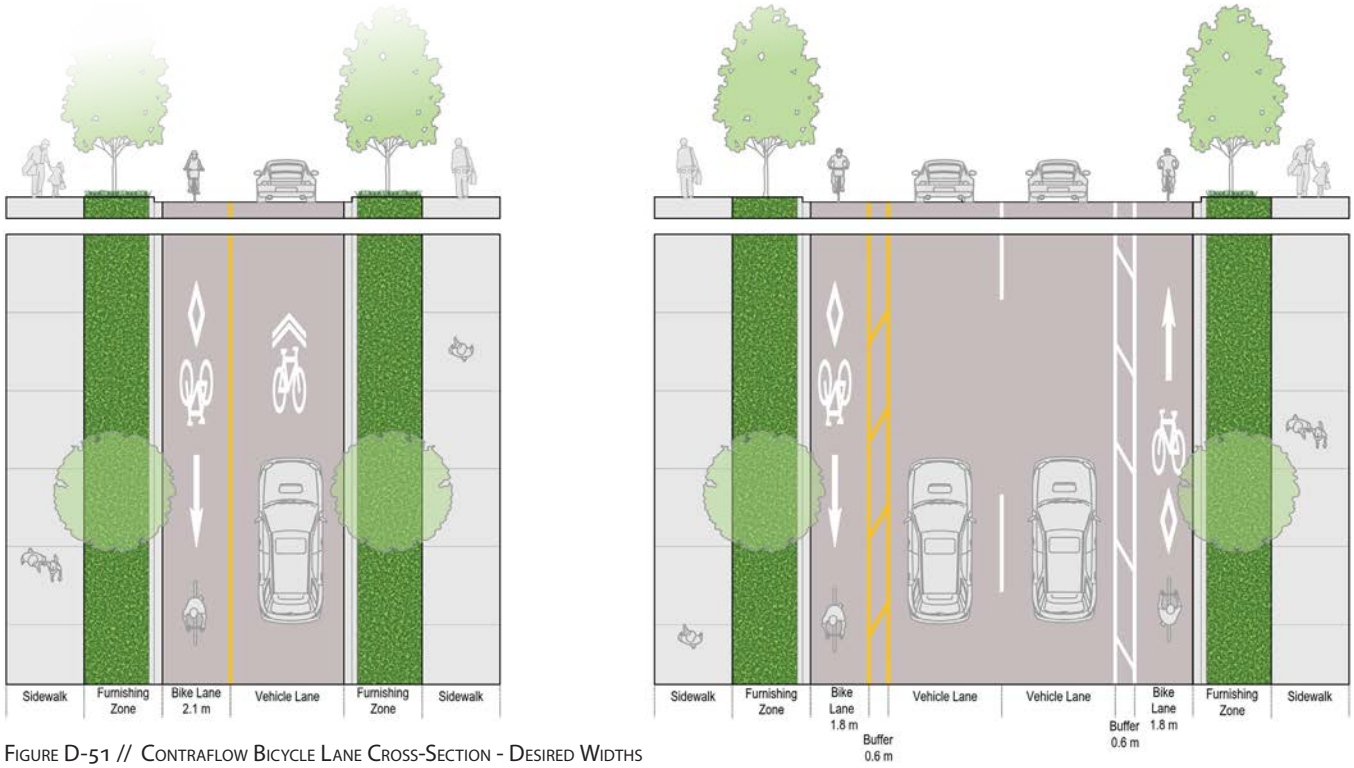


Figure D-51 // Contraflow Bicycle Lane Cross-Section - Desired Widths

Table D-17 // Contraflow Bicycle Lane Width Guidance

FACILITY	DESIRABLE (M)	CONSTRAINED LIMIT (M)
Bicycle Lane	1.8*	1.5
Buffer (between bicycle lane and motor vehicle lane)	0.6	0.3

*For any width greater than 1.8 metres, a buffer should be provided to avoid the lane being mistaken/used for other purposes, such as parking or motor vehicle travel.

Contraflow bicycle Lane, Vancouver, B.C.

Bicycle stencil, Vancouver, B.C.

SIGNAGE

The Reserved Bicycle Lane sign (MUTCDC RB-90, RB-91) should be installed continuously along the length of the bicycle lane. In an urban environment, signs should be placed after every intersection and spaced mid-block at least every 200 metres. In a rural environment, signs should be placed after every intersection and spaced mid-block at least every 200 to 400 metres The Reserved Bicycle Lane Ends sign (MUTCDC RB-92) should be installed at the end of the reserved lane denoting the end of the bicycle lane. Additionally, if there are not by-laws in place that restrict parking in bicycle lanes, then No Parking signs (MUTCDC RB-51; B.C. P-001 Series) and/or No Stopping signs (MUTCDC RB-55; P-058 Series) should be installed along the curbside bicycle lanes. These signs can also be used in areas where there is frequent non-compliance with parking in bicycle lanes where bylaw restrictions are in place. However, design professionals should use caution when installing signage to ensure to not result in reduced effectiveness of existing signage.

