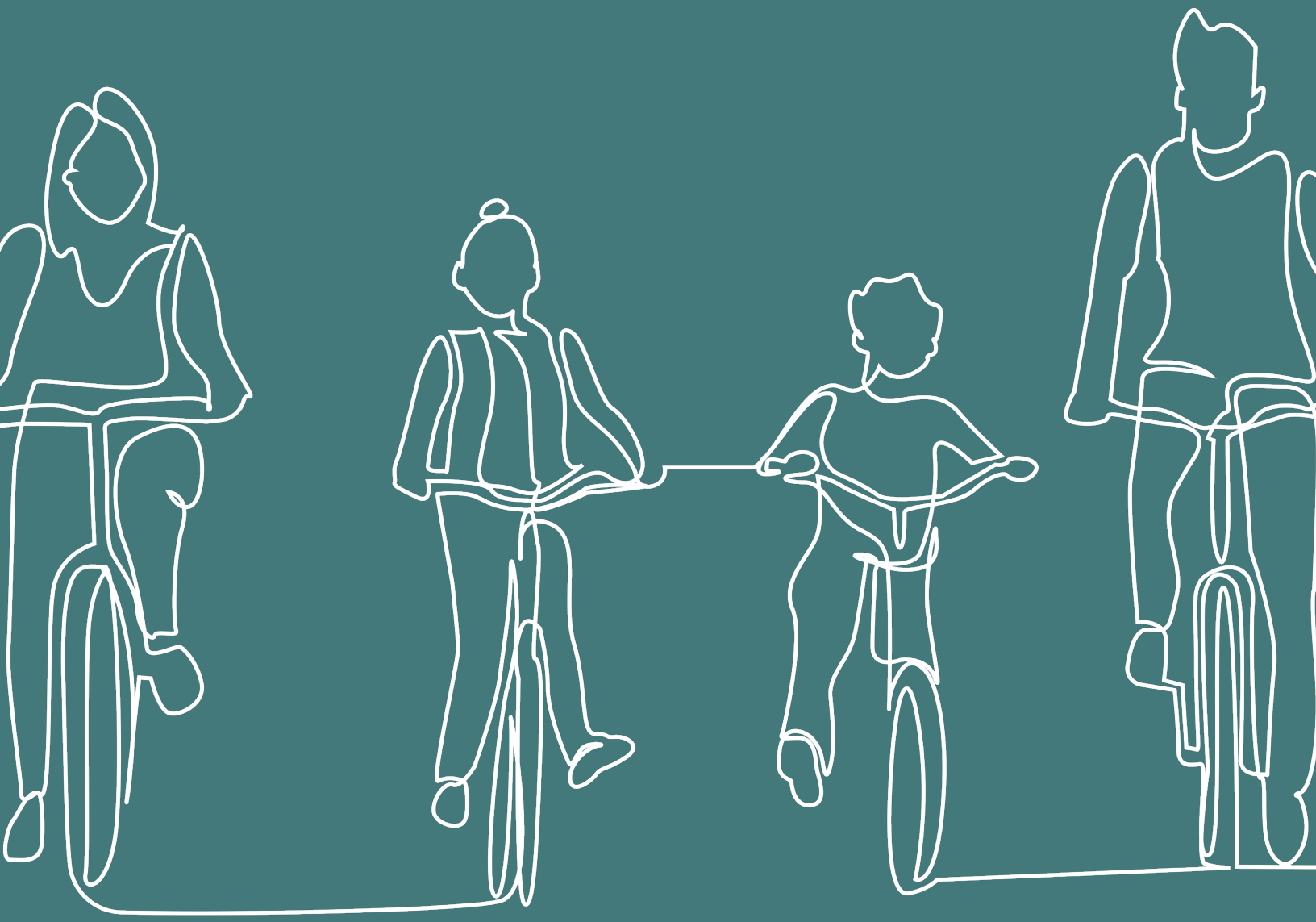
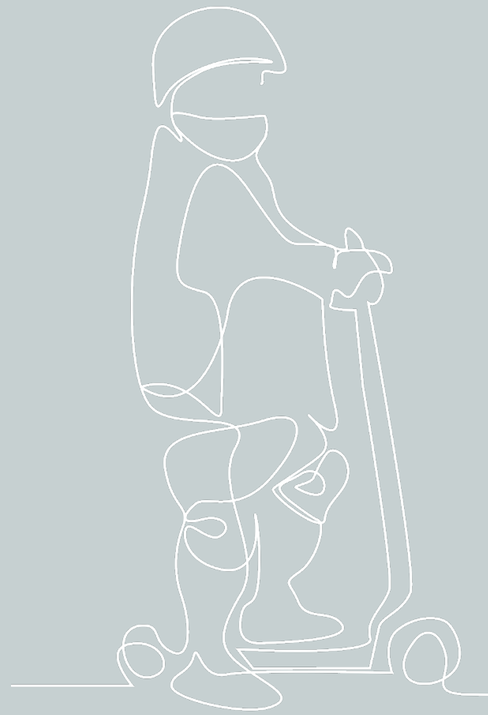


cochrane
HOW THE WEST IS NOW

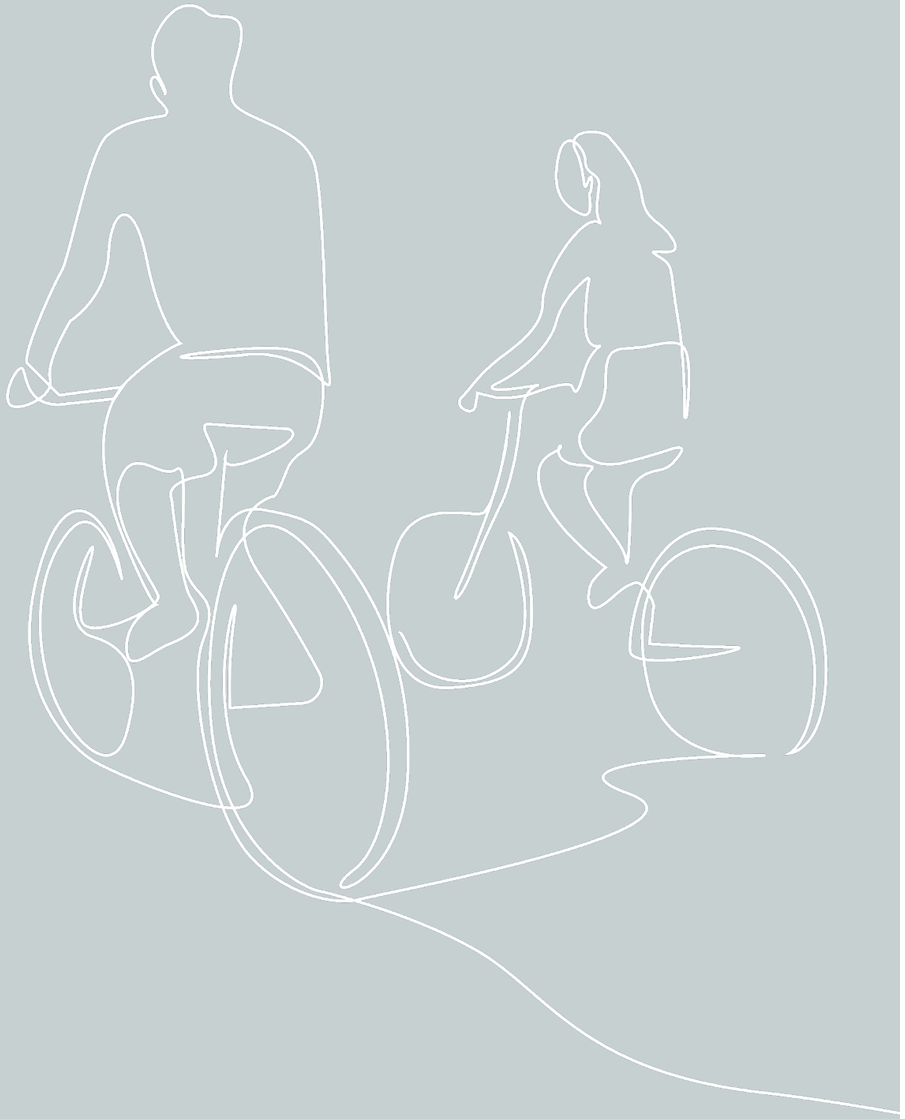
Town of Cochrane

Active Transportation Guidelines

Contents



1. Introduction



1.1. About this document

The purpose of this Active Transportation Design Guide is to provide comprehensive guidance for the Town of Cochrane (the Town) and development within the community regarding the design and implementation of active transportation facilities to promote uniformity within the Town.

The guideline was developed using the following resources:

- Alberta Bicycle Facilities Design Guide Final Draft 2020
- BC Active Transportation Design Guide 2019
- Transportation Association of Canada's (TAC) Geometric Design Guide for Canadian Roads 2017
- Ontario Traffic Manual Book 18 – Cycling Facilities 2021

1.1.1. Guideline goals

- Promote consistency in the design of active transportation facilities throughout the Town.
- Provide clear guidance for developments on how to design for active transportation facilities within the Town.
- Provide direction for the Town on the appropriate type of active transportation facilities for the street condition, and considerations for implementation in new and retrofit situations.

1.1.2. How to use the design guide

The Design Guide is intended to provide design guidance for the planning, construction, maintenance, and operations of all new or improved bicycle facilities in Cochrane. The guide is split into the following sections:

- **Section 2 – General Design Guidance**
- **Section 3 – Facilities Types and Selection**
- **Section 4 – Facilities in Road Right-Of-Way**
- **Section 5 – Facilities in Green Space**
- **Section 6 – Specialized Areas**
- **Section 7 – Maintenance**

Sections 2, **Section 3**, and **Section 7** provide design guidance for all facilities. **Section 4** should be used for facilities in road right-of-way and **Section 5** should be used for facilities in green (and/or park) spaces. **Section 6** provides supplemental guidance for specialized areas and may not apply to every facility type.

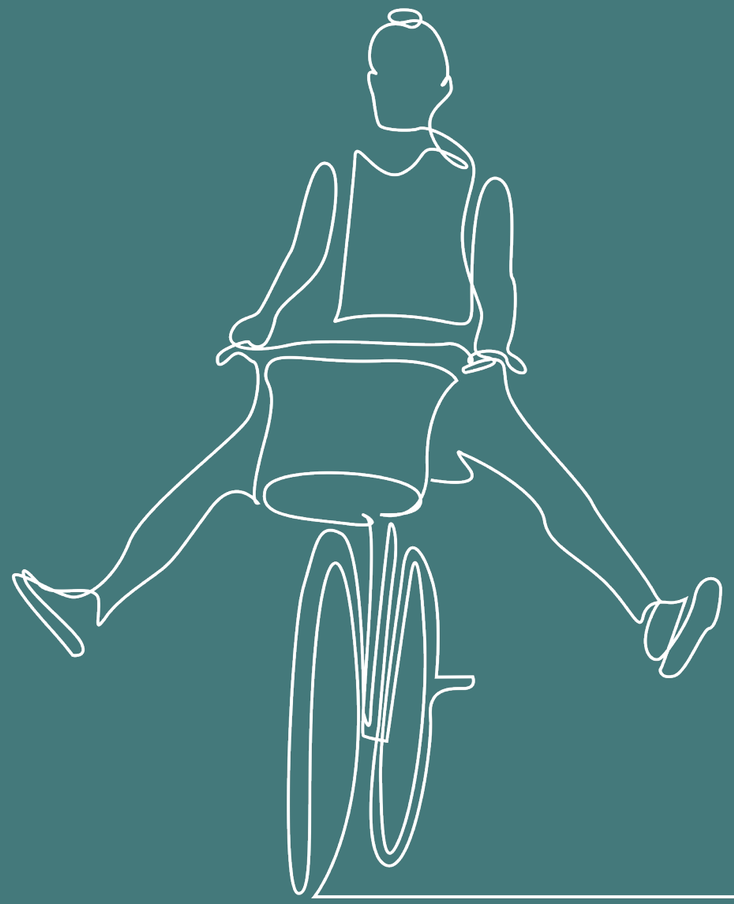
Designers should use the guide along side other current active transportation guidelines like the TAC Geometric Design Guide for Canadian Roads and TAC Manual of Uniform Traffic Control Devices for Canada. This guideline supersedes any information presented in the City of Calgary 2014 Complete Streets Guidelines.

Further when applying this guide, designers should consider the following policies and bylaws:

- Connecting Cochrane Transportation Master Plan (2017)
- Cochrane Active Transportation Master Plan (2024)
- Cochrane Snow & Ice Removal Policy
- Alberta Traffic Safety Act and Rules of the Road Regulation

Those using this guide should strive to achieve the recommended design guidance contained within. However, it is recognized that specific site conditions may not allow for this in all situations. In these cases, good engineering judgment should be followed, with the final recommended design considering for the main design principles of safety, comfort and convenience for active transportation users while balancing the needs of other modes.

2. General Design Guidance



2.1. Bicycle operational and behavioural characteristics

DESIGN DOMAIN

The TAC Geometric Design Guide for Canadian Roads introduced the concept of Design Domain. Design Domain defines a range of specific design parameters that correspond to the utility of a design element. TAC provides four levels within the Design Domain. For the purposes of this Guideline, the focus will be on two Design Domain levels, **Constrained** and **Desirable**. Unless otherwise specified, design parameters should aim to achieve a **Desirable** design domain but can be allowed to fall in the range between **Constrained** and **Desirable** if a **Desirable** design domain cannot be achieved. The **Constrained** and **Desirable** design domains fall within the design limits established in TAC.

For cases where one or more design elements fall outside the recommended Design Domain values, a design exception providing good engineering rationale to support design decisions and justification for deviation from the guidance will need to be submitted to the Town for review prior to approval of the design.

CALCULATING MEASUREMENTS

When measuring facility widths, the following rules should apply:

- If measuring to the edge of the road and there is curb and/or gutter, measure to the lip of gutter and exclude the gutter pan.
- If measuring to the edge of the road and there is NO curb/and or gutter, measure to the edge of pavement.
- If measuring to longitudinal pavement markings, measure to the centre of the painted line.
- If measuring symbol pavement markings, measure to centre of symbols.

Bicycle as a Design Vehicle

In transportation engineering, the design of a given street or facility is dictated by the dimensions and operating potential of the 'design' vehicle. In the case of active transportation facilities, the bicycle is the design vehicle because it is usually the largest vehicle anticipated to use the facility. However, bicycle sizing and operating characteristics are not uniform and vary between bicycle types.

The design of bicycle facilities should consider the full range of bicycle types shown in **Figure 1 - Common Bicycle Types**. Designing for the full range of bicycle types will ensure that all existing and future users can use the facility.

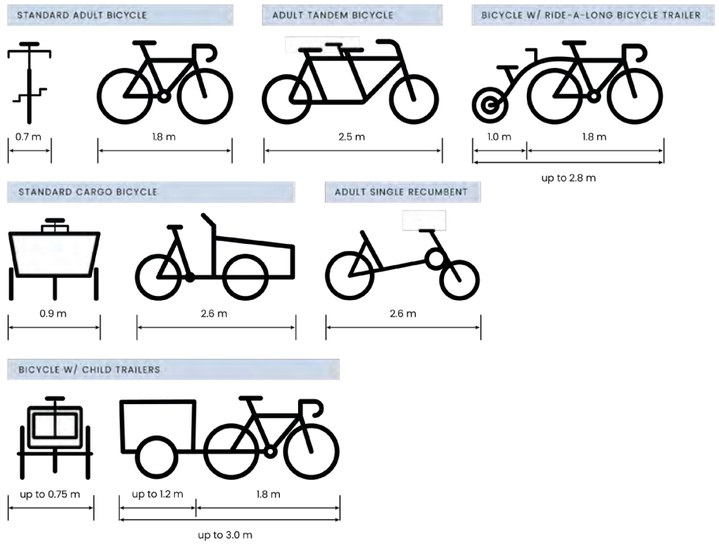


FIGURE 1 - COMMON BICYCLE TYPES

In addition to the variety of bicycle types, the design of bicycle facilities should also consider the variety of users. The "operating space" – the available space in which a user can ride their bicycle – should accommodate the full range of user experience, ability, and preference. Facilities should be wide enough to allow for safe passing and, where possible, side-by-side riding when off-street. This is particularly important for facilities where interactions between different types of users will be more common, such as high-traffic corridors or areas with steeper grades.

The operating spaces required for uni-directional and bi-directional bicycle facilities are shown in **Figure 2 - Operating Space of Bicyclists**.

To allow for comfortable movement through the operating space, bicycle facilities must provide adequate clearance from vertical and horizontal obstructions. **Table 1 - Minimum Clearance from Obstructions** and **Figure 3 - Horizontal and Vertical Clearance** summarizes the minimum clearances required from obstructions.