For contraflow bicycle lanes, a One-Way sign (MUTCDC RB-21; B.C. R-008LR Series) with the Except Bicycles tab (MUTCDC RB-9S; B.C. R-009 Tabs) is the preferred signage treatment along the facility and at intersecting roads, alleys, and driveways. Additionally, an Entry Prohibited sign (MUTCDC RB-23; R-009-1 Series) with the Except Bicycles tab (MUTCDC RB-9S; B.C. R-009 Tabs) is also recommended. Additional signage may also be required for motor vehicle drivers, depending on whether the contraflow bicycle lanes are on a one-way road or two-way road.

More information on this signage is provided in **Appendix B**, including supplementary signs that can be used depending on conditions.

PAVEMENT MARKINGS

Bicycle lanes are delineated by one to two longitudinal lines that border a designated area for bicycle use. The longitudinal line(s) directs motor vehicle and bicycle traffic into appropriate lanes and provides clarity for safe use of the road.

Directional bicycle lane lines are white in colour with a width of 100 to 200 millimetres.

Bicycle lane lines are typically solid, except in locations where motor vehicles are permitted to cross the bicycle lane to complete turning movements. At these locations, dashed white line markings are used. The dashed white line segments should consist of a minimum 1.0 metre long line segment with a one metre gap between the segments, with a 1:10 ratio. For example, for a 1.5 metre wide bicycle lane, a minimum length of 15.0 metres of dashed white line is used.

Similarly, dashed white lines should be used when the bicycle lane is shared with a transit stop. In those instances, the dashed marking should be 30.0 metres long measured from 5.0 metres in front of the transit stop sign, or in line with the transit stop area.

Where a buffer is provided, the buffer is also delineated with two solid white lines and can be located between the bicycle lane and the motor vehicle or parked motor vehicle lane or both. One white line is shared with the bicycle lane. The buffer lines should be a width of 100 millimetres, except when adjacent to the motor vehicles. In that case, they should be 200 millimetres wide and the shared line with the bicycle lane should be 100 millimetres. For the parking buffer, alternatives to the solid white line include cross hatch or 'parking Ts' to delineate the stalls. Cross hatching is more visible, but may require more maintenance than 'parking Ts'. A drawback of 'parking Ts' is that they define specific parking stalls, which may result in an inefficient use of space.

Buffer markings can be enhanced with hatching to decrease ambiguity of the space. If the buffer is greater than 0.6 metres, hatching should be considered; for buffers greater than 0.9 metres hatching is recommended to deter improper use of the space.

Dedicated bicycle lanes also need to include the white bicycle and reserve lane diamond pavement marking symbols. These symbols may be supplemented by directional arrow markings to denote the bicycle lane movement.

Refer to **Appendix B** for more information on pavement marking details.

Advisory bicycle lane, Shaw Road, Gibsons, B.C.

D.5

ADVISORY BICYCLE LANES

Advisory bicycle lanes (also referred to as advisory shoulders, non-compulsory lanes, or dashed bicycle lanes) are bicycle-priority areas within a shared street environment. Bicycle users have priority within dedicated lanes, but motorists may legally enter the advisory bicycle lanes to pass oncoming motor vehicles. Advisory bicycle lanes are not considered an all ages and abilities bicycle facility type.

KEY FEATURES

Advisory bicycle lanes are generally used on narrow roads that are not wide enough for dedicated bicycle lanes, or on roads with higher motor vehicle volumes and/or speeds than are unsuitable for a neighbourhood bikeway. Advisory bicycle lanes provide dedicated (but not exclusive) space for where motor vehicle volumes and/or speeds may make it uncomfortable to share the road. Advisory bicycle lanes are uni-directional and run along either side of a single bi-directional motor vehicle lane.

Where no sidewalk exists, such as in rural contexts, advisory bicycle lanes may be used for both walking and cycling, in which case the facility would be called 'advisory shoulders'. People walking should walk facing traffic, while people cycling should ride in the same direction as traffic on the right side of the road. See **Chapters C.4** and **D.6** for more guidance on rural pedestrian and cycling facilities. Key features of advisory bicycle lanes are shown in **Figure D-52**. Advisory bicycle lanes are located on either side of a **single bi-directional centre motor vehicle lane** 1.

Advisory bicycle lanes are delineated by white dashed longitudinal lines 2, indicating that motor vehicles may legally enter the bicycle lanes. This allows motor vehicles travelling in opposite directions to pass one another by temporarily **pulling into the advisory bicycle lane when safe to do so** 3. Motorists are required to yield to people cycling and walking in advisory bicycle lanes, so they should expect frequent yielding, mixing, and merging. In addition to dashed lines, advisory bicycle lanes may be differentiated from the central motor vehicle lane by using **colour or contrasting pavement materials** 4.

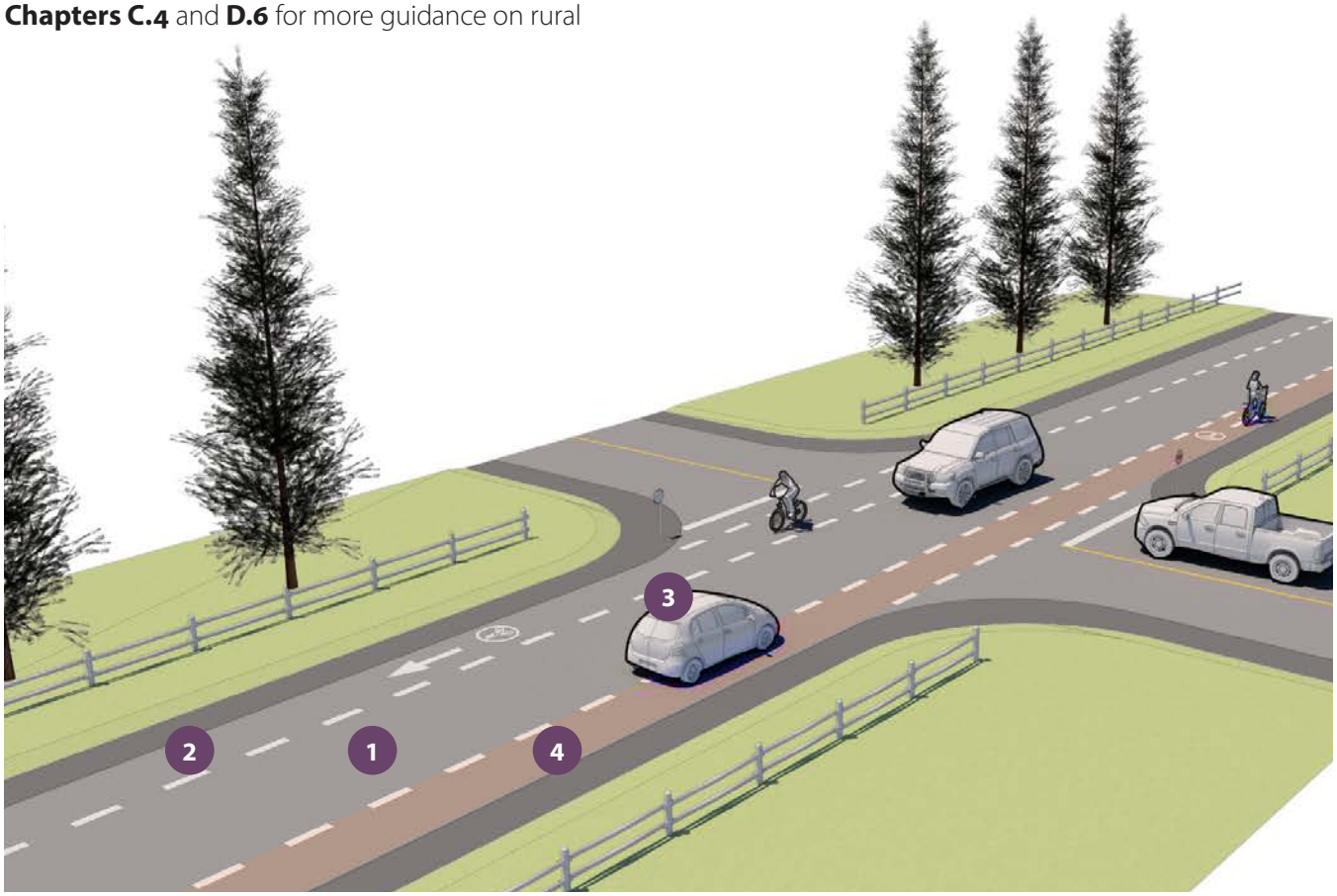


Figure D-52 // Advisory Bicycle Lane

Advisory bicycle lanes are common in Western Europe, with more than 1,000 kilometres of lanes installed in the Netherlands, Scandinavia, and the United Kingdom. In North America, advisory bicycle lanes are a relatively new bicycle facility type, having only been in use since 2011. As such, it is strongly recommended that installation of advisory bicycle lanes is supplemented with a strong public education program and materials, and that appropriate signage is installed. Various North American municipalities have recently installed experimental advisory bicycle lanes and are evaluating their impact.

Advisory bicycle lanes are a relatively new bicycle facility type in North America. Little design guidance and research on the application of advisory bicycle lanes in a North American context exists at the time of publication of the Design Guide. In addition, many road users in a North American context are unfamiliar with the operation of advisory bicycle lanes. As such, design professionals should consider advisory bicycle lanes in conjunction with a comprehensive data collection and monitoring program to monitor their use and effectiveness, along with a public education program to inform all road users about how to use these facilities.

TYPICAL APPLICATIONS

Advisory bicycle lanes are appropriate on narrow roads where there is insufficient space to add dedicated bicycle lanes without widening the road or removing other road amenities. They should only be considered along roads with less than 5,000 motor vehicles per day, and preferably less than 2,500 motor vehicles per day, where it would be rare for two motor vehicles travelling in opposite directions to meet while one or more people are cycling in the same vicinity. For this reason, rural contexts may be more appropriate than urban contexts. It is recommended that the posted speed limit be lowered to 40 km/h or less when implementing an advisory bicycle lane.

Roads with advisory bicycle lanes should be relatively straight and flat with few visual obstructions, as motorists require a clear view of oncoming motor vehicles. This may limit their application in many coastal or mountainous B.C. communities. Advisory bicycle lanes are not appropriate on roads with directional dividing lines (yellow centre lines). Any existing directional dividing lines should be removed when installing an advisory bicycle lane.