TABLE 1 - MINIMUM CLEARANCE FROM OBSTRUCTIONS

Parameter	Details	Constrained (m)	Desirable (m)
Vertical Clearance	Bicycle facility surface to overhead structure/foliage	3.0	3.6
Horizontal Clearance	objects < 100mm in height	0.0[1]	n/a
	objects 100 – 750mm in height	0.2[2]	n/a
	objects > 750mm in height	0.5	n/a

Notes:

[1] *Objects less than 100 mm are not considered an obstruction because they are shorter than a bicycle pedal*

[2] *Note that while a standard curb is 140mm in height and would be considered a horizontal obstruction, a standard gutter pan is 250mm wide and would provide sufficient horizontal clearance from the curb.*

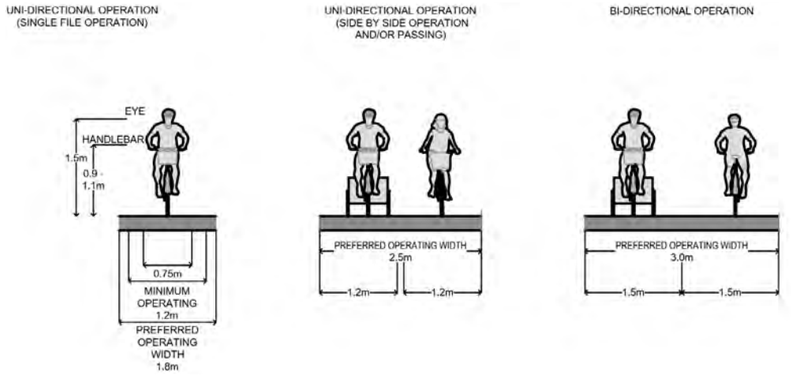


FIGURE 2 - OPERATING SPACE OF BICYCLISTS

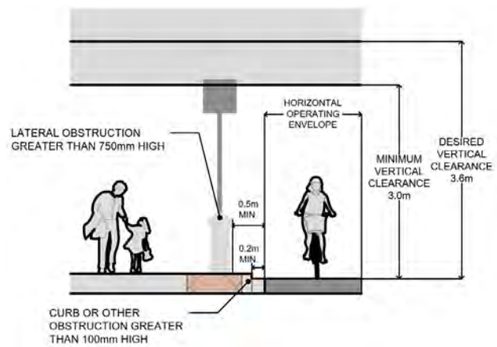


FIGURE 3 - HORIZONTAL AND VERTICAL CLEARANCE

The major operating characteristics of bicycles is the design speed. Design speed is a design control that determines geometric design and signal timings. Design speed should consider the ability of the user, the type of bicycle being used, the condition, surface material and grade of the facility, and number of users on the facility.

Generally, typical bicycle operating speed is between 15 to 30 km/h. The higher number of electric bicycles now in use has increased the operating speed, as such a design speed of 30 km/h should be used for bicycle facility design.

Adjustments to design speed should be made as follows:

- Design speed should be increased by 0.9 km/h for every 1% increase in downhill grade
- Design speed should be decreased by 1.4 km/h for every 1% increase in uphill grade
- A lower design speed (20 km/h) may be considered on unpaved paths to account for reduced braking
- A lower design speed (15 km/h) may be considered on urban bike facilities with frequent conflict points (driveways, intersections, other users, etc.) , however the higher speed should be considered for sight line analysis
- A lower design speed (12 km/h) should be considered for intersection crossings when determining signal timings to provide more time for slower bicyclists to clear the intersection, however the higher speed should be considered for sight line analysis

Refer to Chapter 5 – Bicycle Integrated Design of the TAC Geometric Design Guide for Canadian Roads for detailed information on stopping sight distance required for bicycles.

2.2. Signage

This section provides a list of typical regulatory , warning and information signage required to support the various bicycle facilities detailed in this guideline. Within the following sections on the design of each facility, the appropriate signage for each facility is listed. For sign placement and frequency refer to the Manual of Uniform Traffic Control Devices for Canada (MUTCDC).

Additional signage for context sensitive condition can also be found in the MUTCDC.

For signage related to wayfinding, refer to **Section 2.4**.

Sign	Image	Application
Regulatory Signs		
Keep Right / Keep Left Sign (RB-25R, RB-25L)	 	Used on open ends of protected bicycle lanes to alert users of the hazard of the physical barrier between road and bicycle lane (planters, concrete barriers, etc.). Used along with 'Except Bicycles' Tab Sign. Used in conjunction with or in place of 'Object Marker' Sign.
Except Bicycle Tab Sign (custom, no TAC code)		Used to indicate if a road sign does not apply to bicyclists. If bicyclists are at street grade, they are considered vehicles. Typically used with a Do Not Enter sign or No Left Turn signs when a specific movement through an intersection is exclusive to bicycles.

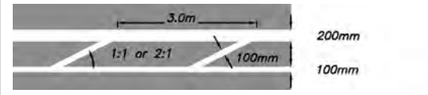
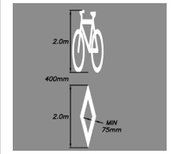
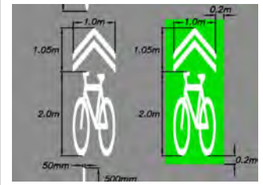
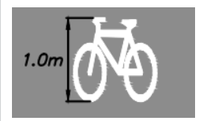
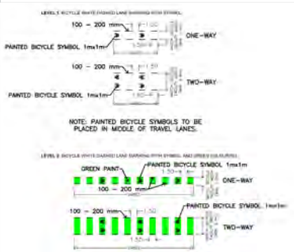
Sign	Image	Application
Turning Vehicles Yield to Bicycles Sign (RB-37)		Used at intersections and conflicts zones where motorists are crossing a bicyclist facility and must yield to bicyclists.
Turning Vehicles Yield to Bicycles and Pedestrians Sign (RB-38)		Used at intersections and conflicts on shared pathways where motorists must yield to bicyclists and pedestrians.
Stopping Prohibited Sign (RB-55)		Used with curbside painted bicycle lanes where vehicles may stop in the bicycle lane.
Dismount and Walk Sign and Tab Sign (RB-79, RB-79T)		Used to indicate that bicyclists must dismount their bicycles through a specific area. Recognizing people may use bikes as a mobility aid and may be unable to dismount without difficulty, use of this sign should be avoided. Instead, bike facilities and shared facilities should be designed to eliminate situations where dismounting is required.
Reserved Bicycle Lane Signs (RB-91, RB-92)	 	Used to formally designate an on-street bicycle lane (painted or protected) for the exclusive use of bicyclists.

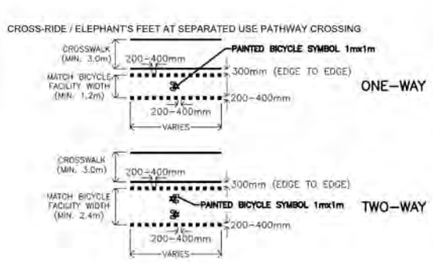
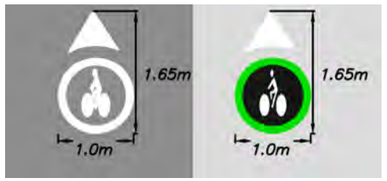
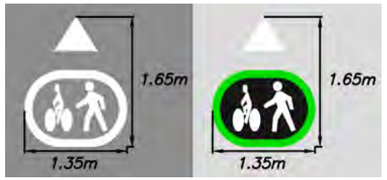
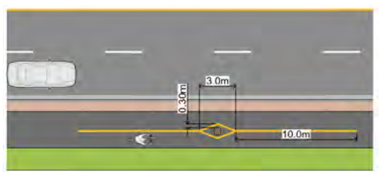
Sign	Image	Application
Shared Pathway Sign (RB-93)		Used along shared pathways to remind users that bicyclists and pedestrians are expected to share the facility.
Pathway Organization Sign (RB-94R, RB-94L)	 	Used on facilities wide enough to accommodate separate pedestrian and bicycle operation to indicate which side of the facility users should travel on.
Warning Signs		
Share the Road Sign and Share the Road Tab Sign (WC-19, WC-19S)		Used to remind drivers that they should provide adequate space for bicyclists on an upcoming section of road. Can be used in addition to the Bicycle Route Marker. Placed where conditions allow for side-by-side operation of vehicles and bicycles, and where vehicles can safely pass bicycles. Placed along a shared lane where a bicycle lane ends to indicate that bicyclists are transitioning from a separated facility to a shared lane.

Sign	Image	Application
Shared Use Single File Sign (WC-20), Single File Tab Sign (WC-20S/WC-20SF)		Used to mark obstructions adjacent to or within the road or bikeway. Used on open ends of protected bicycle lanes to alert users of the hazard of the physical barrier between road and bicycle lane (planters, concrete barriers, etc.). Used in conjunction with or in place of Keep Right / Keep Left signs paired with a Except Bicycle tab.
Object Marker Sign (WA-36, WA-36L/WA-36R)		Use to indicate that cyclists are on a designated bicycle route. Place before and after decisions points (intersections, turns, etc.) on a bike route. Alternative designs and colours may be used to brand a route. Refer also to **Section 2.4** for guidance on Town specific wayfinding signs and markers.
Bicycle Route Marker (IB-23)		Use to indicate that cyclists are on a designated bicycle route. Place before and after decisions points (intersections, turns, etc.) on a bike route. Alternative designs and colours may be used to brand a route. Refer also to **Section 2.4** for guidance on Town specific wayfinding signs and markers.

2.3. Pavement Markings

This section provides a list of typical pavement marking required to support the various bicycle facilities detailed in this guideline. The appropriate pavement marking for each facility is listed within the following sections on the design of each facility. For additional pavement marking guidance, refer to the MUTCDC. For pavement markings related to wayfinding, refer to **Section 2.4**.

Marking	Image	Application
Solid lane line		Delineates edge of travel lane dedicated for bicycle use. Recommend use of 200mm where there is no physical protection.
Dashed lane line		Permits motor vehicle to cross bicycle lane to perform a turning movement.
Buffer		Creates separation between bicycles and vehicles moving I the same direction.
Bicycle Symbol Reserved Use Lane		Indicate exclusive use of lane for bicyclists.
Bicycle Symbol Shared Use Lane		Indicates lane is shared between bicycles and motor vehicles. Green background provides additional awareness to drivers to share the lane.
Non-elongated Bicycle Symbol		Used with cross-ride and conflict zone marking to mark bicycle crossings at intersections and driveways to provide additional awareness to drivers of potential conflict.
Conflict zone markings		Used at conflict zones like intersections and driveway crossings for bicycle only facilities. More guidance on conflict zone markings is included in **Section 2.5.5**.

Marking	Image	Application
Cross-ride markings		Used where a shared or separated pathways crosses the street. Cross-rides and green paint provides additional awareness to drivers of potential conflict with bicyclists. More guidance on cross-ride markings is included in **Section 2.5.6**.
Bicycle wayfinding Symbol		Used to direct bicyclists along a route. Can also be used to denote that a pathway is intended for the exclusive use of bicyclists and not pedestrians. A green outline can be used when applying to bicycle spaces on concrete surfaces for increase visibility.
Shared Pathway Symbol		Used to denote shared facilities and indicate that both bicyclists and pedestrians are allowed in the space. Can be used with out without the directional arrow. A green outline can be used when applying to bicycle spaces on concrete surfaces for increase visibility.
Hazard Pavement Marking for Obstructions within Pathway		Used to indicate obstruction in the pathway

2.4. Wayfinding

Wayfinding consists of multiple visual and physical measures to convey messaging to the user. In consideration of this, the below section outlines parameters for typical wayfinding interventions including signage, pavement markings and contextual details intended to guide decisions and design surrounding this subject in an active transportation context. For signage , for the purposes of this Guideline, is additional to regulatory signage and is the source of relevant information offered to users related to confirming direction, decisions and navigation throughout the network where helpful to support its functionality.

2.4.1. Principles and Objectives

Clarity and Functionality: Ensure signs are easy to read and understand at a glance while creating an intuitive understanding of how users are able to effectively use the network to get to their desired destination. Provide clear and accurate directions to help users navigate the active transportation network.

Consistency and Progression: Use a uniform style, format and placement methodology to create a cohesive system and provide only relevant information to limit confusion.

Safety and Accessibility: Design signage to be visible, accessible, and non-intrusive for all users, including those with disabilities. Enhance navigability of Active Transportation facilities by minimizing confusion to mitigate accidents and improve traffic flow.

Visibility: Ensure signs are prominently placed and easily visible in various conditions, while meeting sight visibility requirements.

Local Context and Brand: Reflect local culture and characteristics to foster a sense of place and community brand through aesthetic design and materials. Incorporate local symbols and themes to foster community pride and make navigation more engaging and recognizable. Wayfinding component design should consider the current Cochrane Branding Guidelines and "Western Heritage" character in design decisions.

2.4.2. Signage Hierarchy

VEHICULAR SCALE TYPE:

- **Major Route Markers**: Signage for major routes that intersect or run parallel to the active transportation network. These signs should direct drivers to key access points or parking areas that connect them to the Active Transportation network.

Examples: "Bike Parking Area," "Trail Access," "Bicycle corridor signs," "Pedestrian Crossing Ahead"

MULTI-MODE SCALE TYPE:

- **Informational Signs:** Informational-based wayfinding elements offer details about the local area, including amenities and services available along the routes. The installation may have concise information as well as elaborate on a particular subject such as in the case of interpretive or etiquette signage and messaging.

Examples: "Public Restrooms," "Bike Repair Stations," "Local Attractions"

- **Directional Signs:** Directional signs and interventions provide directions and information along active transportation routes, including intersections and key points of interest. These may also be referred to as Decision Signs as directions indicated may present options and opportunities for decision.

Examples: "Trail Junction," "Cycling Route to Downtown," "Railway Crossing"

- **Navigation Signs:** Navigation signs and wayfinding cues help users navigate within the network by indicating distances and directions to significant destinations.

Examples: "5 km to Park," "Visitor Center – 2 km", "Historic Downtown – 5mins"

- **Confirmation Signs:** These signs or indications re-affirm the user that they are in fact on the path anticipated. The key to confirmation signage is that they do not include a directional element such as arrows and are relatively simple.
- **Pavement Markings.** Integration of pavement markings is a useful tool in reinforcing direction and confirmation for on-street applications. These marking can be effective in lending to intuitive navigation where multiple routes coalesce or where there is an opportunity to reinforce placemaking. It is important to specify materials and procedures to enhance durability and consider maintenance operations and seasonal conditions.

Note that in conditions where snow and ice are present for a significant duration, these may be less effective and as such may require pairing with vertical signage elements. Messaging on pavement markings should be concise and lean heavily on symbols. See **Section 2.3** for more information on pavement markings.

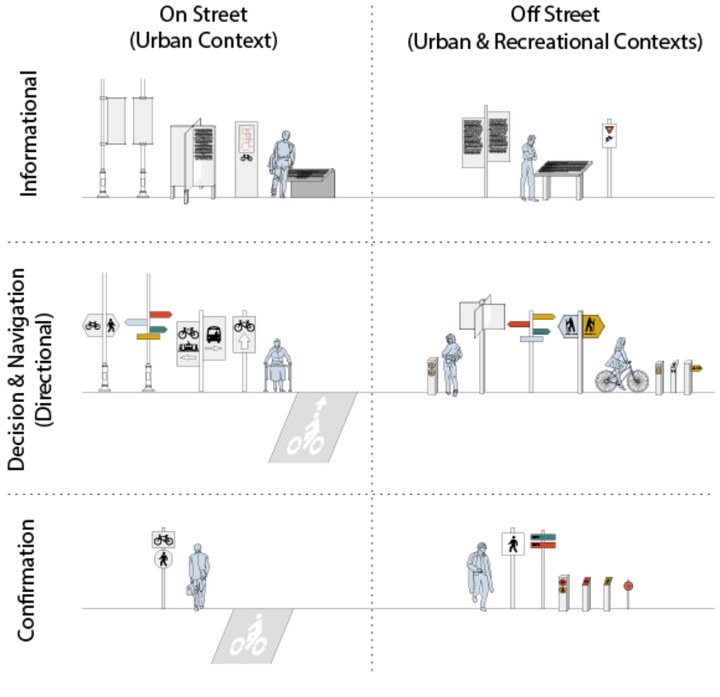


FIGURE 4 - WAYFINDING SIGN TYPE EXAMPLES

2.4.3. Placement Methodology

LOCATION STRATEGY:

When considering and articulating how and where wayfinding elements should be placed, the following guidance is provided:

- **Destinations:** In shaping the framework of the wayfinding system, it is critical to identify where users ultimately want to go by identifying destinations. A destination hierarchy establish a priority of sign types and information communicated to users. These destinations are to be prioritized based on a spectrum of regional to local significance. Signs should be positioned at key landmarks, trailheads, and points of interest to capture the largest visibility, establish identity, provide clear information and direction.
- **Major Intersections/Points of Decision:** Place signs at major junctions / decision points to guide users in choosing the correct path. Wayfinding elements should be placed with priority for locations with higher levels of activity where necessary.
- **Informational Nodes:** Include signage at locations where users may need additional information and lend to "pause" in travel, such as rest areas or bike repair stations. It is important to factor in the diversity of audience, pace and supportive features to increase the benefit of the

- **Context and Frequency:** Based on the facility type, the information being conveyed will vary based on facility type due to anticipated audiences, urban or recreational interfaces, route complexity, travel speed and volume of destination and decision points.
  For illustration, On-street and Off-street signage will adapt to address the situational context, not only in content, but also frequency. It is typical that On-street facilities, based on proximity to road network and the number of decisions required, may require a higher frequency of wayfinding elements. Off-road facilities may require less frequent spacing to present choices at intersections or opportunities for decisions. Key considerations for frequency are below:
    - » For On-street facilities, consider signage for each block to communicate directional changes or affirmation. Where it is possible to leverage existing infrastructure for mounting purposes, it is advised to do so. However, visual clutter must be a consideration.
    - » For Off-street facilities, such as regional pathways, consider a wayfinding element being placed no further than 500m apart with priority going to decision points and informational nodes that may be more frequent.
    - » General bicycle symbol pavement marking placement is recommended every 50 to 100 metres, but tighter spacing may be considered near sharp corners. Bicycle symbol pavement markings should also be used at pathway entrances and on the far side of crossings.
- **Situational Considerations:**
    - » Placement is preferred in areas with an opportunity to leverage existing lighting to allow for readability at dawn, dusk or after dark and in low-light seasonal conditions.
    - » It is recommended that directional signage, where a decision is required, should be placed 50 metres in advance of intersections.
    - » For route confirmation, signs should be placed 10 to 20 metres after the decision point. These are not always necessary but are encouraged to be included on high-traffic routes where an alternate path is greater than 2 kilometres away.

SAFETY (SETBACKS, SIGHTLINES):

- **Setbacks:** Ensure that signs are positioned a safe distance from active paths to avoid obstructing users or causing accidents. For pathways, a minimum setback of 0.5 metres from the edge of the path is recommended to allow for a clear zone, however, context may invoke another methodology based on complexities of each site. In any case, it is important to create a comprehensive methodology to the full alignment when planning and designing for sign location.
- **Sightlines:** Place signs in locations where they do not obstruct the view of other users or potential hazards. Ensure visibility by positioning signs at a height and angle that is easily seen from a distance. Avoid sign clutter and streamline signage to the extent possible to ensure key messages are legible and to reduce distraction or confusion. Regulatory signage should take priority where there is a risk of oversupply.
- **Reflectivity, Luminance and Lighting:** Use reflective materials or integrated lighting to ensure visibility during low-light conditions, adverse weather and night-time use. From a visual accessibility lens, a measure of luminance, or colour contrast, can be helpful in achieving a higher degree of visibility. The copy-face should be as close to ambient light conditions as possible.

2.4.4. Design Parametres

General Considerations:

- **Local Significance:** Integrate colors and materials that reflect local branding or natural surroundings. A consistent brand along a corridor or network that is easily tied to local context is helpful to ensure that users know they are continuing along the same route.
- **Colour Selection:** Use high-contrast color schemes for text and background to ensure readability. For example, white or bright colors on dark backgrounds. Beyond branding considerations and cohesion, colors should be chosen to stand out against the surrounding environment, including natural elements like foliage and weather conditions.

Materials

- **Durability:** Use weather-resistant, traffic-grade signage materials such as aluminum, high-density polyethylene (HDPE), or durable composites that can withstand environmental conditions. This should extend to adhesives and vinyl applications. Where pavement markings are applied to supplement vertical wayfinding installations, use superior-grade thermal plastics that consider climate and maintenance strategies.
- **Maintenance:** Select materials that are easy to clean and maintain with resistance to graffiti and vandalism. I.e. Gloss or semi-gloss finishes preferred over matte. Signs should be inspected intentionally, on a consistent interval, to ensure they are in good working order and repairs can be made proactively to not disrupt the signage system's functionality for users.

Content

- **Progression:** It is important to provide a manageable amount of information to people at one time, as too much information can be difficult to understand and be unnecessary. Too much information can make decision-making challenging and leave people second guessing themselves. In particular, wayfinding for cycling is similar to guide signing for drivers: information provided to riders who are moving must be provided in advance of where major changes in direction are required, repeated as necessary, and confirmed when the turning movement is complete.
- **Order of Information:** Where signage is indicating multiple destinations or directional cues, destinations closer to the user's current position (the location of the sign) should be presented first, at the top, while subsequent destinations should follow in order of proximity. Should there be a series of destinations along multiple routes as well as decision making points requiring a change in direction, the order in which the destination or decision point appears should be reflected in the order of information on a sign.

Typography:

- **Legibility:** Use clear, sans-serif fonts such as 'Fieldwork Geo' or 'Poppins' as specified in the 2023 Cochrane Brand Guidelines or an approved typeface, with consideration for the Town's brand guidelines, to ensure readability. Font sizes should be large enough to be read from a distance, considering design speed of travel for the fastest user. For this, pedestrian, cyclist and other modes' speeds would be considered. As a tool, the MUTCD provides guidance and criteria to drivers – this information can be used to infer and make decisions related to other modes when taken into context.
- **Hierarchy:** Employ different font sizes or weights to indicate primary and secondary information (e.g., larger text for main directions, smaller text for supplementary details).

Symbols / Logo:

- **Icons**: Use universally recognized symbols for common features, such as a bicycle icon for cycling routes, a pedestrian figure for walking paths, and a map icon for informational signs.
- **Local Branding**: Incorporate the Town's logo or emblem to create a cohesive identity across the active transportation network and promote local pride.
- **Accessibility**: Ensure symbols are designed with accessibility in mind, using clear and straightforward imagery that can be understood by all users, including those with visual impairments.
    - » Braille is suggested to be used on key pedestrian routes where there is assumed to be a high degree of diverse users, or, where routes are adjacent to or in advance of public amenities such as schools or healthcare facilities.
    - » Accessibility measures, when implemented along the active transportation network are to reflect the current CSA (Canadian Standards Association) and National Building Code minimum standards.

2.5. Intersections and Crossings

2.5.1. Design Principles

Intersections are critical design locations for all active transportation facilities. Poor design at intersections can make users feel uncomfortable, unsafe, and inconvenienced, even if protected facilities are provided along the corridor.

Intersections are where the most conflict points occur along a corridor and are generally where most collisions occur. Motor vehicles turning at an intersection present a significant risk to people walking and cycling because motorists are typically focused on finding a gap in traffic rather than on the people walking or cycling. This risk necessitates additional considerations when designing and installing crossing treatments.

Additional design consideration should be made at intersections where two bicycle facilities intersect as bicyclist will be making turning movements in addition to through movements, increasing potential conflicts and the complexity of bicyclist-motor vehicle interactions. To improve safety and comfort at intersections for all users, the following design principles should be followed:

- Design for all ages and abilities
- Minimize conflicts between users
- Ensure clarity of right-of-way
- Reduce speed at conflict points
- Ensure clear sightlines for all users and between users
- Make intersection as compact as possible
- Provide dedicated space for bicyclists to manoeuvre

The following are considerations that influence the design principles:

- Motor vehicle volumes
- Pedestrian and bicyclists' volumes
- Demographic of pedestrians and bicyclists
- User delay
- User sightlines
- Design speed, and rates of acceleration and deceleration
- Traffic control, signage, and pavement markings
- Accessibility
- On-street parking, including accessible and loading zones
- Transit stops
- Lighting
- Adjacent land use(s)

2.5.2. Sightlines

Ensuring that all users have adequate sight lines at potential conflict points is important to ensuring that either user can stop with enough time, if needed, to avoid the conflict between the two users.

Stopping Sight Distance

Minimum stopping sight distance is the distance required to bring the vehicle (ie, motor vehicles, bicycles) to a controlled full stop and is a factor of speed, the surface material and condition, perception-reaction time, and grade of the facility. The stopping sight distance can be greater for bicyclists than motorists, especially on downgrades, and needs to be considered in the design of bikeways. Chapter 5 of the TAC Geometric Design Guide (GDG) for Canadian Roads, Section 5.5 provides details on how to determine the minimum stopping sight distance for bicycles. For motor vehicle sight distances, refer to Chapter 2 of the TAC GDG for Canadian Roads.

Intersection Sight Distance

Two types of clear sight triangles are considered in intersection design: the approach and departure sight triangles. Refer to the Chapter 9 of TAC Geometric Design Guide for Canadian Roads, Section 9.9.2 for details on determining the appropriate sight distances and sight triangles to provide at an intersection based on the vehicle maneuver and the traffic control at the intersection.

2.5.3. Signals

Traffic signals provide higher level control of traffic movements at intersections and crossings; however, they also have a higher level of costs for installation, operations and maintenance. TAC provides guidelines for traffic signal warrants and for pedestrian control warrants to ensure that they are installed in appropriate locations. The TAC warrants should be completed to confirm whether a location meets the warrant criteria.

If warrants are close to being met, additional assessment on the condition and latent demand should be completed to determine potential timing of change in traffic pattern with the proposed traffic control in place. Common traffic signal systems are described in the table below, indicating key characteristics of the system.

TABLE 2 - TYPE OF TRAFFIC SIGNALS

System Type	Description
Traffic Signal **(Full Signal)**	Full Signals regulate all road users and control all approach of an intersections. Use at intersections of major and minor roads. Installation determined by warrant process.
Pedestrian and Cycling Activated Signals **(Half Signals)**	Half Signals regulate motor vehicle movements and control approaches on one road only, typically the main through road. Used for controlling vehicle movement to allow for the safe crossing of pedestrian and bikes across a major road. Can be used at intersection of major and minor roads OR at mid-block crossing. Installation determined by warrant process. Can create some confusion, and conflict with stop or yield control on minor road without signals and are not desirable on full movement intersections (where there are no turn restrictions, and all movements are permitted).
Overhead Pedestrian Flashers	Overhead Pedestrian Flashers have amber flashing lights, and enhance warning and awareness of crosswalks, and when pedestrians are crossing for motorists. Consist of an overhead pedestrian crossing sign with pedestrian-activates flashing amber lights. Use at crosswalks at intersections and/or mid-block locations. Typically installed on one side of an intersection only, providing pedestrian push buttons on both sides will increase costs but will also increase accessibility particularly at high pedestrian locations. Advanced flashers can be used where sightlines approaching the crosswalk are poor.

System Type	Description
Rectangular Rapid Flashing Beacons **(RRFBs)**	RRFBs enhance warning and awareness of crosswalks for motorists Consist of amber flashing beacon installed on either side of the road and on the median if applicable Use at crosswalks at intersections and/or mid-block location Can be less effective on wider roadways where side street controls are not as visible

More information about traffic signals for bicycles can be found in the TAC Traffic Signal Guidelines for Bicycles (2014) and the TAC Pedestrian Crossing Control Guide (2018).

2.5.4. Bicycle Boxes, Two-Stage Left Turn Bicycle Boxes, and Jughandles

BICYCLE BOXES

A bicycle box is an area designated for bicyclists at a signalized locations where bicyclists can wait for a green phase. Bicycle boxes are located in-front of motor vehicle lanes to position bicyclists ahead of waiting motor vehicles, ensuring that the bicyclists are visible to motorists and allowing bicyclists to enter the intersection ahead of motor vehicles. Motor vehicles cannot stop within the bicycle box when waiting at a light but may pass through the box when the light turns green.

Bicycle boxes can prevent 'right-hook' conflicts at the start of the green signal phase. Right-hook conflicts occur when a motor vehicle is traveling in the same direction as a bicyclist and turns right across the pathway of the bicyclist.

Bicycle boxes are also beneficial for left turning bicyclists, who can position themselves in the bike box during a red phase, putting themselves at the start of the queue and eliminating the need to weave across the motor vehicle lane to make their turn. This use of the bicycle box is only effective during the red phase and bicyclist approaching the intersection on a green phase would either have to weave into the main travel lane or wait for a red phase to use the bicycle box.

For a bicycle box to be effective, a Right Turn on Red Traffic Signal Prohibited sign (RB-17R) should be installed at traffic signals to ensure that motorists are not encroaching into the bicycle box during a red indication. **Figure 5 - Typical Bicycle Box Configuration** shows the layout of a typical bicycle box, along the Right Turn on Red Traffic Signal Prohibited sign.

Bicycle boxes can be used at the following locations:

- Signalized intersections with high volumes of left-turning bicyclists.
- Signalized intersection where through bicyclists are anticipated to be waiting for a green phase.
- Intersections where a bicycle lane is transitioning to a neighbourhood bikeway.

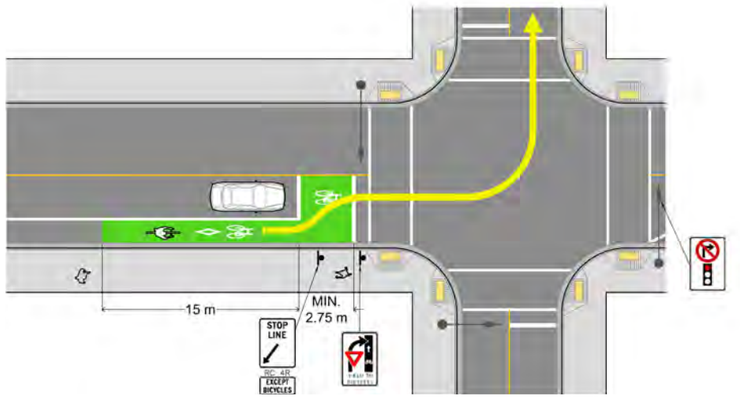


FIGURE 5 - TYPICAL BICYCLE BOX CONFIGURATION

TWO-STAGE LEFT TURN BICYCLE BOXES

A two-stage left turn bicycle box is a designated waiting area outside of the travel lanes on the crossing street that provides bicyclists with an area to wait to complete a left turn in two stages or two signal phases. The left turning bicyclists, when on a green phase, can proceed to the waiting area on the cross- street and turn across the intersection when the cross-street traffic gets the green phase. These boxes improve safety by reducing the turning conflicts between motor vehicles and bicycles, as well as remove the need for bicyclists to weave across traffic and turn from the vehicle lane.

Two-stage left turn bicycle boxes can be considered at the follow locations:

- At signalized intersections where there are few safe gaps in traffic for left-turning bicyclists.
- At multi-lane signalized intersections to help bicyclists make left turns safely.
- Where protected bicycle lanes are continued up to an intersection and a protected intersection is not provided.
- Where right turning bicycles must turn across through motor vehicle lanes from a left side facility (like for bi-directional protected bicycle lanes).
- At mid-block crossing locations to orient bicyclists properly for safe crossings.
- At rail crossing, to orient bicyclists at a safe angle to cross in-ground tracks.

An example of a two-stage left turn bike box configuration can be seen in **Figure 6 - Two Stage Left Turn Bicycle Boxes**. Please see Chapter 5 of the TAC GDG for Canadian Roads for more detailed design guidance on bicycle boxes.

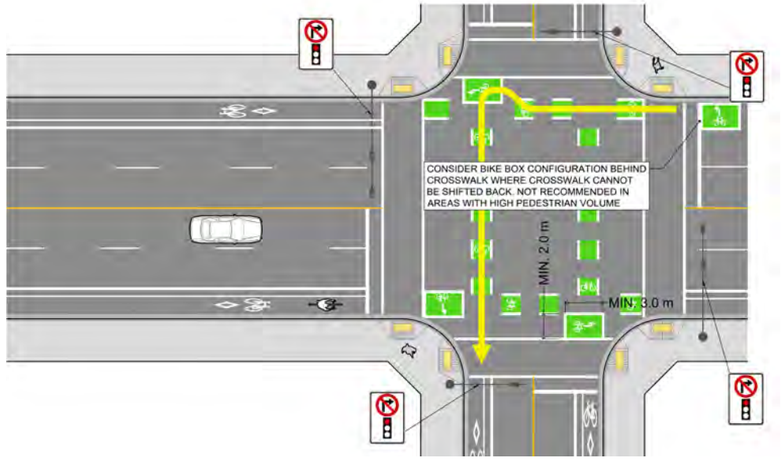


FIGURE 6 - TWO-STAGE LEFT TURN BICYCLE BOXES

JUGHANDLES

Jughandles are a variation of two-stage left turn bicycle boxes where the bike box is inset into the sidewalk. Jughandles can also take the form of a small section of separated pathway that ramp bicyclists off the street and reorient them in the direction of the crossing. The application of jughandles is limited to mid-block crossings and T-intersections. A typical jughandle treatments can be seen in **Figure 7 - Jug Handle Treatment**.

FIGURE 7 - JUG HANDLE TREATMENT

2.5.5. Conflict Zone Markings

Conflict zone markings are pavement markings that can be used to guide bicyclists and motorists through conflict zones or complex intersections. Conflict zone markings can raise awareness to the presence and visibility of bicyclists, make cycling movements more predictable, and provide clarity of right-of-way.

Conflict zone markings are typically provided where bicyclists have right-of-way, but where this may not be clear to motorists or people cycling. The level of conflict zone marking provided is based off the level of conflict at a given location. The following is guidance on the application of conflict zone markings.

- **Use Conflict Zone Markings**:
  - » Through intersections for all dedicated on-street bicycle facilities.
  - » Across signalized intersections where the path of the bicycle is unclear and/or there are conflicts between turning motorists and bicyclists.
  - » Where typical motor vehicle movements encroach into bicycle space, such as where a dedicated right turn lane is on the right side of a bicycle lane.
  - » At driveway and laneway crossings.
- **Do Not Use Conflict Markings**:
  - » Where bicyclists are expected to yield to motorists, and/or the motorists have right of way over the bicyclists.
  - » On shared pedestrian and bicycle crossings (use cross-ride markings as described in the next section).

Table 3 provides guidance on different levels of conflict zone markings, and when to apply them. Additional details on the conflict zone markings are shown provided in **Section 2.3 Pavement Markings**.

TABLE 3 - CONFLICT ZONE MARKING TREATMENT SELECTION

Level	Level 1	Level 2
Treatment	White Dashed Bicycle Lane Line and Bicycle Symbols	White Dashed Bicycle Lane Line, Bicycle Symbols, and Green Pavement Markings
Volume of turning motor vehicle conflicts with bicycle facility	≥50 and <100 motor vehicles per peak hour	≥100 motor vehicles per peak hour
Other criteria	Locations with a bicycle activated warning beacon	Locations with a bicycle activated warning beacon Commercial and industrial driveway crossings

2.5.6. Cross-Ride Markings

Cross-ride pavement markings, also known as “elephant’s feet” pavement markings, consist of a series of white squares laid out in a parallel line across a roadway. Cross-ride markings can be used at any location where the design professional intends to alert both motorists and bicyclists to where an off-street bicycle facility is crossing an access or street. The cross-ride markings, similar to the crosswalk markings, only indicate location and/or presence of a bicycle crossing but does not designate right of way. Existing bylaws and legislation would need to be updated to indicate whether bicyclists have right-of-way over the motor vehicle traffic at the bicycle crossing and under what conditions.

Once bylaws are updated and enacted, additional signage (where applicable, regulatory signage) should be implemented alongside cross-ride for additional awareness of right-of-way. Cross-rides can still be useful in also alerting motorists that bicyclists may be present; however, prior to bylaw and legislation update, the presence of cross-rides may cause confusion to bicyclists that they have right-of way over motorists. Designers need to consider the traffic control of motor vehicles, design speed of both users, sight lines and the ability to stop/avoid conflict in the implementation of cross-ride markings. Off-street bicyclists travel at higher speeds than pedestrians and require greater stopping sight distances. Cross-ride markings are shown in **Section 2.3 Pavement Markings.**

2.5.7. Driveways and Lane Crossings

Bicycle facilities with numerous laneway and driveway crossings have a greater potential for conflict. The number of driveway and laneway crossings along a corridor should be considered during network planning and the bicycle facility selection process. Design considerations are necessary to mitigate potential conflicts where these crossings exist.

Providing sufficient sightlines for both bicycle users and motorists is critical and may require removing obstructions and restricting on-street parking on either side of the laneway or driveway. For high-use driveways and laneways, conflict zone markings can be used to enhance visibility of the crossing.