When implementing a treatment that shifts users' expectations, such as advisory bicycle lanes, an educational campaign is imperative and should be implemented in advance of installing the facility.

BENEFITS + LIMITATIONS

Benefits

- Can be relatively low cost. Advisory bicycle lanes can often be accommodated through road re-striping or re-configuration, requiring little to no widening of the road.
- Requires little right-of-way and can be used on narrow roads that cannot accommodate a dedicated bicycle lane, opening the possibility for adding bicycle facilities to more roads.
- People cycling have a dedicated (but not exclusive) area where they have priority.
- Increases predictability of bicycle positioning on the road.
- On-street bicycle facilities can be maintained with other road maintenance activities.
- Can serve as an interim solution until fully dedicated bicycle facilities are built.

Limitations

- Do not provide for the exclusive use of bicycles. Motor vehicles are legally allowed to enter the advisory bicycle lane when passing (see **Figure D-53**), which increases potential for conflicts and collisions.
- Some people cycling may be uncomfortable riding adjacent to motor vehicle traffic. Advisory bicycle lanes are not an all ages and abilities facility.
- Narrow advisory bicycle lanes or advisory bicycle lanes without a buffer adjacent to parked motor vehicles can result in risk of 'dooring.'
- Not a well-known or widely used facility type, which may result in user confusion.
- A public education campaign is required when implementing an advisory bicycle lane. Additional signage and markings may also be required for education and awareness.
- Contrasting pavement materials and colours are costly.
- Requires removal of directional dividing line if one exists.
- Striping may not be intuitive, with a white painted line on both sides of motor vehicles but on a two-way road.
- If separate pedestrian facilities are not provided, advisory bicycle lanes may be utilized by people walking, which may lead to additional confusion and potential conflicts.
- Road should be relatively straight and flat with few visual obstructions, as motorists require a clear view of oncoming motor vehicles.

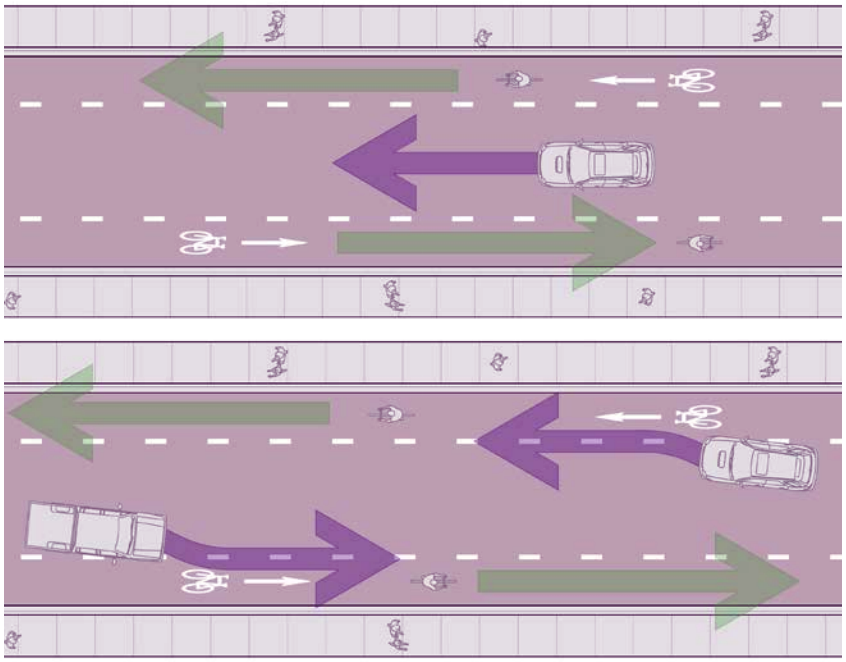


Figure D-53 // Passing on an Advisory Bicycle Lane

Case Study

Shaw Road Advisory Bicycle Lane, Gibsons, B.C.

In 2016, the Town of Gibsons received a provincial grant to create a cycling link between Upper and Lower Gibsons, which was divided between a new low-gradient trail through a wooded natural space ('Helen's Way') and a new advisory bicycle lane on Shaw Road between Inglis Road and Gibsons Way (approximately 700 metres). This was the first advisory bicycle lane in B.C. and the first known installation in Western Canada.


Gibsons, B.C.

The initial planning of the corridor included conventional bicycle lanes. However, the public concern over a loss of on-street parking required that the town develop an alternative solution. The advisory bicycle lane was a design solution that fit within the existing roadway and retained the majority of the on-street parking. The final design includes an advisory bicycle lane in the northbound direction and a shared lane (bicycles and motor vehicles) buffered from on-street parking in the southbound direction. The northbound advisory bicycle lane is on an incline and provides space for bicycle users to climb that is separated from vehicles.

Gibsons, B.C.