Where possible, bicycle facilities should maintain a consistent elevation through laneway or driveway crossings. This applies to sidewalk-level and intermediate-level protected bicycle lanes; in which case the active mode facilities remain at a consistent elevation while the laneway or driveway ramps down to road level past the bicycle facility.

2.6. Considerations for End of Trip Amenities

End of trip amenities increase the convenience of bicycle trips and make bicycling an attractive transportation option. Amenities can include bicycle parking and bike fix-It stations.

2.6.1. Bicycle Parking

Bicycle parking provides a secure place for people leave their bicycle between trips. There are two categories of bicycle parking equipment, categorized by the length of time a bicycle will be parked. The categories are as follows:

- **Short-term bicycle parking** is oriented towards bicyclists stopping for less than four hours, usually to take part in activities such as shopping, having a meal, going to an appointment, or participating in a recreational activity. This type of parking generally consists of outdoor bicycle racks located in public right-of-way near key community destinations.
- **Long-term bicycle parking** is oriented towards bicyclists stopping for four hours or longer. This type of bicycle parking should consist of larger secured facilities, such as bicycle rooms, bicycle cages, or full-service bicycle stations. These facilities can be provided both publicly and privately and are usually located at places of work, residences, and transit stations.

TYPES OF SHORT-TERM BICYCLE PARKING

- **Bicycle racks** are the most versatile and common type of short-term bicycle parking. Bicycle racks should provide support to maintain a bicycle in an upright position and lock its frame to the rack. Bicycle racks should be located near the entrances of key destinations. When placed on the sidewalk, bicycle racks should be in the furniture zone to avoid creating obstructions in the pedestrian clearway.
- **Bicycle corrals** consist of a group of bicycle racks located in the parking lane. Bicycle corrals can convert one on-street motor vehicle space into approximately 6 to 10 bicycle parking spaces. The corral should be protected from motor vehicles with physical barriers such as curbs, barriers, or bollards. Alternatively, the bicycle corral can be raised to sidewalk level using quick build or permanent materials. Bicycle corrals are also be placed near intersections or crosswalks as a means to 'daylight' the intersection and improve sight lines often blocked by parked motor vehicles.
- **Covered bicycle parking** can be used where there is sufficient space to erect a structure over a group of bicycle racks to provide protection from the elements. Priority locations for covered bicycle parking are everyday destinations like grocery stores, schools, and heavily used transit stops.

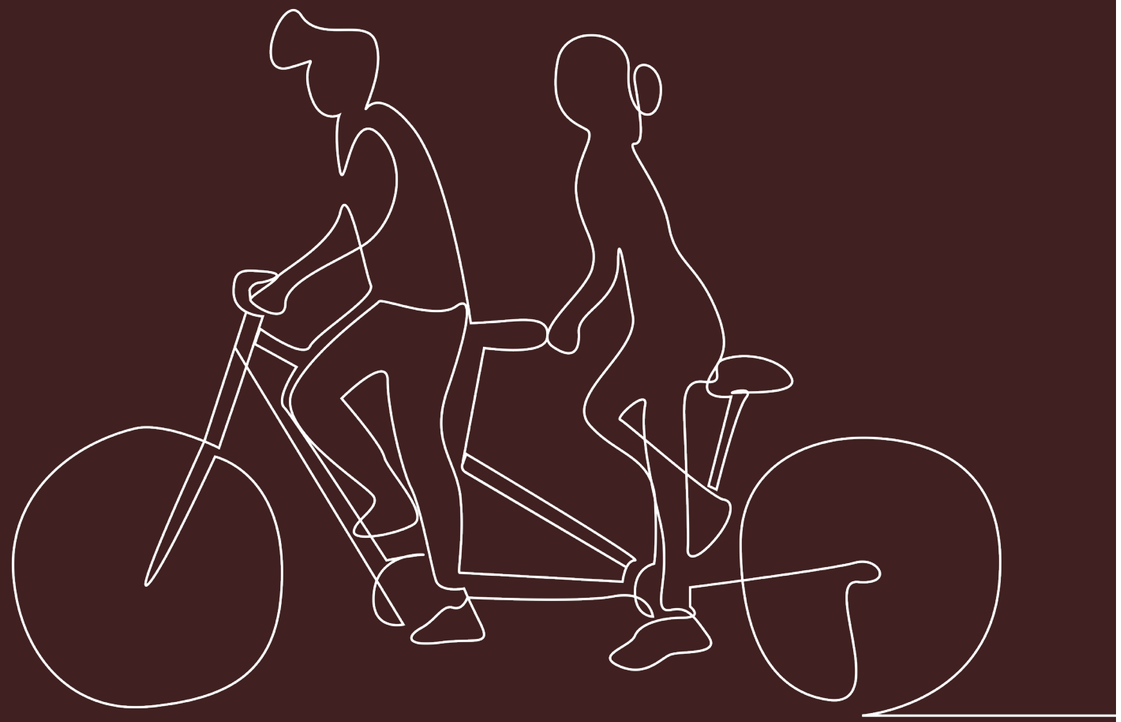
TYPE OF LONG-TERM BICYCLE PARKING

- **Bicycle lockers** are large stand-alone boxes that allow bicyclists to store and lock their bikes in individual compartments. Bicycle lockers are usually made available on a sign-up basis where a key or code is assigned to an individual bicyclist, however other shared access models exist. The Town currently has bicycle lockers at The Station available for rent through a third-party vendor, and is situated just north of the main building, allowing for 24-hour access.
- **Bicycle shelters** are structures with an access-controlled door or on-site monitor that allows people to park and lock their bicycle. Bike shelters are a higher capacity form of bike parking and can include U-racks, vertical wall racks, or double tiered racks. Typical locations for bicycle shelters include post-secondary institutions, transit stations, and dense commercial or residential buildings.

2.6.2. Bicycle Fix-It Stations

Bicycle fix-it stations are another important amenity to increase the convenience of bicycling. Fix-it stations can include bicycle pumps and a variety of repair tools and allow bicyclists to make small repairs when not at home. Fix-it stations should be placed at high-volume locations and be co-located with higher order types of bicycle parking.

3. Facility Types and Selection



3.1. Facility Types

The facility types discussed in this guide are summarized in **Table 4**, Bicycle accessible shoulders and other highway bicycle facilities are not included in this guide as highways through the Town of Cochrane are owned, operated and maintained by the Province's Transportation and Economic Corridors (TEC) Ministry, and are not under the jurisdiction of the Town

TABLE 4 - FACILITY TYPES

On-Street Facilities		
	**Neighbourhood Bikeways** Neighborhood bikeways are streets with low motor vehicle speeds and volumes where it is suitable for bicyclists to share the road with motorists. Neighborhood bikeways utilize treatments such as signage, pavement markings, traffic calming, and traffic diversion to prioritize bicycle traffic and create a comfortable facility for all users.	**Section 4.1**
	**Bicycle Lanes** Bicycle lanes are separate travel lanes designed for the exclusive use of people bicycling. Bicycle lanes are delineated from the road with a painted line or a painted buffer area.	**Section 4.2**

	**Protected Bicycle Lanes** Protected bicycle lanes are separate travel lanes designed for the exclusive use of people bicycling. Protected bicycle lanes are physically separated from motor vehicles and pedestrians by vertical and horizontal elements like plastic delineators and/or concrete curb.	**Section 4.3**
Off-Street Facilities		
	**Shared Pathways** Shared pathways are pathways where pedestrians and bicyclists share the space.	**Section 4.4 and Section 5.1**
	**Separated Pathways** Separated pathways are pathways where pedestrians and bicyclists each have their own dedicated space.	**Section 4.5 and Section 5.1**

3.2. Facility Selection

Motor vehicle speeds and volumes are the main factors involved in selecting a bicycle facility type for a specific area. **Table 5 - Facility Selection** illustrates the recommended bicycle facility types given motor vehicle speeds and motor vehicle volumes.

An additional factor that should be included in the selection process is curbside activity. Curbside activity includes zones where activities happen near a curb including on-street parking, loading zones, ride hailing zones, transit stops, street patios, and driveways. Areas where curbside activity is high will have a high potential for conflicts between users (bikes, pedestrians, vehicles, etc.). Uni-directional protected bicycle lanes are the most suitable facility type in these areas, regardless of the street's operational characteristics.

In addition to the general direction provided in **Table 5 - Facility Selection**, other factors should be considered in the ultimate facility selected including available space, street function, conflict points, motor vehicle mix, user types, collision history, on-street parking, construction cost and feasibility, function of route within the bicycle network.

Given the many factors that feed into facility selection, it is not always a straightforward decision. **Table 5 - Facility Selection** illustrates this through two different colours. The dark blue indicates that the facility would be suitable when designed to the recommended parameters outlined within this guide. The light blue indicates the facility may be suitable, but other factors would need to be considered. The double cross symbol indicates that the facility has the potential to be an All Ages and Abilities (AAA) facility, depending on the intersections and conflict zone treatments implemented. Where neither light nor dark blue is shown, the facility type is not suitable for design users.

TABLE 5 - FACILITY SELECTION

Existing Street Characteristics	Existing Operational Characteristics			On-Street Bikeways					Off-Street Pathways		
	Posted Motor Vehicle Speed	Average Daily Motor Vehicle Volumes	Motor Vehicles Lanes	Neighbourhood Bikeway	Bicycle Lane		Protected Bicycle Lane		Shared Pathway	Separated Pathway	
					No Buffer	With Buffer	Uni-directional	Bi-Directional		Uni-Directional	Bi-Directional
High curbside activity	Any	Any	Any				++			++	
Low curbside activity	≤30 km/hr	<1,000	No centre line	++	++	++					
		1,000 - 2,500			++	++					
		<2,500	With centre line		++	++	++	++	++	++	++
		2,500 - 5,000				++	++	++	++	++	++
		>5,000					++	++	++	++	++
	>30 km/hr to ≤50 km/hr	<1,000	No centre line			++					
		1,000 - 2,500				++	++	++	++	++	++
		<2,500	With centre line			++	++	++	++	++	++
		2,500 - 5,000				++	++	++	++	++	++
		>5,000					++	++	++	++	++
	>50 km/hr to <=80 km/hr	<2,500	With centre line				++	++	++	++	++
		2,500 - 5,000					++	++	++	++	++
		>5,000					++	++	++	++	++
	>80 km/hr	Any volume	With centre line						++	++	++

Facility is suitable

Depends on context

++ Potential to be an All Ages and Abilities bicycle facility depending on intersection and conflict zone treatments

4. Facilities in Road Right-of-Way

4.1. Neighbourhood Bikeways

4.1.1. General

Neighborhood bikeways are streets with low motor vehicle speeds and volumes and have been enhanced to prioritize bicycle traffic. Neighborhood bikeways should include signage and pavement markings and can include a range of traffic calming measures to reduce motor vehicle volumes and speeds. The most critical design treatments for neighborhood bikeways are crossings of major streets. Signalized and non-signalized crossing treatments should be provided at major intersections to facilitate bicycle crossings. Neighborhood bikeways work best in street networks with a strong, continuous grid pattern. They are effective as a complementary type of bicycle facility and should not be considered a replacement for provision of bicycle facilities on major streets.

LEVEL OF TREATMENTS

Neighborhood bikeways can be defined based on the degree to which bicycles are prioritized over motorists. Prioritization of bicycle traffic over motor vehicle traffic can be achieved through a range of corridor and intersection treatments. Neighborhood bikeways are categorized into three levels, with each level building onto the last, to add an additional degree of prioritization

- **Level 1 – Required Treatments (Intersection Treatments, Signage, and Pavement Markings)**. The critical locations on neighborhood bikeways are where they intersect major streets. Intersections treatments such as signalization and bicycle detection should be used to assist bicyclists in crossing major streets. At minor street crossings, intersection treatments should give the neighborhood bikeway right-of-way over cross streets to create continuous flow along the corridor. Signage and pavement markings help identify neighbourhood bikeways to both bicycles and motorists and help establish that there is a higher presence of bicycle traffic along the neighborhood bikeway. In cases where motor vehicle volumes and speeds are sufficiently low, signage, pavement, markings, and intersections treatments may be the only treatments required to create a neighborhood bikeway.

- **Level 2 – Traffic Calming (Speed Management)**. In addition to Level 1 treatments, traffic calming measures can be provided to reduce motor vehicle speed. Reducing speeds along the neighbourhood bikeway improves the cycling environment and is critical to creating a comfortable and effective neighbourhood bikeway.
- **Level 3 – Traffic Diversion (Volume Management)**. In addition to Level 1 and 2 treatments, traffic diversion measures can also be provided to reduce motor vehicle volumes and discourage through motor vehicle traffic. Traffic diversion measure should still permit through access for bicyclist and pedestrians and local access for motor vehicles. Reducing motor vehicle volumes is important to reducing potential conflicts between bicyclists and motor vehicles to create a safe and comfortable riding experience.

Details regarding the benefits and limitations of neighborhood bikeway are provided in **Table 6**, including additional details regarding the application of treatments for the levels described above.

TABLE 6 - BENEFITS AND LIMITATIONS OF NEIGHBOURHOOD BIKEWAYS

Considerations	Benefits	Limitations
Safety	Traffic calming and diversion measure reduce motor vehicles speeds and volumes improving safety for all road users Intersection treatments improve road crossings for bicyclists and pedestrians	Combines road users travelling at different speeds Bicyclists may be less visible or expected by motorists
Cost (installation and maintenance)	Typically implemented on existing residential streets, and have low impacts and costs Winter maintenance may be able to be completed using existing snow and ice control equipment	Special equipment may be required for winter maintenance at intersection with traffic diversion measures
Impacts to road users	Traffic calming and diversion measures may reduce motor vehicle volumes and speeds, benefiting all other road users through improved safety Can improve aesthetics of the street if traffic calming measures include enhance landscaping features	Bikeways may not connect to destinations on major streets Facilities with insufficient traffic calming and diversion treatments may increase "cut through" motor vehicle traffic Traffic diversion measures may be unpopular with residents and can increase traffic on parallel streets
Applicability	Ideal for local/residential streets in a grid street network Ideal for streets with low motor vehicle speeds and volumes	Not appropriate for major streets Should not be considered a substitute for bicycle facilities on a parallel major street

ROAD NETWORK CHARACTERISTICS

Road networks can generally be characterized as 'grid' networks or 'loop & lollipop' networks as shown in **Figure 8 - Street Network Comparison**. Grid networks are more prevalent in urban areas and 'loop and lollipop' networks in rural and suburban areas.

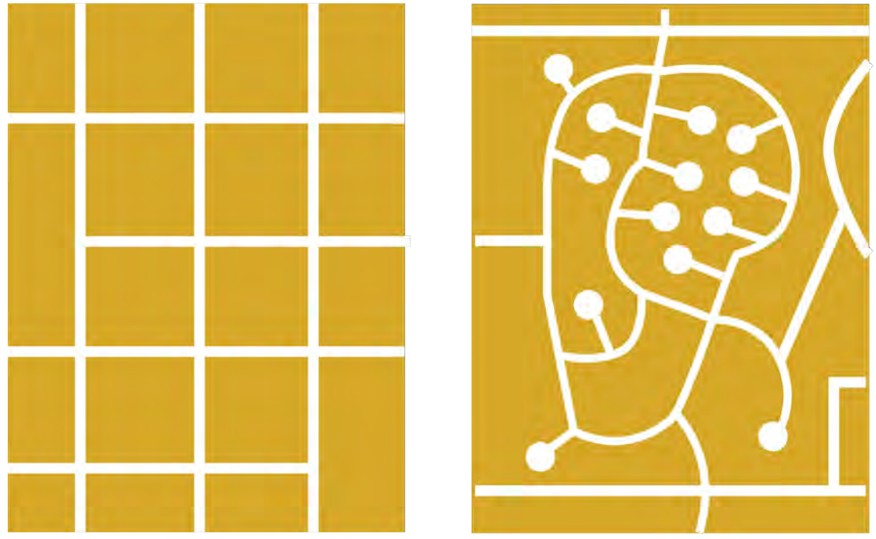


FIGURE 8 - STREET NETWORK COMPARISON

The 'loop and lollipop' pattern has reduced connectivity and concentrates vehicle traffic on collector and arterial streets. This creates challenges in implementing neighborhood bikeway facilities as the desirable, more direct, through routes have high vehicle speeds and volumes. For these types of networks, establishing off-street facilities and connections through green spaces may be necessary to provide more direct routes for bicyclists and pedestrians.

On the other hand, grid networks have more distributed volumes and can be managed to prioritize different modes on parallels of the grid without compromising access through the network. This makes grid networks well suited for neighbourhood bikeways, as there are functional route alternatives for diverted traffic.

TRAFFIC SPEEDS AND VOLUMES

Neighbourhood bikeways should only be implemented on low volume and low speed roads. The desired average daily traffic is 500 motor vehicles per day (vpd) or less and should not exceed 1,000 vpd. Posted speed limits and vehicles operating speeds should be 30 km/hr or less. Neighbourhood bikeways may be considered on streets with existing volume and speed conditions that exceed those thresholds if traffic calming and traffic diversion treatments are implemented; to encourage the desired speeds and volumes.

Design guidance on the level of treatments required for the street to operate as a neighbourhood bikeway, based on the existing motor vehicle volumes and speeds, is shown in **Table 7**. As noted previously, higher traffic volumes and speeds along the neighbourhood bikeway may result it in no longer being suitable for all ages and abilities of bicyclists.

TABLE 7 - 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	Level 2: Traffic Calming	Level 3: Traffic Diversion
<1,000	30 km/hr or less	X		
<1,000	30 to 50 km/hr	X	X	
1,000 – 2,500	30 km/hr or less	X		X
1,000 – 2,500	30 to 50 km/hr	X	X	X
>2,500	>50 km/hr	Consider alternate facility type		

CLEAR WIDTH

The clear width of a road is the operating space within a roadway. It is either the width between curbs or width between vehicles if on-street parking is permitted. Neighbourhood bikeways should have a clear width between 4.0m and 5.5m. This is the desirable range for motorists and bicyclists to share the road comfortably, while encouraging similar speeds between the two transportation modes. Widths narrower will not allow vehicles travelling opposing directions to comfortably pass each other while widths wider will encourage drivers to travel at higher speeds.

Note that neighbourhood bikeways do not include a center line as the entire clear width is intended for two-way traffic.

4.1.2. Facility Design Elements

LEVEL 1 - REQUIRED TREATMENTS

- **Intersection Treatments**
  - » **Minimize stops at local street crossings**. Stop signs increase cycling time and energy expenditure due to frequent starting and stopping. Neighbourhood bikeways should minimize the number of stops along the route by re-orienting stop signs at local street crossings to give right-of-way to the neighbourhood bikeway and stop cross traffic instead. After the intersection is modified, an increase in motor vehicle volume or speed along the route may occur as drivers realize the right-of-way priority allows for shortcutting. This can be mitigated by implementing traffic calming and traffic diversion measures to deter motor vehicle traffic from using the route as a shortcut, and to keep motor vehicle speed lower along the route.
  - » **Use signalized crossings at major street crossings**. Signalizing crossings should be provided where speeds on a cross street are greater than 30 km/hr or where crossing the street would delay bicyclists and other road users. Traffic signals are recommended when crossing arterial and collector streets but would need to be confirmed by completing traffic signal warrants using TAC guidelines. Refer to **Section 2.5.2** for guidance on application of traffic signals.
  - » **Provide bicycle detection at traffic signals**. Bicycle detection can include bicycle loop detectors, bicycle pushbuttons, video detection, and other technologies. Signage and pavement marking should be used to inform bicyclists how to trigger the detection system and active the traffic signal. Further, visual confirmation for bicyclists that they have been detected should be provided at traffic signals where a loop detectors or video detection is used.
  - » **Improve crossings at off-set intersections**. Off-set intersections are where opposite legs of an intersection are not directly across from one another. This creates a discontinuity in the neighbourhood bikeway where the route jogs laterally along a cross street before continuing in the original direction. Without additional intersection treatments, bicyclists would have to ride a short distance along the cross street to continue along the neighbourhood bikeway. This can create a hazard as the cross street may not be safe or comfortable for bicyclists to use.
    To mitigate this hazard, the preferred design treatment is to provide a bi-directional pathway on one side of the street to connect the two legs of the bikeway. Alternatively, the off-set intersection can be signalized to provide a phase that allows for bicycles to safely cross the cross street. Lastly, where the cross street has low traffic volumes or has a minor classification, consider using traffic diversion measures to remove traffic from the cross street entirely.

- **Signage**
  - » Signage alone does not necessarily create the conditions necessary for a neighbourhood bikeway. However, if motor vehicle volumes and speeds are already low and intersections facilitate bicycle travel, then signage may be all that is required to safely create a neighbourhood bikeway.
  - » Signage should identify routes to both bicyclists and motorists. Additional wayfinding signage is recommended to provide information regarding direction, distance, and/or estimated travel time to destinations for bicyclists to reach their destination (see **Section 2.2** and **Section 2.4**).
  - » It is recommended that along neighbourhood bikeways, the reflective green and white Bicycle Route sign (IB-23) be used and/or a custom wayfinding sign created by the Town. Section A4.3.3 of the MUTCDC provides guidance regarding signage used to mark bicycle routes and also provides guidance on signage spacing and location. It is recommended that street name blade signs include a bicycle symbol to enhance route visibility.
- **Pavement Markings**
  - » In addition to signs, bicycle pavement wayfinding markings can be placed on the street to identify the route as a bikeway. The installation of 'Shared Use Lane' symbol (also known as 'Sharrow') pavement markings are suggested along neighbourhood bikeways. Section 7.4.3 of the TAC Bikeway Traffic Control Guidelines for Canada provides guidance on the installation of these pavement markings. Additionally, custom wayfinding pavement markings (also known as 'dinner plate' pavement markings) with a directional arrow can be used at intersections and decision points as wayfinding.

A typical pavement marking layout can be seen in **Figure 9 - Neighbourhood Bikeway Typical Pavement Marking Layout.**

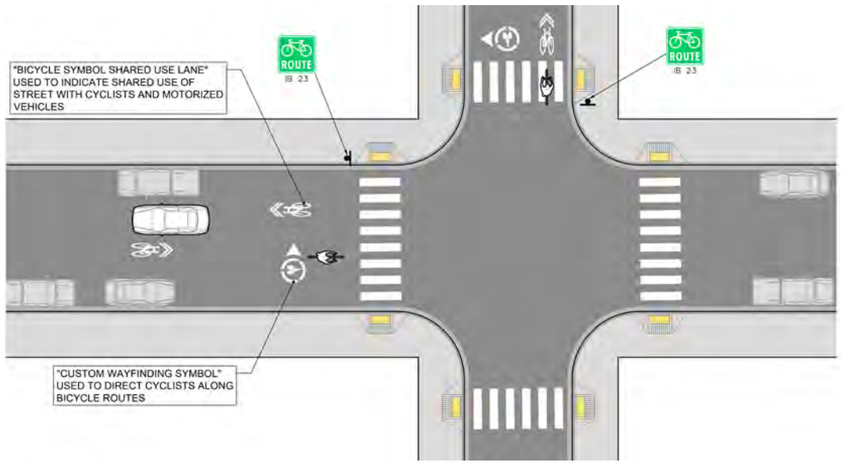


FIGURE 9 - NEIGHBOURHOOD BIKEWAY TYPICAL PAVEMENT MARKING LAYOUT

LEVEL 2 - TRAFFIC CALMING (SPEED MANAGEMENT)

Traffic calming measures consist of devices that provide a horizontal or vertical deflection to reduce motor vehicle speeds and improve safety for all road users. These speed management measures help bring motor vehicle speeds closer to those of bicyclists. In many cases, traffic calming measures can also be effective at reducing motor vehicle volumes. These measures are distinct from those that restrict motor vehicle access, which are discussed below under Level 3 – Traffic Diversion (Volume Management) treatments.

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 detailed design guidance on these treatments. The selection and application of traffic calming measures is at the discretion of the Town of Cochrane.

Horizontal Deflection

Horizontal deflection 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 street or a need to navigate a curving travel lane. Various horizontal deflection measures are described below and shown in **Figure 9 - Sample Traffic Calming Measures**.

- **Curb extensions** (also know as. neckdowns, curb bulks, or bump-outs) provide horizontal intrusion of the curb into the road near intersections and crossings to narrow the roadway. Curb extensions reduce motor vehicle speeds, reduce crossing distances for pedestrians, increase visibility of crossing pedestrians, and prevent parking close to intersections and crossings.
- **Traffic circles** (also known as, traffic buttons) are created by placing islands in the centre of an intersection, requiring vehicles to navigate through the intersection in a counterclockwise direction around the island. Traffic circles typically replace uncontrolled intersections or intersections controlled with stop signs. Traffic circles can reduce motor vehicle speeds through the intersection and eliminate the need for bicyclists to stop when the intersection would have been otherwise stop controlled. The use of traffic circles along neighbourhood bikeways has recently been questioned as studies and feedback from bicyclists have identified increased safety risk caused by 'wrong way' left turns, improper yielding, and motorists overtaking bicyclists in the traffic circle.
- **Chicanes** are a series of curb extensions (or islands) on alternating sides of the road, which narrow the road and deflect drivers' path of travel back and forth, reducing motor vehicle speeds. Chicanes are not a 'typical' treatment and should be used with caution and the appropriate signage to inform drivers of the chicane.
- **Curb radius reduction** reconstructs or modifies an intersection corner to have a smaller radius, typically between 3.0 m and 5.0 m. This slows right-turning motor vehicles, reduces crossing distance for pedestrians, and improves the visibility of bicycles and pedestrians at intersections.

Vertical deflection

Vertical deflection measures provide slight pavement elevation changes that cause a vertical upward movement of motor vehicles and self-enforce a slower speed for motorists. Examples of vertical deflection measures that can be considered along bicycle boulevards are provided and shown in **Figure 10 - Sample Traffic Calming Measures**.

- **Speed humps** (also known as, speed bumps) are raised area of a street used to cause discomfort to drivers travelling at higher speeds as a mean to reduce motor vehicle speeds. Speed humps should have a sinusoidal profile and should extend across the full width of the street with gaps for drainage at the curb. It should be noted that speed humps may reduce appeal to bicyclists if they must also travel over them.
- **Speed tables** are elongated raised speed humps with a flat-topped section that is long enough to raise the entire wheelbase of a motor vehicle. Speed tables may be used on transit and emergency response routes. Like speed humps, speed tables should have a sinusoidal profile and should extend across the full width of the street, with a minimum 3.0 metre raised flat-top section in the centre.
- **Speed cushions** are a raised area on a road like a speed hump, but with gaps along the width of the raised section. 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 allow bicyclists and larger motor vehicles such as buses and emergency vehicles to pass without difficulty. The space between the cushions can vary slightly depending on the overall roadway width. Speed cushions should be used with caution, as people driving sometimes seek out the space between the cushions, reducing the traffic calming effect and causing unpredictable driving behaviour. As well, speed cushions can be challenging to maintain during life cycling of the road structure.
- **Raised crosswalks** are like speed tables but also include a marked pedestrian crosswalk at an intersection or mid-block location. A raised crosswalk should extend fully across the street, to the connecting wheelchair ramps, with a minimum 2.5m crosswalk width.
- **Raised intersections** are full intersections that are constructed at a higher elevation than the adjacent approach roads. 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 streets.

Reduced Speed Limits

For a neighbourhood bikeway to be considered an effective facility, the posted speed limit should be no more than 30 km/hr. Changing only the posted speed can be insufficient to modify the behaviour of motorists, if the street feels the same and/or is designed for a higher speed.

As such, traffic calming measures described in the bullets above should be used to support the change and encourage the lower speed.

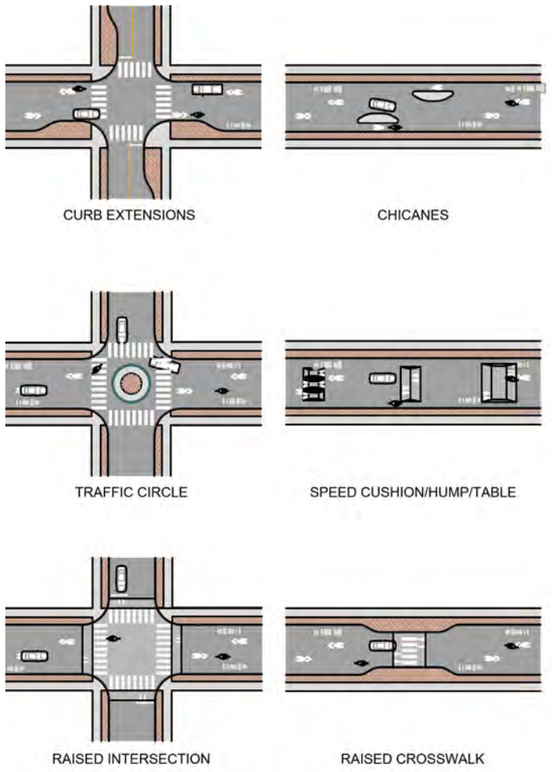


FIGURE 10 - SAMPLE TRAFFIC CALMING MEASURES

LEVEL 3 - TRAFFIC DIVERSION (VOLUME MANAGEMENT)

Traffic diversions measures refer to devices that restrict motor vehicle movement at intersections, reducing through traffic on the neighbourhood bikeway. Bicycle and pedestrian access is always maintained where traffic diversion measures are installed.

The Town of Cochrane should consult road users impacted by traffic diversion measures like emergency services, transit agencies, waste collection, maintenance, and residents and businesses in the adjacent community to ensure that impacts to ingress and egress are understood and managed. Various horizontal deflection measures are described on the following page and shown in **Figure 10 - Sample Traffic Diversion Measures**.

The following traffic diversion measures can be considered to restrict motor vehicle access and reduce motor vehicle volumes on a neighbourhood bikeway. Refer to the TAC Canadian Guide to Traffic Calming for detailed design guidance on these treatments, including consideration for what traffic controls are required.

Traffic control and signage needs to consider if bicyclist movements are to be considered on-street or off street for each condition, and ensure the appropriate signage are installed to support the design.

- **Directional closures** consist of curb extensions, raised islands, or vertical barriers extending to the dividing line of the street, prohibiting one direction of motor vehicle traffic. Access for bicyclists travelling in the direction of the directional closure should be maintained by providing a ramp over the curb extension or a cut through between the barrier and the curb line. When using directional closures, include signing changes to make the road one-way only for motor vehicle traffic travelling in the opposite direction of the closure.
- **Diverters** are raised islands or vertical barriers placed diagonally across an intersection that force motor vehicles to turn instead of proceeding through the intersection. Diverters should include gaps for bicyclists and pedestrians.
- **Full closures** consist of a raised island or vertical barrier extending the entire width of the street which obstructs all motor vehicle traffic from continuing down the street. A full closure can convert a four-way intersection into a three-way intersection. Considerations should be made as to how motor vehicle traffic approaching the non-intersection side of the closure is diverted. Full closures can extend a full block (intersection-to-intersection) or half block (intersection-to-laneway) if local motor vehicle access does not need to be maintained. Gaps should be provided for bicyclists and pedestrians through the closure.
- **Intersection channelization** is the use of raised islands or vertical barriers to obstruct traffic movements and physically direct motor vehicle traffic through an intersection. The treatment is similar to directional closures; however, intersection channelization is generally more permissive with maintaining motor vehicle movements. Bicyclists should be permitted to make all movements and should be provided gaps through channelizing islands as needed.
- **Right-in / right-out island** is a specific type of intersection channelization that limits the movements of an approach to right-in and right-out only, obstructing through and left movements.
- **Raised medians through intersection** are concrete or asphalt islands located on the dividing line of the street crossing the neighbourhood bikeway. This treatment works similarly to the right-in / right-out island, in that it obstructs left and through movements to and from the bikeway. The raised median also creates a refuge for bicyclists and pedestrians crossing the street, improving the safety of the intersection.

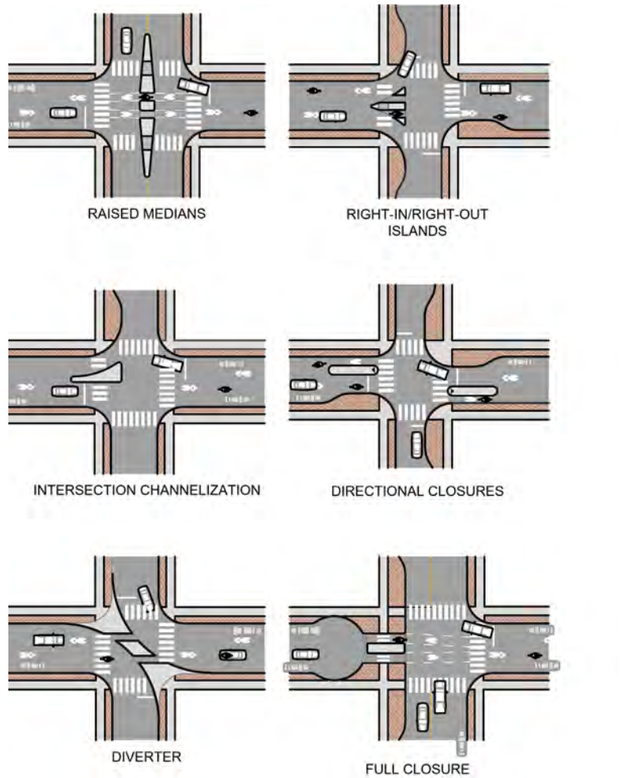


FIGURE 11 - SAMPLE TRAFFIC DIVERSION MEASURES

WAYFINDING

Due to the casual, informal nature of neighbourhood bikeways facilities, wayfinding plays a crucial role in ensuring bicyclists can identify and follow the facility. Neighbourhood bikeways should be easily identifiable and distinct from other residential streets. This is especially important when neighbourhood bikeways are in a grid network, where many streets look and feel the same.

Specific attention should be paid to adding wayfinding at intersections, bends or turns, and where neighbourhood bikeways intersect other facilities.

Guidance on wayfinding can be found in **Section 2.4**.

4.1.3. Intersections and Crossings

General design guidance for intersections and crossings can be seen in **Section 2.5**. This section speaks to facility-specific considerations for neighbourhood bikeways at intersections.

MAJOR STREET CROSSINGS

Major street crossings are crossing of high volume, high speeds roads and can come in the form of both unsignalized or signalized intersections. In both instances, the traffic calming and diversion measures discussed earlier in the section should be used to treat these intersections. The following are additional consideration for major street crossings.

- **Signalize the intersection** at crossings with higher motor vehicle volumes, three or more travel lanes, and/or posted speeds of 50 km/hr or greater. See **Section 2.5** for more guidance on signalized crossings.
- **Provide longer minimum green time for bicyclists** to account for slower acceleration speeds
- **Use bicycle detection** that does not require the bicyclist to dismount

MINOR STREET CROSSINGS

Minor street crossings are crossings of minor roads that are typically uncontrolled or controlled by a stop or yield sign. Minor street crossings should be treated with the intersection-specific traffic calming and diversion measures discussed above, where suitable. The following are additional considerations for minor street crossing design for neighbourhood bikeways.

- **Give neighborhood bikeways right-of-way over local cross streets**. However, Yield or Stop controls should not be installed on a higher volume street unless justified by a traffic engineering study. If two streets have relatively equal volumes the intersection control should:
  - » Control the direction that conflicts the most with pedestrian crossing activity, school routes, or bicycle crossings; or
  - » Control the direction that has obscured sight lines or other conditions that require motorist to use lower operating speeds
- **Limit the number of stop signs along a bicycle route** to minimize delay and create a continuous flow for the bicycle facility
- **Prevent motorists from shortcutting along the bikeway**. Use traffic calming and diversion measures in coordination with the above approaches to prevent motorists from taking advantage of the priority signing and right-of-way conditions at minor road crossings along neighbourhood bikeways.
- **Use sharrow pavement markings on the approach and across the intersection** to enhance awareness of bicycle crossings. On higher volume roads, green-backed 'super sharrows' can further enhance visibility.