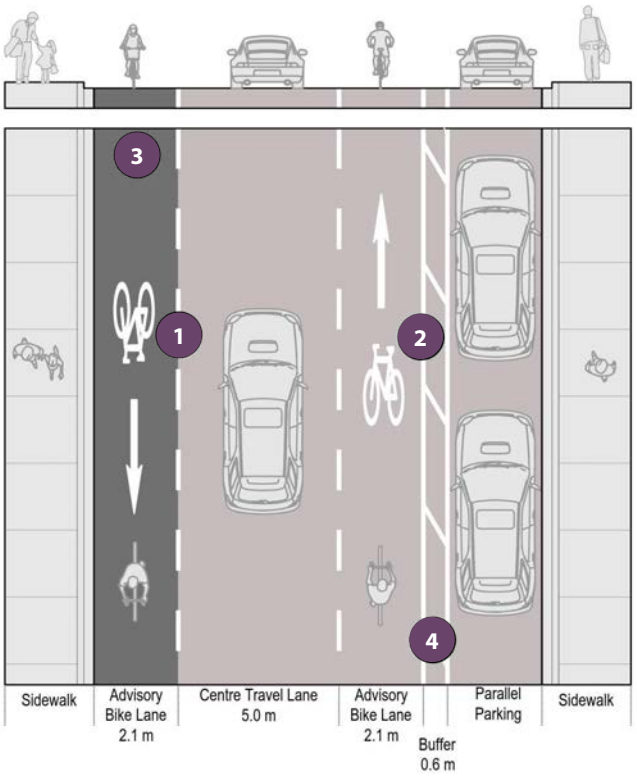
The Shaw Road cycling facilities have been received by the public with mixed results. The Sunshine Coast does not generally have non-conventional transportation facilities and the introduction of uncommon cycling facilities has resulted in both motorist and cyclist comprehension issues, as follows:

- The buffer area used for scooter travel;
- Southbound motorists using unoccupied on-street parking areas to pass people cycling; and
- Uncertainty over the meaning of lane markings.

Overall, the town has viewed the installation as a success and a good use of available right-of-way in response to the need to preserve parking. It will pursue opportunities to install advisory bicycle lanes on other corridors in Gibsons, which staff anticipate will make them more broadly understood and therefore more effective in future.

DESIGN GUIDANCE

Advisory bicycle lanes are located on either side of a single bi-directional motor vehicle lane and distinguished from the adjacent motor vehicle lanes with a dashed white longitudinal line. See **Figure D-54** and **Figure D-55**).



1. *100-200mm dashed white Line*
2. *100mm solid white line adjacent to on-street parking*
3. *Recommended Contrasting Pavement Treatments*
4. *Buffer between parked motor vehicles and advisory bicycle lane, with optional diagonal hatch pavement markings*

Figure D-54 // Advisory Bicycle Lane Cross-section - Desired Widths and Key Features

If the available width of the centre travel lane is in excess of 5.5 metres, dedicated or protected bicycle lanes may be a more suitable facility type.

Width

The desirable width of an advisory bicycle lane is 2.1 metres. This provides sufficient width for single file bicycle traffic, allows for basic bicycle passing movements, and provides spacing between bicycle users and the central motor vehicle travel lane. In constrained conditions, the advisory bicycle lane width can be 1.8 metres with an absolute minimum width of 1.5 metres.

The desired width of the centre travel lane for roads with a maximum posted speed limit of 40 km/h is 5.0 metres to allow for two-way motor vehicle travel with minimal intrusion into the advisory bicycle lanes (see **Table D-18**). The centre travel lane may be no narrower than 3.0 metres in constrained locations and no wider than 5.5 metres to ensure it can be differentiated from a full width two-way road.

Where both the desired advisory bicycle lane and centre travel lane widths cannot be achieved, the desired advisory bicycle lane width should be prioritized to ensure comfortable cycling conditions.

Table D-18 // Advisory Bicycle Lane Width, Desirable and Constrained Limit

FACILITY	DESIRABLE (M)	CONSTRAINED LIMIT (M)
Road with advisory bicycle lanes on both sides	9.2	6.6
Advisory bicycle lane component	2.1	1.8
Bi-directional centre travel lane component	5.0	3.0

On-Street Parking

A separate parking area should be provided where on-street parking is adjacent to an advisory bicycle lane. The advisory bicycle lane and parking area should be separated by a solid white line and/or contrasting pavement material. A buffer zone is strongly recommended to provide separation between the advisory bicycle lane and the parking area to allow for doors opening and loading/unloading from parked motor vehicles without presenting a hazard to through bicycle users. The desired width for the buffer zone is 0.9 metres, and may be reduced to 0.6 metres in constrained locations.

Parallel parking configurations are appropriate adjacent to advisory bicycle lanes, while angled or perpendicular configurations should be avoided. Additionally, on-street parking that experiences low utilization should be avoided adjacent to an advisory bicycle lane. Where low utilization of on-street parking is anticipated adjacent to an advisory bicycle lane, dedicated or protected bicycle lanes may be more suitable facility types.

Because advisory bicycle lanes are a new facility in B.C., contrasting pavement materials are strongly recommended with all advisory bicycle lanes.