4.2. Bicycle Lanes

Bicycle lanes are separate travel lanes designed for the exclusive use of people cycling. Bicycle lanes are typically positioned adjacent to the curb or adjacent to on-street parking.

4.2.1. General

PAINTED (CONVENTIONAL) BICYCLE LANES

Painted bicycle lanes are identified by signage and pavement markings. The pavement markings include solid longitudinal lines and bicycle reserved lane diamond symbol pavement markings. The signage includes a Reserved Bicycle Lane Sign (RB-91), as outlined in **Section 2.2**. Both signage and pavement markings are placed at regular intervals. Painted (conventional) bicycle lanes without buffers are not recommended adjacent to on-street parking. This is discussed further in the following subsection for Parking Adjacent Bicycle Lanes.

Painted bicycle lanes should ideally be reserved to cases where right-of-way space is too constrained to permit the addition of a buffer. They can be used when motor vehicle speeds are less than 50km/h and/or when motor vehicle volumes are less than 2,500 vehicles per day. They can also be used in combination with other traffic calming techniques to lower motor vehicle speeds. The desired width of a painted bicycle lane is 1.8m and the constrained limit is 1.5m. Further details on bicycle lane widths are provided in **Section 4.2.2**.

TABLE 8 - BENEFITS AND LIMITATIONS OF PAINTED BICYCLE LANES

	Benefit	Limitations
Safety	Separates road users travelling at different speeds. Provides a designated space on the road for bicyclists, facilitating predictable behaviour and orderly movements. Reminds all road uses of bicyclists' right to the street.	No physical protection provided between bicyclists and motor vehicles. No physical barrier to prevent motor vehicles from stopping and/or parking in the bicycle lane. Bicycle lanes can be prone to poor winter maintenance as snow is pushed aside by motor vehicles accumulating in the bicycle lane.
Cost (installing and maintaining)	Low cost to install and only requires road re-striping Can be maintained as part of standard street maintenance activities. Does not impact the existing drainage pattern of the road.	If existing motor vehicles lanes cannot be narrowed or removed, costs will increase with required curb adjustments.
Impacts to road users	If vehicle lanes are narrowed to accommodate bike lanes, motor vehicle speeds may decrease.	May require the removal of motor vehicle travel lanes or parking lanes if lane widths cannot be reduced. Managing conflicts between motor vehicles and bicyclists has a higher dependency on individual behaviour.
Applicability	Best suited in retrofits with moderate motor vehicle speeds and volumes where there is insufficient room for physical protection.	Not appropriate on streets with high vehicle traffic and speeds. Not recommended where changes to the curb are required. Not recommended to be implemented adjacent to on-street parking.

BUFFERED BICYCLE LANES

The following sections detail the different design considerations for buffered bicycle lanes. Buffered bicycle lanes are similar to conventional bicycle lanes but have the addition of a painted buffer between the bicycle and vehicle lane. The constrained buffer width is 0.3m and the desirable buffer width is 0.6m. The pavement markings include solid longitudinal lines and bicycle reserved lane diamond symbol pavement markings. Buffer can also be enhanced with hatched/diagonal striping. The signage includes a Reserved Bicycle Lane Sign (RB-91), as outlined in **Section 2.2**. Both signage and pavement markings are placed at regular intervals.

Like conventional bicycle lanes, buffered bicycle lanes should not be adjacent to on-street parking. In scenarios where on-street parking cannot be removed, a buffered bicycle lane may be installed with a second 0.9m buffer between the parking lane and the bicycle lane. This is discussed further below. While buffered bicycle lanes generally share the same benefits and limitations as conventional bicycle lanes, the addition of a painted buffer can improve bicyclists' safety and comfort.

TABLE 9 - BENEFITS AND LIMITATIONS OF BUFFERED BICYCLE LANES

	Benefit	Limitations
Safety	Additional separation provided between road users travelling at different speeds. Buffers can be used for snow storage, allowing for better winter maintenance. Can be upgraded to protected bicycle lanes without requiring additional road width. Additional width can allow for safe passing of bicyclists travelling at different speeds.	No physical protection between bicyclists and faster moving vehicle traffic. No physical barrier preventing motor vehicles from stopping and/or parking in the bicycle lane. Additional width and no physical barrier can increase likelihood of facility being used by motor vehicles for parking or driving/passing.
Cost (installing and maintaining)	Low cost to install and only requires road re-striping Can be maintained as part of standard street maintenance activities. Does not impact the existing drainage pattern of the road.	Using buffer as snow storage may require specialized snow clearing equipment to clear the bicycle facility separately.
Impacts to road users	If vehicle lanes are narrowed to accommodate bike lanes, motor vehicle speeds may decrease.	May require the removal of motor vehicle travel lanes or parking lanes if lane widths cannot be reduced.
Applicability	Best suited in retrofits with moderate motor vehicle speeds and volumes where there is insufficient room Can be used on roads with higher vehicle speeds and traffic than.	Not recommended where changes to the curb is required. Should not be implemented adjacent to on-street parking without providing a second buffer between the parking lanes.

PARKING ADJACENT BICYCLE LANES

Not to be confused with parking protected bicycle lanes (see **Section 4.3** for details regarding these facilities), this design involves placing the bicycle lane between the motor vehicle lane and the on-street parking lane. Research has shown that parking adjacent bicycle lanes are one of the least comfortable, and least safe types of bicycle facilities and has even been found to be less safe than not providing any bicycle infrastructure. The major issues presented by these lanes are:

- Additional conflict points for bicycle users
- Greater risk of people cycling in the lane being hit by a parked vehicle's door being opened (i.e. "doored") as all vehicles have a driver but not all vehicles have a passenger.
- People bicycling risk severe injury from "dooring," either by veering into traffic to avoid the car door, being hit by the door, or being hit by traffic after the door strikes them.
- These type of bicycle lanes are also often blocked by delivery vehicles, taxis, poorly parked private vehicles or used for snow storage.

The recommended best practice is to avoid the use of this facility type. If bicycle facilities are recommended on a street with on-street parking, practitioners should carry out the following steps:

1. Remove on-street parking
2. If on-street parking cannot be removed, provide a parking protected bicycle lane (see Section 4.3)
3. If a parking protected bicycle lane cannot be provided, provide a buffered bicycle lane with a sufficient buffer width (0.9m) between parked motor vehicles and the bicycle lane; or
4. Consider another corridor or facility type.

The use of parking adjacent bicycle lanes without a buffer is not recommended in this design guide.

4.2.2. Facility Design Elements

TABLE 10 - BICYCLE LANE WIDTH GUIDANCE

Facility	Zone	Desirable (m)	Constrained (m)
Painted Bicycle Lanes	Bicycle Lane	1.8	1.5
Buffered Bicycle Lanes	Bicycle Lane	1.8	1.5
	Buffer	0.6	0.3
Parking Adjacent Bicycle Lanes	Bicycle lane	1.8	1.5
	Buffer (with Travel lane)	0.6	0.3
	Buffer (with curbside Parking lane)	0.9	-

Where the total available width for the bicycle lane is greater than 1.8m (the sum of the constrained bicycle lane and constrained buffer width), extra road width should be allocated to provide the desirable bicycle lane width first. If additional space remains, the buffer width should be increased to achieve as close to the desirable width as possible. When the total available width for the bicycle lane is greater than 2.4m (the sum of the desirable bicycle lane width and desirable buffer width), a protected bicycle lane should be considered instead. At this width of wider, the combined width becomes inviting for drivers to use this space to bypass traffic. If a protected bicycle lane is not desired, additional buffer width may be provided on either side of the bicycle lane.

4.2.3. Signs and Pavement Markings

Bicycle lanes should include the white solid edge line, Bicycle symbol and Reserved Use diamond symbol. The white edge line may be dashed where motor vehicles are permitted to cross the bicycle lane to complete a turning movement or for transit vehicles to enter a bus stop. For bicycle lane with no buffer, a thicker 200mm wide line should be used for greater visual separation between the two lanes. For buffered lanes, the buffer is delineated with two solid white lines which can include cross hatching to better delineate the buffer and decrease ambiguity.

The Bicycle symbol should point in the direction of travel with the diamond below it and is recommended to be placed at each approach to all crossings and major accesses and laneways with higher traffic volumes. These symbols may be supplemented by directional arrow markings to denote the bicycle lane movement and to deter wrong way riding. Green pavement markings should be reserved for high conflict points, including driveways and intersections, as well as bike boxes and two-stage turn boxes.

Signage used for bicycle lanes typically include (see **Section 2.2**):

- Reserved Bicycle Lane sign (RB-90, RB-91)
- Reserved Bicycle Lane Ahead sign (WB-10 TAC)
- Turning Vehicles Yield to Bicycles sign (RB-37)

4.2.4. Intersections and Crossings

General design guidance for bicycle movements through intersections and crossings is provided in **Section 2.5**, which includes guidance on bicycle turning movements. This section speaks to facility-specific considerations for painted bicycle lanes only.

Note that buffered bicycle lanes should follow the same design guidance as protected bicycle lanes as seen in **Section 4.3.4**.

THROUGH BICYCLE MOVEMENTS

Bicyclists travelling through an intersection in bicycle lanes can encounter conflicts with motor vehicles turning across the bicycle lane. The following section provides guidance on treatments to reduce conflicts between bicyclists and right-turning motorists and describes the design considerations for the different types of intersection layouts.

Design Guidance

The following design guidance should be implemented for bicycle lanes that go through a street intersection.

- In areas where there is a dedicated right turn lane, bicycle lanes should be placed to the left of the right turn lane
- In areas where there is no dedicated right turn lane, a transition area should be provided before the intersection where motorists can position themselves adjacent the curb (in the bicycle lane) before making their turn. The transition area is shown by using dashed lane lines between the bicycle lane and motor vehicle lane.
- The width of the bicycle lane through the transition area and intersection should match the width of the lane on the approach

Painted through bicycle lanes should not be used on streets with double right turn lanes, instead, bicycle lanes should transition off street, to a shared use pathway, in advance of the right turn lanes.

Recommended Features

The following design features are recommended for bicycle movements through an intersection.

  - » Conflict zone markings may be supplemented with additional pavement markings and coloured surface treatment as described in **Section 2.5.4**.
  - » Signage for motor vehicle right turns should be installed including 'Right Turn Only Lane" sign (RB-41R) and 'Turning Vehicles Yield to Bicycles' sign (RB-37)
  - » At signalized intersections, bicycle signal detection should be configured to detect bicycles in the through lane.
- **Continuous Bicycle Lane without Right Turn Lane**
  The following are additional considerations for bicycle lanes without separate right turn lanes.
  - » At signalized intersections, a protected bicycle signal phase can be implemented to mitigate conflicts between bicyclists and right-turning vehicles. A 'Right Turn on Traffic Signal Prohibited' sign (RB-17R) would need to be added to ensure motor vehicles are not crossing over the bicycle lane during the protected signal phase.
  - » At unsignalized intersections, additional conflict markings should be installed to highlight the conflict area. Refer to **Section 2.5.4** for the warrants and different types of conflict markings.
  - » **Figure 12 - Continuous Bicycle Lane without Right Turn Lane** provides guidance on pavement markings for continuous bicycle lanes without a right turn lane

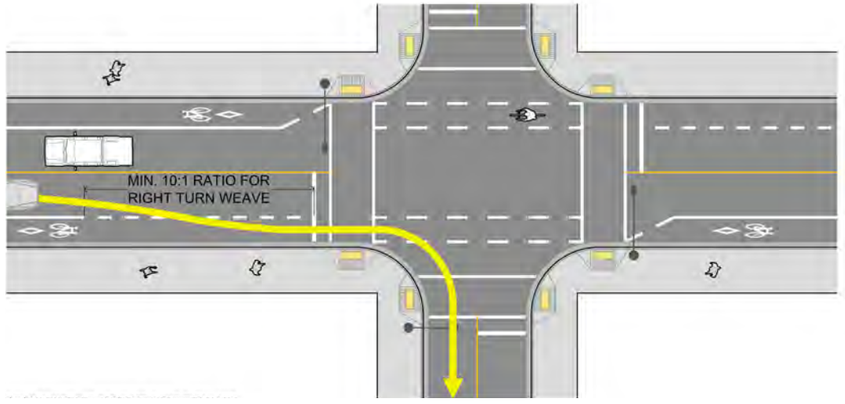


FIGURE 12 - CONTINUOUS BICYCLE LANE WITHOUT RIGHT TURN LANE

- **Continuous Bicycle Lane with Right Turn Lane**
  The following are additional considerations for bicycle lanes with exclusive/dedicated right turn lanes.
    - » Exclusive right turn lanes should be designed with adequate storage so motor vehicles are not stopping in the bicycle lane. **Figure 13 - Continuous Bicycle Lane with Right Turn Lane** provides guidance on pavement markings for continuous bicycle lanes with a right turn lane.

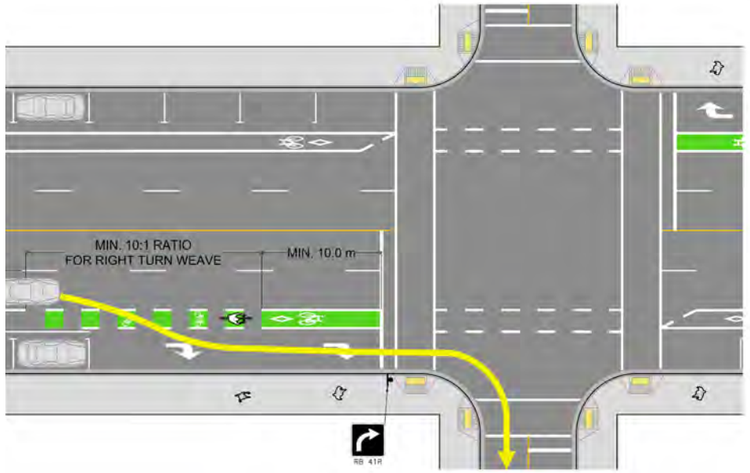


FIGURE 13 - CONTINUOUS BICYCLE LANE WITH RIGHT TURN LANE

    - » When a through travel lane transitions into a right turn only lane, it is recommended the bicycle lane stay to the right of the through travel lane to minimize weaving across the motor vehicle lane. Where possible, the bicycle lane should transition to a protected facility at the intersection and be provided with a protected signal phase to minimize conflicts with the high volume of right turning vehicles.
    - » Bicycle lanes should not terminate before the intersection.
    - » Where the minimum width of a dedicated bicycle lane can not be achieved approaching an intersection, transitioning the bicycle lane off street into a shared pathway should be considered. A shared bicycle/right turn lane should only be considered if all other more protected facility cannot be achieved.

- **Bicycle Lane with Channelized Right Turn Island**
  Channelized right turn islands are found at intersections along higher volume streets, and also where larger truck vehicles require wider corners for larger turning radius. They can be challenging for bicyclists to maneuverer due to the high speed of turning vehicles. Consideration should be made to remove or adjust the channelized island to a smart right turn island to reduce motor vehicle speeds. If channelized islands can not be removed, consider the following method to address the transition of bicycle lanes at these intersections.

On-Street Option:

- Provides direct route for bicycles through intersection, however there is a large conflict area where bicyclists and motorists are mixing.
- Use colour conflict zone pavement markings through the bicycle conflict area.
- **Figure 14 - Bicycle Lane with Channelized Right Turn Island** provides additional guidance on pavement markings for the on-street option.

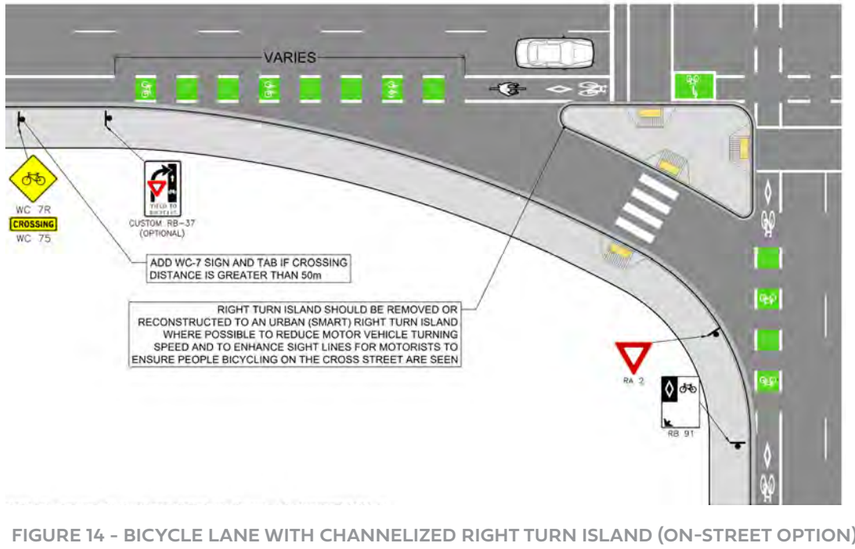


FIGURE 14 - BICYCLE LANE WITH CHANNELIZED RIGHT TURN ISLAND (ON-STREET OPTION)

Off-Street Option:

- Minimizes length of exposure of bicyclists to motorists but creates a less direct route through the intersection.
- Transition off-street to a shared pathway or separate pathway at the start of the auxiliary lane. Refer to **Section 4.4** and **Section 4.5** for guidance on shared pathways and separate pathways.
- Once off-street, the bicyclists would continue to the corner and cross over to the right turn island at the same location as the pedestrians.

BICYCLE LEFT TURN CONSIDERATIONS

For intersections where there is the ability to turn left from a bicycle lane to another bicycle facility, bicycle boxes, two-stage left turn bike boxes, and jughandles should be used. Design guidance for these treatments can be found in **Section 2.5**.