End Treatments

Advisory bicycle lanes should be discontinued 50 metres in advance of any intersections controlled by a stop sign or traffic signal. When discontinued, one of the following should take the place of the advisory bicycle lane:

- Widen the road and provide conventional bicycle lanes;
- Provide a bicycle accessible shoulder; or
- Integrate motor vehicle and bicycle travel in a shared lane.

Advisory bicycle lane striping (and construction material or colour, if applicable) should be maintained at crossings of driveways and minor intersections.

Contrasting Pavement Materials

Contrasting pavement materials and/or coloured pavement markings may be used to differentiate the advisory bicycle lane from the centre travel lane, and from the parking lane if applicable (see **Figure D-52**). Contrasting pavement materials can help to discourage unnecessary encroachment into the advisory bicycle lane. If not already being used along the entire advisory bicycle lane, green conflict zone pavement markings can be used as a backing to the bicycle symbol to increase its conspicuity in this application.

No Sidewalk

No Parking

Painted Buffer with Parking

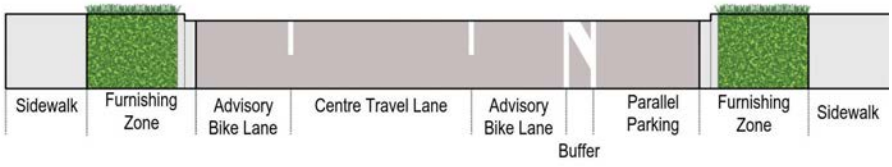


Figure D-55 // Advisory Bicycle Lane Cross-section, Possible Configurations

SIGNAGE

Providing signage along advisory bicycle lanes is important, as it is a relatively new and uncommon bicycle facility type in North America. At the time of writing, neither the TAC *MUTCDC* nor the B.C. Provincial Sign Program have a specific sign for advisory bicycle lanes. A standard sign that may be used is the Bicycle Route Marker sign (MUTCDC IB-23). Two-Way Traffic Ahead signs (MUTCDC WB-3; B.C. W-020 Series) are also recommended to indicate two-way road use for motor vehicles.

Some jurisdictions, including Gibsons, B.C., have also created custom signs and display boards that explain the movement of bicycles and motor vehicles and warn motorist to yield to bicycles. A custom dedicated sign can be created following the MUTCDC and examples from other jurisdictions. Where advisory bicycle lanes will be used by both people walking and cycling, a custom sign that includes both people walking and cycling should be created. See **Appendix B** for more details on signage.

PAVEMENT MARKINGS

Advisory bicycle lanes require two basic pavement markings, as follows:

1. White dashed longitudinal lines should delineate the advisory bicycle lane from the adjacent roadway.

2. The bicycle symbol in combination with an arrow oriented in the cycling travel direction should be used to mark an advisory bicycle lane.

The reserved lane diamond symbol should not be used, as the advisory bicycle lane is not reserved exclusively for use by bicycles and can also be used by motor vehicles. In contexts where advisory bicycle lanes are also intended to be used by people walking, the bicycle symbol should not be used; instead, a shared-use symbol with the bicycle and pedestrian symbol in a circular plate (wayfinding pavement marking) may be used.

No directional dividing line (e.g. yellow centre line) should be on roads with advisory bicycle lanes. If a directional dividing line exists when an advisory bicycle lane is installed, it should be removed. Short sections of the directional dividing line may be reintroduced to denote the separation of traffic at potential conflict points such as approaches to at-grade crossings and at bridges.

Refer to **Appendix B** for more information on pavement marking details including dimension, spacing and placement.

Advisory bicycle lane, Province of Groningen, Netherlands
Source: Modacity

Village of Queen Charlotte, B.C.

D.6

RURAL CYCLING DESIGN CONSIDERATIONS

Shoulders are often provided along rural roadways for a variety of reasons and can be shared by a variety of users, including pedestrians and motor vehicles when required for safety, operations, and maintenance. However, not all shoulders are considered to be 'bicycle accessible.'

On many roadways throughout B.C., particularly in rural contexts, paved shoulders can be used as on-street bicycle facilities. Shoulders are paved spaces on the edge of rural roads and highways outside of the vehicle travel lanes, but within the road right-of-way, that can be used by people cycling and, in some cases, also by people walking and using other active modes. The focus of this chapter is bicycle accessible shoulders on roadways under local and regional government jurisdiction in rural contexts. Refer to **Chapter C.4** for design guidance on pedestrian facilities in rural contexts. Refer to **Chapter F.1** for rural design consideration on roadways under provincial jurisdiction.

The Difference Between a Shoulder and a Bicycle Accessible Shoulder

Shoulders can provide a separate space for people riding their bicycle, similar to painted bicycle lanes. They are delineated by a solid white longitudinal line and can be supplemented by signage and pavement markings alerting motorists to expect bicycle travel along the roadway. Unlike painted bicycle lanes, however, shoulders do not provide an exclusive space for people cycling, as the shoulder space can be shared by a variety of users, including pedestrians and motor vehicles when required for safety, operations, and maintenance.

While not considered an all ages and abilities bicycle facility, shoulders can attract a range of bicycle users and help to provide a space for some people to feel comfortable riding in rural areas. Shoulders can be used to provide connections between communities and help to provide more transportation choices. There are, however, conditions where cycling in shoulders is not appropriate, which are outlined in more detail in this chapter.