Left turn bicycle lanes are an alternate form of intersection treatment, where an additional bicycle lane is provided to the left of the through travel lanes, creating a designated place for bicyclists to make a left turn. This treatment forces bicyclists to weave across the motor vehicle lane to get from the through bicycle lane to the left turn bicycle lane, creating additional conflicts between bicyclists and motorists.

This treatment should only be considered on lower speed and volume streets, where there are sufficient sight lines, not motor vehicle left turn, and the left turn is necessary to connect to an existing bicycle facility.

FACILITY TRANSITION

This section provides design guidance for when a bicycle lane transitions to another facility type along a corridor. In retrofit situations, the suitability of a facility type may change along the corridor as a response to variations of available right-of-way and to motor vehicle traffic patterns changes. Typically, facility transitions are located at intersections where corridor characteristics are more likely to change. Transitioning between facility types will require signage and pavement markings to indicate the beginning and end of the two facility types. Signage and pavement markings are provided in **Sections 2.2** and **2.3**. **Figures 15 - Bicycle Lane to Shared Pathway**, **Figure 16 - Bicycle Lane to Protected Bicycle Lane**, and **Figure 17 - Bicycle Lane to Neighbourhood Bikeway** provides guidance on common bicycle facility transitions.

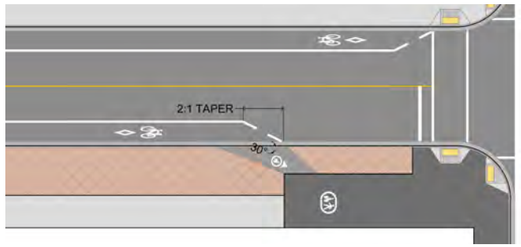


FIGURE 15 - BICYCLE LANE TO SHARED PATHWAY

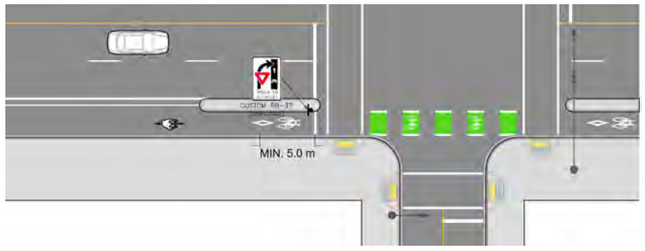


FIGURE 16 - BICYCLE LANE TO PROTECTED BICYCLE LANE

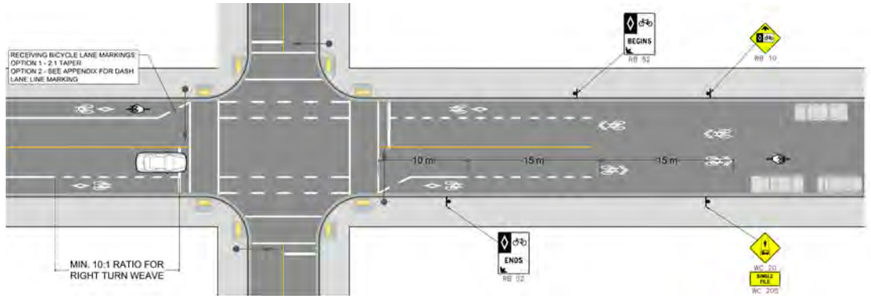


FIGURE 17 - BICYCLE LANE TO NEIGHBOURHOOD BIKEWAY

4.3. Protected Bicycle Lanes

Protected bicycle lanes are separate travel lanes designed for the exclusive use of people cycling and are physically separated from motor vehicles and pedestrians by vertical and horizontal elements.

4.3.1. General

Protected bicycle lanes are most appropriate on streets with higher motor vehicle volumes and speeds, multiple motor vehicle lanes, relatively high bicycle volumes, and relatively few alleyways and driveways. Protected bicycle lanes are most suitable under the following conditions:

- Where motor vehicle speeds are posted between 30 and 50 km/h and motor vehicle volumes are greater than 2,500 motor vehicles per day.
- Where motor vehicle speeds are posted between 50 and 80 km/h, at any motor vehicle volume.
- At any location with high curbside activity, regardless of posted motor vehicle speeds or motor vehicle volumes due to the high potential for conflicts with other modes.

TABLE 11 - BENEFITS AND LIMITATIONS OF PROTECTED BICYCLE LANES

	Benefit	Limitations
Safety	Physical separation from motor vehicle traffic increases user safety and comfort. Physical separation from pedestrians reduces likelihood of sidewalk cycling and increases safety for pedestrians.	Visibility and potential conflicts at intersections and driveways May impact bicyclist turning movements, particularly the ability to turn left. Level of protection may be reduced along corridors with many driveways and access points.
Cost (installing and maintaining)	Provides significant benefits in terms of increased ridership and crash reduction if properly designed.	Costs are highly variable and based on existing conditions and design.
Impacts to road users	By providing dedicated space for all road users, they increase predictability and orderly behaviour between all users. Can be implemented on existing streets to reduce implementation costs and utility impacts.	May impact street operations at driveways and intersections. A larger portion of the street is required compared to bicycle lanes or off-street pathways. Potential loss of parking. Can collect trash and debris, requiring more frequent maintenance. May require specialized equipment to regularly sweep lanes of snow and debris, causing higher maintenance costs and impacts. Snow removal needs to be considered when selecting the appropriate width. May require changes to the traffic control at intersections including signage and traffic signals.
Applicability	Best suited in retrofits along streets with high motor vehicle speeds and volumes Suitable on streets with lower motor vehicles speeds and volumes where a higher user comfort is desired for bicyclists.	Challenging for streets with many driveways and access points as protection in street buffer zone will be interrupted with gaps for vehicle access.

Protected bicycle lanes are typically characterized by three separate zones:

Bicycle lane zone:

- This is the space in which the bicyclist operates. It is located between the street buffer and the sidewalk buffer.

Sidewalk buffer zone (or amenity zone):

- This is the space that provides physical separation between the sidewalk and the protected bicycle lane. This separation prevents encroachment of users, enhancing safety and comfort for all users. Providing separation between the two zones is especially relevant for universal accessibility when installing intermediate level or sidewalk level protected bicycle lanes. Separation can be provided through curb separation, different surface materials or colours or by objects in the buffer space such as grass, trees, planters, or benches.

Street buffer zone:

- This is the space that provides physical separation between the protected bicycle lane and the motor vehicle lane. Factors that impact the street buffers zone type and materials include:
  - Use of adjacent roadway (ex. parking lane vs. travel lane)
  - Number of travel lanes
  - Motor vehicle volumes and speeds
  - Elevation of the bicycle lane
  - Maintenance (including consideration for snow storage)
  - Drainage
  - Existing right-of-way
  - Whether or not to include signage
  - Durability
  - Access (for emergency and service vehicles, access to parked cars)
  - Cost
  - Aesthetics

4.3.2. Facility Design Elements

TRAVEL DIRECTION

Protected bicycle lanes can be one-way in the direction of motorized travel, one-way in a contraflow direction to motorized travel, or two-way. However, in the Town of Cochrane the preferred design is one-way in the direction of motorized travel (i.e. bicycle lanes on each side of the street). This design accommodates two-way bicycle travel and provides full access to both sides of the street for cyclists. Further, the number of conflict points is reduced with bicyclists and motorists travelling in the same direction because travel behaviour is more predictable. As with bicycle lanes, turning motor vehicles yielding to bicycle lane users remains the primary conflict. Parking should be restricted close to intersections to ensure sightlines are unobstructed. While this design requires more width and impacts both sides of the street, existing traffic signals and phasing can likely be used since the bicyclists are travelling in the same direction as the motor vehicles. Special circumstances may warrant other configurations but should be discussed with the Town prior to any design work being carried out.

WIDTH

The following **Table 12** provides design guidelines for desirable widths for the different zones of the protected bicycle lanes.

TABLE 12 - PROTECTED BICYCLE LANE WIDTH GUIDANCE

Zone	Desirable (m)	Constrained (m)
Bicycle Through Zone (uni-directional)	2.5 [1]	1.8
Sidewalk Buffer Zone [2]	2.0	0.3
Street Buffer Zone	1.0 [1]	0.6

[1] *If Street buffer zone is not adjacent to on-street motor vehicle parking, the desirable width is ≥ 1.0 m, with a wide buffer creating additional cycling comfort*

[2] *This zone is especially relevant for sidewalk level protected bicycle lanes, where there is no grade difference between people cycling and people walking.*

ELEVATION

Protected bicycle lanes placed at street level generally follows the rules of the road of a vehicle. A range of vertical separation measures are used to separate the bicycle lane from motor vehicle traffic. Maintenance may be more difficult because the bicycle lane is not at the same level as the sidewalk, and they are separated from travel lanes (and hence street maintenance equipment for the general travel lane) by a vertical barrier.

Bikeways placed at sidewalk level, or an intermediate level in between the two should reference the Separated Pathway, **Section 4.5**, and considered an off-street user. Design of elevated bikeway with a curb separation need additional consideration to accommodate for anticipated bicyclist's speed, in particular, drivers will require greater sightlines at conflict points for a bicyclist than a pedestrian.

TYPE OF SEPARATION

Street Buffer Zone

There are several different techniques to providing separation between vehicles and the protected bicycle lane. Differences in type, dimensions, and spacing of separating elements (such as flexible delineators, raised medians, planters, etc.) should be considered when determining the appropriate measure to use in the buffer zone. When placing vertical objects, preference should be given to maximizing the width of the protected bicycle lane. Additionally, vertical separation must be visible in the winter and should consider maintenance requirements. **Figure 18 - Types of Separation** illustrates various types of potential street buffer options.

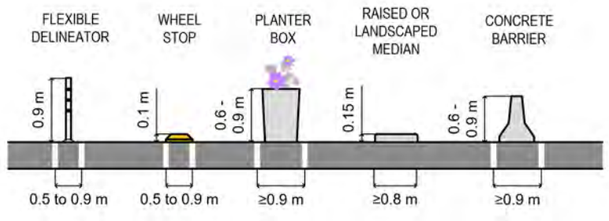


FIGURE 18 - TYPES OF SEPARATION

On corridors where posted motor vehicle speeds are 50 km/h or less, temporary or movable vertical elements such as planter boxes and flexible delineator posts may be used. Where posted speeds are greater than 50 km/h, using continuous barriers such as raised medians is more desirable. Section 5.7.5 of the TAC Geometric Design Guide for Canadian Roads provides details on the recommended spacing, dimensions, and type of separation based on the posted speed limit of the adjacent motor vehicle lane.

As previously mentioned, there are many other factors, in addition to speed, that influence the most appropriate separation type to use along a corridor. The following table provides initial context considerations and additional design notes to help narrow down the appropriate separation provided.

TABLE 13 - INITIAL CONSIDERATIONS FOR USE OF SEPARATION TYPES FOR STREET BUFFER ZONE

	Appropriate Context	Design Notes
Parking Lane	Where on-street parking exists, the protected bike lane can be places between the parking and the sidewalk.	Intended to provide continuous vertical separation.
Flexible Delineator post	Lower speed environments, and may not be appropriate for roads with posted speed limits that exceed 50 km/h. Recommended treatment adjacent to motor vehicle parking to allow access to sidewalks.	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.
Planter Box	Lower speed environments. Planter boxes with periodic or intermittent spacing are not appropriate on roads with posted speed limits that exceed 50km/h.	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 additional clear zone. Should have reflective markings or be signed. Can be used in conjunction with concrete barrier for more rigid protection.
Raised or Landscaped Median	Recommended where more physical protection from motor vehicles is needed (ex. bridges with high-speed or high-volume traffic).	Intended to provide continuous vertical separation. On higher speed roads, crash cushions should be included at barrier ends. May require less regular maintenance to maintain, as it is sturdier structurally.
Wheel Stop	Lower speed environments, and may not be appropriate for roads with posted speed limits that exceed 50 km/h.	Can be used in constrained situations. Must be pinned down. Consider use of end treatments such as tapered end barriers or nosing. 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.
Concrete Barrier	Recommended where more physical protection from motor vehicles is needed (ex. bridges with high-speed or high-volume traffic). Should not be used with on-street parking.	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 but can be painted to reduce impact.

Table 14 below provides a high-level summary of the benefits and drawbacks of each separation type. The selection of the type of separation used in the street buffer zone should consider the maintenance and ownership of the asset. Special consideration should be given to the application of planter boxes, as additional resources are required to maintain both the boxes and the vegetation within them.

TABLE 14 - COMPARISON OF SEPARATION TYPES FOR STREET BUFFER ZONE

	Parking Lane	Flexible Delineator Post	Planter Box	Raised or Landscaped Median	Wheel Stop	Concrete Barrier
Protection from Vehicles	✓✓	✓	✓✓	✓✓	✓✓	✓✓✓
Ease of Implementation	✓✓✓	✓✓	✓✓	✓	✓✓	✓✓
Pedestrian Permeability	✓✓	✓✓✓	✓✓✓	✓	✓✓	✓✓
Capital Cost	$	$	$$	$$$	$	$$
Durability	?[1]	✓	✓✓[2]	✓✓✓	✓✓✓	✓✓✓
Maintenance Cost	$	$$$	$$$	$$$	$$	$
Suitable Posted Speed (km/h)	≤ 50	≤ 60	40 - 60	≥ 40	≤ 40	≥ 50
Aesthetic Value	✓✓	✓	✓✓✓	✓✓✓	✓✓	✓
Suggested Width (m)	0.3	0.5 - 0.9	≥ 0.9	≥ 0.8	0.3	≥ 0.9

[1] *Depends on additional separation used.*

[2] *Depends on material used.*

DRAINAGE

The design of protected bicycle lanes should consider drainage in all seasons. For street-level protected bicycle lanes, gaps should be left in the street buffer zone to allow runoff from the street to drain through the buffer, across the bicycle lane, and into the gutter.

Drainage considerations are more complex and determinant on whether the bicycle lane is being installed as a retrofit or greenfield corridor. On retrofits, drainage needs to consider the existing road profile and cross section, placement of catch basins, position of bicycle lane relative the existing curb line, and other constraints like private property tie-in points. Ideally, both the sidewalk, bicycle lane, and buffer zones should all drain towards the road where water can collect in the gutter between the street buffer zone and roadway.

This may not always be achievable, and the bicycle lane may need to be constructed to backslope to a second gutter being between the bicycle lane and sidewalk buffer zone. This treatment will require additional catch basin systems to capture water in the second gutter.

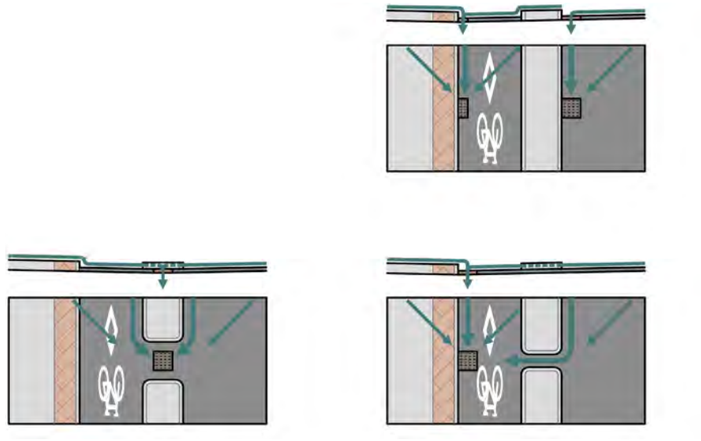


FIGURE 19 - DRAINAGE CONFIGURATIONS FOR PROTECTED BICYCLE LANES

4.3.3. Signs and 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. Additional guidance on pavement markings at intersections and crossings is provided in **Section 2.5**.

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

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.

4.3.4. Intersections and Crossings

General design guidance for intersections and crossings can be seen in **Section 2.5**. This section speaks to facility-specific considerations for protected bicycle lanes at intersections.

THROUGH MOVEMENTS

Similar, to non-protected bicycle lanes the main conflict points for through bicycle movements for protected bicycle lanes are motor vehicles turning across the bicycle lane in the intersection. The following sections provides a summary of treatments for common scenarios for protected bicycle lanes through intersections.

Uni-Directional to Uni-Directional

When a protected bicycle lane crosses an intersection, the design should mitigate conflicts between motorists and bicyclists. The following treatments should be considered to mitigate conflicts.

- **In General**
  - » Use conflict zone markings through the intersection as per guidance in **Section 2.5.4**.
  - » Limit or restrict on-street parking and vertical barriers near the intersection to improve sightlines and visibility of bicyclists
  - » Set back the stop bars for the right turn lane to improve visibility of bicyclists queuing at the intersection to right-turning motorists
- **At Signalized Intersections, Without Right Turn Lane**
  - » Where possible, use a protected bicycle phase with a 'No Right Turn on Red' ('Right Turn on Traffic Signal Prohibited') condition to remove conflicts between right-turning vehicles and bicyclists. This may impact the operation of the intersection depending on the length of the bicycle phase.
  - » If a permissive right turn on red phase is considered, there will be a higher exposure and potential conflicts for bicyclists. Additional signage should be used to indicate to motorists that they are required to yield to bicyclists.
- **At Signalized Intersections, With Right Turn Lane**
  - » Provide the right turn lane with separate signal phasing (protected right at the start or end of the phase) to reduce conflicts between bicycles and right-turning vehicles.
- **At Unsignalized Intersections**
  - » Install 'Turning Vehicles Yield to Bicycle Sign' (RB-37R) on the approach to intersection
- **At Intersection with Channelized Right Turn Lane**
  - » Refer to the discussion in **Section 4.2.4** for design guidance for bicycle lanes through intersections with channelized right turns

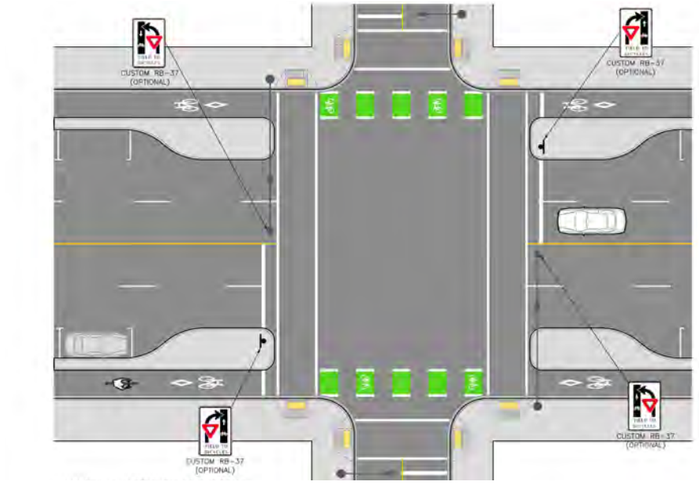


FIGURE 20 - CONTINUOUS PROTECTED BICYCLE LANE AT AN INTERSECTION (WITHOUT RIGHT TURN LANE)

LEFT TURN CONSIDERATIONS

For intersections where there is the ability to turn left from a protected bicycle lane to another bicycle facility, two-stage turn bike boxes or jughandles are recommended for less conflict. The two-stage approach would increase travel time, as bicyclist would need to make the left turn through two signal phases, however, the two-stage approach would have less conflicts with motorists by not needing mix in the general travel lane. Design guidance for these treatments can be found in **Section 2.5.3**.