As highlighted in the TAC *Geometric Design Guide for Canadian Roads,* shoulders may be considered to be bicycle accessible if:

- Pavement markings are present that separate the shoulder from adjacent motor vehicle traffic;
- There is sufficient operating space; and
- There is a smooth, paved surface that is clear of snow and debris. Bicycle travel on bicycle accessible shoulders is always one-way in the same direction as motor vehicle traffic. In some cases, particularly in rural areas, bicycle accessible shoulders may also be shared with pedestrians. This chapter does not provide detailed design guidance on the design of shoulders in general, but focuses specifically on design considerations to make shoulders bicycle accessible.

TYPICAL APPLICATIONS

Bicycle accessible shoulders are typically found along rural roads that provide connections between communities or destinations. This chapter focuses on bicycle accessible shoulders on roadways under local or regional government jurisdiction. Refer to **Chapter F.1** for design guidance on bicycle accessible shoulders on roadways under provincial jurisdiction. Arterial and collector roadways are often the most direct route through a community; however, the higher motor vehicle volumes and speeds can make them less comfortable for people cycling.

Bicycle accessible shoulders on are a lower cost option when compared to off-street pathways; however, they do not provide an all ages and abilities facility particularly on roadways that are typically characterized as having higher motor vehicle speeds and volumes. If widening a roadway to enhance the shoulder space is required, it can be cost prohibitive depending on road condition and constraints. Ultimately, in many cases, a bicycle facility that is separated from the roadway, such as an off-street pathway, that provides a direct route to destinations is a preferred bicycle facility type. Where this treatment is not feasible and/or funding is not available, a bicycle accessible shoulder can be considered an interim measure.

Bicycle accessible shoulders are generally suitable on roads with posted speeds of 50 km/h or less and with 5,000 or fewer motor vehicles per day. In the following situations, a physically separated bicycle facility such as an off-street pathway or a alternative quieter route may be more appropriate.

- On roads where the posted speeds are greater than 80 km/h and motor vehicle volumes are higher than 10,000 vehicles per day; or
- If the road contains a large proportion of heavy motor vehicles.

DESIGN GUIDANCE

Width

This section reflects the desirable width of a bicycle accessible shoulders on roadways under local or regional government jurisdiction. The appropriate width of bicycle accessible shoulders on is dependent on the speed of motor vehicles.

Table D-19 outlines the desirable and constrained limit widths for bicycle accessible shoulders based on posted motor vehicle speeds and volumes on municipal roadways under local and regional government jurisdiction. As shown in **Figure D-56**, shoulder widths of 1.8 metres are the desired width for lower speed roadways (50 km/h or less). This width provides sufficient space for single file bicycle traffic and allows for basic bicycle passing movements. Bicycle accessible shoulders are not a desired facility if posted speeds are greater than 50 km/h, unless additional buffer width or separation is provided. However, if bicycle accessible shoulders are provided on roadways with speeds above 50 km/h, the desired width is 2.5 or greater, as shown in **Figure D-57**. This width can accommodate people cycling side-by-side.

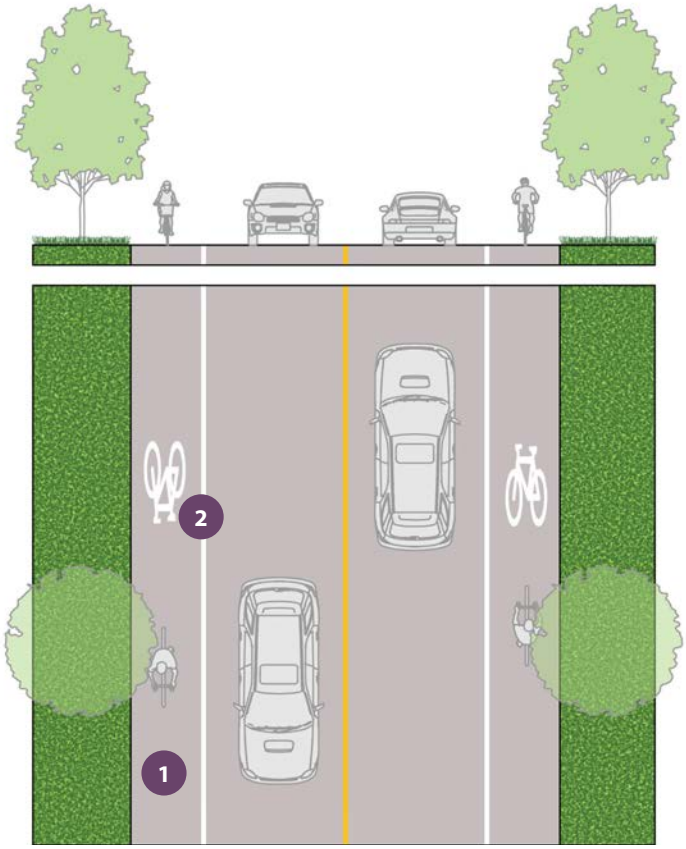
A width between 1.2 metres and 1.5 metres should only be considered for short distances (less than 100 metres) in constrained areas. Shoulder widths of 1.2 metres or less should not be signed or marked as a bicycle accessible facility. The absolute minimum shoulder width is 1.2 metres based on the horizontal operating envelope of a person cycling.

Table D-19 // Bicycle Accessible Shoulder Width Guidance

FACILITY BY DESIGN SPEED	DESIRABLE (M)	CONSTRAINED LIMIT (M)
Rural ≤50 km/h	1.8	1.5
Rural < 70 km/h	2.5	1.5
Rural > 70 km/h	3.0	2.0
Buffer (between shoulder and motor vehicle lane for higher posted speed and/or higher motor vehicle volumes)	1.2	0.9

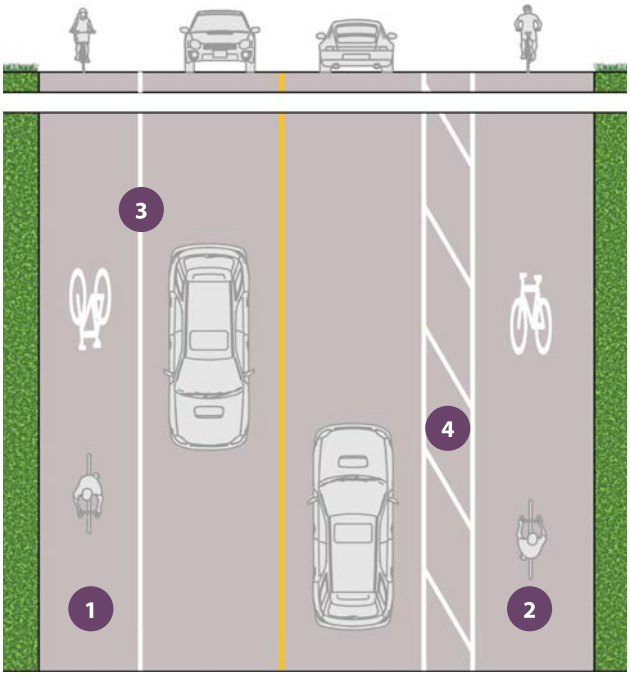
A painted buffer can provide additional separation between people cycling and motor vehicles. If the width of the buffer is between 0.9 to 1.2 metres, additional hatch markings or thicker longitudinal striping may be considered to more clearly denote the space for users such that they can position themselves appropriately.

When shoulders are located adjacent to a continuous vertical barrier, an additional 0.5 metres should be provided in the shoulder width to account for horizontal clearance. Bicycle accessible shoulders should be free of obstructions such as drainage aprons. Parking along rural roads and highways is typically not permitted; however, where parking currently exists, accommodation should be made to address the loss of this parking. Accommodation could include adding periodic laybys, alternative parking spaces nearby, and/or adding signage to prohibit parking to reduce conflicts between people cycling and parked motor vehicles.



1. *Desired width of 1.8 metres if speeds are 50 km/h or less*
2. *White longitudinal lines should be painted as a single 100mm-200mm solid white line*

Figure D-56 // Bicycle Accessible Shoulder – Low Motor Vehicle Speed



1. *Desired width of 2.5 metres if speeds are 70 km/h or less*
2. *Desired width of 3.0 metres or more if speeds are over 70 km/hr. Additional buffer space is recommended.*
3. *If buffers are not provided or are less than 0.9 metres, white longitudinal lines should be painted as a single 100mm-200mm solid white line*
4. *Buffers > 0.9m can be enhanced with two lines and hatched striping*

Figure D-57 // Bicycle Accessible Shoulder – High Motor Vehicle Speed

SIGNAGE

Regulatory signage is not required on bicycle accessible shoulders. Unlike bicycle lanes, Reserved Bicycle Lane signs (MUTCDC RB-90/RB-91) should not be used. However, there are opportunities to install guide and information signage that can be used as wayfinding and help to raise awareness of the presence of people cycling on the roadway. The Bike Route sign (IB-23, B-G-001) may be used to identify a facility as a designated bicycle route. It does not indicate the type of facility and can be used on a number of facility types including bicycle accessible shoulders.

PAVEMENT MARKINGS

Bicycle accessible shoulders are delineated by a solid white longitudinal line along the side of the travelled lane.

A solid white line of 100 to 200 millimetres is recommended to delineate the lane edge line and separate motor vehicle travel lanes from the shoulder.

Pavement markings within bicycle accessible shoulders are typically installed in conjunction with an appropriate bicycle sign. When placed in conjunction with a bicycle route guide sign, the stencil should be located within 10 metres of the sign location, preferably in advance of the sign. Bicycle stencils should be installed after every signalized intersection. Supplementary symbols may also be placed between intersections. On rural shoulders, it is recommended they are spaced every 1.5 to 2 kilometres.

The typical pavement marking used to identify bicycle routes should be the standard TAC bicycle pavement marking. This elongated bicycle symbol is 1.0 metres wide by 2.0 metres tall.

Coloured bicycle pavement markings are not intended to be used on bicycle accessible shoulders, except at intersections or crossing points (see **Chapter G.1**).