Alternatively, consider using a protected intersection to manage turns from one facility to another. **Section 6.1** provides design guidance on protected intersections.

4.4. Shared Pathways

4.4.1. General

Shared pathways are off-street facilities that are physically separated from motor vehicle traffic and open to shared use by all types of active transportation modes. Shared pathways typically accommodate bi-directional travel for all users. Users travelling at different speeds (bikes and pedestrians) can be separated onto different sections of the pathway or different pathways altogether. Separated pathways are discussed further in **Section 4.5**. Shared pathways may be installed in a variety of land-use contexts and environments, including but not limited to:

- Parallel to an urban street, rural street, or highway.
- Parallel to or within rail, utility, and greenway corridors.
- Through park sites or adjacent to water features such as rivers or lakes.

Pathways in green spaces or outside the road right of way are discussed in **Section 5.0**.

While most shared pathways are comfortable for people of all ages and abilities, the diverse mix of users and speeds on shared pathways can create safety issues. The University of British Columbia Cycling in Cities Bicyclists' Injuries & the Cycling Environment - Bicycle Crash Circumstances Vary by Route Type: A Cross-sectional Analysis study found an increased injury risk associated with shared pathways as compared to separated bicycle pathways. The study found that this was due to the increase in conflicts between different types of pathway users.

The planning and design of shared pathways must be done with the same care and attention to user needs as the design of on-street bicycle facilities. Pathways need to consider connectivity to the network and destinations. A pathway on one side of the street is only appropriate when there are limited destinations on the other side. The intended use of the pathway is a key consideration to work out at the planning stage and is required to inform design.

Considerations should include whether the pathway will be used for commuting or recreation and the skill levels of intended users (beginner, intermediate or experienced). Facilities should serve the intended use and minimize potential conflicts between users of varying speeds, abilities, and purposes. **Table 15** provides an overview of key benefits and limitations associated with shared pathways.

TABLE 15 - KEY BENEFITS AND LIMITATIONS OF SHARED PATHWAYS

	Benefit	Limitations
Safety	Moves bicyclists off-street creating full separation between motor vehicles and cyclists. Comfortable for users of all ages and abilities.	Combines bicyclists and pedestrians creating conflicts between active modes users travelling at different speeds Visibility of bicyclists may be limited when approaching intersections mid-block crossings, alleyways, and driveways Conflicts at road crossings are more significant when bicycle traffic is bi-directional Level of protection may be reduced along corridors with many driveways and access points.
Cost (installing and maintaining)	Facilities are wider and vary less in width. Can be cost effective where existing corridors have larger boulevard in right of way.	May require additional road right-of-way, access easement or setback and would require consultation with impacted landowners. May impact existing utilities or trees in boulevard area. May require additional street lighting required to illuminate pathway. May require additional storm water systems (swales, culverts) to manage pathway drainage.
Impacts to road users	Generally, no impact to motor vehicle operations except at crossings No loss of parking or traffic lanes when the pathway can be built behind the existing curb line.	Crossing points can impact street operations as additional treatments may be required for safety. Pedestrians may lose dedicated facility as sidewalk is replaced by pathway. May not be as attractive for commuter bicyclists.
Applicability	Better suited for recreational uses Best suited along roads with wide boulevards or additional road right-of-way Can be used to upgrade pedestrian access on streets where sidewalks do not exist.	Not well suited for areas with high pedestrian or bicycle traffic. Not well suited along streets with frequent driveway/ access crossings.

TYPICAL APPLICATIONS

Shared pathways can be installed in a variety of contexts, within or parallel to different types of rights-of-ways and in various land use settings. Longer pathways will often use a variety of rights-of-way and pass through many diverse environments. Shared pathways are most appropriate in locations where there are few intersections, alleyways, and driveways. Specific applications of shared pathways are described below.

Urban and Rural Street Corridors

Shared pathways can be provided directly adjacent to the street with a horizontal and vertical separation. Pathways that follow the street are an attractive option as they provide the benefits of a direct route to services and land uses offered by on-street facilities, while providing a high level of comfort for users.

Shared pathways that are located within an urban street right-of-way may be considered along corridors where:

- Available right-of-way width is sufficient to install a pathway, additional lands can be acquired but will result in more impact and costs;
- The number of vehicle crossings across the pathway is limited (including driveways, accesses, laneways, and intersections);
- Pedestrian volumes are low;
- Land use along the corridor is not built up or not street-oriented;
- And/or continuity can be provided with an existing in-park pathway through a street corridor.

Highway Corridors

Pathways in highway corridors are under the jurisdiction of the Province's Transportation and Economic Corridor (TEC) Ministry. For discussion and design guidance for pathways in highway corridors refer to the Trails in Alberta Highway Rights-of-Way Policies, Guidelines, and Standards. Note the reference to a 'trail' in the Alberta Transportation document is equivalent to a shared pathway as referenced in this guideline.

In Parks and Green Space

Shared pathways are an ideal facility type for parks and green space. The application of pathways in parks and green space is discussed further in **Section 5**.

4.4.2. Facility Design Elements

This section provides design guidance for shared pathways in urban street right-of-way. Design guidance for pathways in parks and green space can be found in **Section 5.1**.

TRAVEL DIRECTION

Shared pathways typically function as bi-directional facilities. These facilities create a situation where a portion of the bicycle traffic rides against the normal flow of motor vehicle traffic, which can create safety and operational challenges at intersections and crossings. At intersections, turning motorists may not expect bicyclists approaching from the direction opposite the normal flow of traffic and fail to yield to these bicyclists as they turn through the intersection.

For instance, a left turning vehicle driver is typically looking for gaps in the approaching traffic and not from behind approaching the conflict point. Appropriate sight distances between motorists and bicyclists are important to allow both parties to react accordingly. Potential conflicts associated with pathway crossings can be mitigated through signage, pavement markings, and other design measures. These additional measures can help raise awareness to the drivers to the presence of bicyclists and where the bicyclists are coming from.

WIDTH

The width of shared pathways is described in **Table 16**. A typical section of a shared pathway with desirable width can be seen in **Figure 21 - Shared Pathway Adjacent to Roadways**.

TABLE 16 - SHARED PATHWAY WIDTH GUIDANCE

Facility Context	Desirable Width (m)	Constrained Width (m)
Collector and Arterial Streets		
Pathway Width	4.0	3.0
Buffer Width*	≥2.0	0.6
Local Streets		
Pathway Width	3.0	3.0
Buffer Width*	≥1.5	0.0

** Where a paved shoulder is present, the buffer begins at the outside edge of the shoulder. The width of paved shoulder does not count towards the buffer width.*

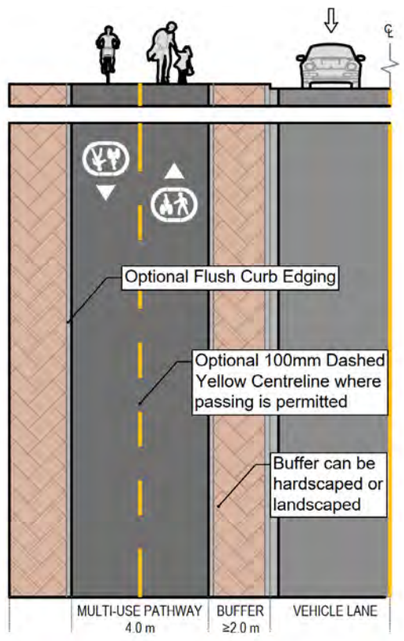


FIGURE 21 - SHARED PATHWAY ADJACENT TO ROADWAYS

LONGITUDINAL GRADE, CROSS SLOPE, SIDE SLOPE, AND DRAINAGE

Surface Materials

Asphalt is the preferred surface type as it creates a smooth continuous surface that accommodates the wide range of users served by shared pathways. Textured surfaces should be avoided as they can cause discomfort to bicyclists through vibration in movements.

Multi-Use Sidewalks

In some context-specific sections where other facility-types will not work, a shared sidewalk can be used to accommodate a short segment of a bicycle route. A shared sidewalk is a segment of sidewalk where bicyclists are legally permitted to ride. This would require the Town to designate this segment of sidewalk as a pathway through the addition of signage and pavement markings to denote the shared space, and/or update to the Towns pathway network map. The presence of signage and pavement markings on the segment will help communicate onsite that bicyclists may also use the sidewalk. Generally, a shared sidewalk will make use of an existing, wide sidewalk to connect two bike facilities through a constrained urban corridor. However, shared sidewalks should note be used in high traffic locations or high conflict locations without first mitigating the potential conflicts. Shared sidewalks should not be considered in new construction.

Shared sidewalks should have a minimum (constrained) width of 2.7m. This is the minimum width to accommodate the operating envelope of one bicyclist and two pedestrians' side by side. The length of a shared sidewalk should not exceed 200m or one typical Town block. Appropriate signage should be displayed noting the facility is a shared space (see the guidance for signage and pavement markings for shared pathways above).

4.4.3. Signage and Pavement Markings

The Shared Pathway (RB-93) sign indicates that both bicyclists and pedestrians are permitted to use the pathway. The sign should be placed at pathway entrances and other points along the pathway. Shared pathway symbols should be used to supplement signage and enhance awareness of the shared nature of the space. Shared pathway symbols should be placed at pathway entrances, far side of crossings, where a bicycle facility transitions onto a pathway, and any other areas where users may be entering the pathway.

Hazard striping should be added around any objects that intrude into or out of the pathway.

Pathways may use a directional (yellow) dividing line to distinguish the area for each direction of travel on the facility. The directional dividing line is recommended under the following conditions:

- On hills with a grade steeper than 5.0%
- At locations where passing is dangerous due to space or visibility constraints
- At locations where pathways experience high bi-directional volumes
- At access points and approaches, where the dividing line is used as tool to support wayfinding and demark the pathway

4.4.4. Intersections and Crossings

General design guidance for intersections and crossings can be seen in **Section 2.5**. This section speaks to facility-specific considerations for protected bicycle lanes at intersections.

INTERSECTIONS AND SIDE STREET CROSSINGS

There are two approaches to designing the alignment of a pathway as it approaches a side street crossing at an intersection: bending the pathway towards the parallel street or bending the pathway away from the parallel street. Bending the pathway away from the street is recommended as it provides greater safety benefits where a turning vehicle can stop off the street but before the crossing. Whereas bending the pathway towards the street requires less space. The benefits and constraints of each approach are described below.

BEND-IN CROSSING

A typical bend-in crossing is shown in **Figure 22 - Shared Pathway Bend-In Crossing.**

Benefits

- Easier to combine bicycle and pedestrian signals with existing traffic signals
- Requires less space to construct
- Allows side street motor vehicles to park closer to the intersection, improving intersection efficiency

Constraints

- Less space for pedestrian queuing to cross the parallel street
- Less space for turning vehicle stacking

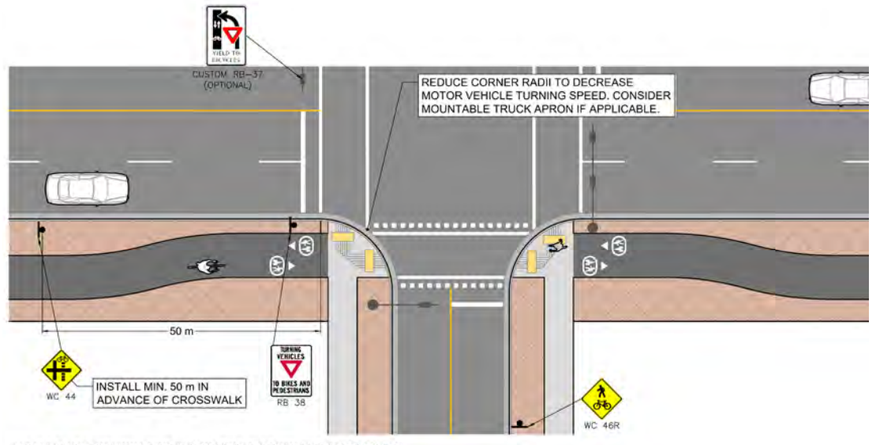


FIGURE 22 - SHARED PATHWAY BEND-IN CROSSING

BEND-OUT CROSSING

A typical bend-in crossing is shown in **Figure 23 - Shared Pathway Bend-Out Crossing**.

Benefits

- Provides additional reaction time for motorists turning onto the side street.
- Allows motorists to orient their vehicles perpendicular to the pathway before crossing, improving sightlines to pathway users in both directions.
- Provides stacking space for turning vehicles.
- Provides room for a bicycle box to facilitate bicyclists turning left off the pathway.
- Provides more space for pedestrians queuing to cross the parallel street.

Constraints

- Requires more space to construct.
- Sightlines for motorists on the side street may be reduced as the stop line is set back.
- Requires adequate sightlines for the turning motorists from the main street to the pathway crossing

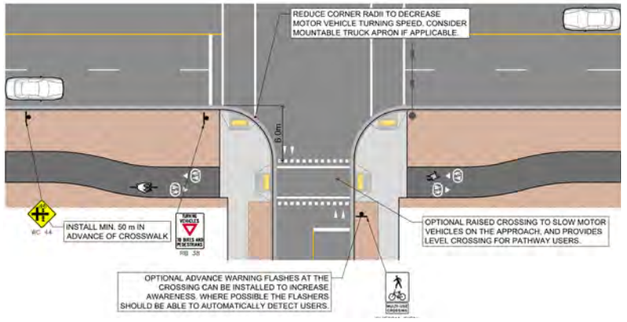


FIGURE 23 - SHARED PATHWAY BEND-OUT CROSSING

ALLEYWAY AND DRIVEWAY CROSSINGS

Pathways have a higher potential for conflicts at alleyway and driveway crossings due to bi-directional travel of bicyclists. Alleyway and driveway crossings should consider the following design guidance:

- Ensure sufficient sight lines for bicyclists and motorists to see each other approach the driveway. Remove on-street parking and other visual obstructions near the crossing to improve sightlines as necessary.
- Maintain material continuity through alleyway and driveway crossings to highlight to motorists they are crossing a bicycle facility.
- Maintain consistent pathway elevation through crossings and avoid ramping bicyclists up or down at steep grades.
- Use additional traffic control signage to reinforce motorist's legal requirement to stop before entering the street from an alleyway or driveway
- Where appropriate, bend the pathway toward or away from the parallel street. Design guidance for bending pathways at crossings is discussed earlier in this section. Bending pathways at crossings may be constrained depending on the built environment.

4.5. Separated Pathways

4.5.1. General

Separated pathways are off-street pathways designed for the exclusive use of bicyclists, separate from pedestrians. Separated pathways can accommodate uni-directional and bi-directional bicycle travel.

Separated pathways should always be used parallel to a separate pedestrian only facility (ie. sidewalk), otherwise pedestrians may use the separated pathway and limit its functionality as an exclusive facility. A buffer space should be provided between the separated pathway and the pedestrian facility to prevent encroachment into the exclusive facilities by the respective modes.

When used in conjunction with a parallel pedestrian facility, separated pathways act similar to shared pathways, except users are separated by speed where those on the pedestrian only facility travel at a lower speed. By separating the pathway by operating speed, this reduces conflicts and provides a more comfortable experience for both pedestrians and bicyclists. Separated pathways within road rights-of-way are also more suitable when designing for uni-directional bicycle travel.

TABLE 17 - BENEFITS AND LIMITATIONS OF SEPARATED PATHWAYS

	Benefit	Limitations
Safety	Moves bicyclists off-street creating full separation between motor vehicles and cyclists. Comfortable for users of all ages and abilities. Separates pathway users travelling at different speeds.	Visibility of bicyclists may be limited when approaching intersections mid-block crossings, alleyways, and driveways. Conflicts at road crossings are more significant when bicycle traffic is bi-directional.
Cost (installing and maintaining)	Winter maintenance easier than other facilities that require special maintenance equipment as facilities are wider and vary less in width Can be cost effective where existing corridors exist	Generally, more expensive than installing on-street facilities within existing road width. Requires additional road right-of-way, access easement or setback and would require consultation with impacted landowners. May impact existing utilities or trees in boulevard area. May require additional street lighting to illuminate pathway. May require additional storm water systems (swales, culverts) to manage pathway drainage.
Impacts to road users	Generally, no impact to motor vehicle operations except at crossings. No loss of parking or traffic lanes when the pathway can be built behind the existing curb line.	Crossing points can impact street operations as additional treatments may be required for safety.
Applicability	Best suited along streets with wide boulevards or additional road right-of-way. Along corridors with higher volumes of pedestrian and bicyclists' traffic.	Not well suited along roads with frequent driveway crossings

4.5.2. Facility Design Elements

TRAVEL DIRECTION

Separated pathways should be placed between pedestrian facilities and the street. Separated pathways can accommodate both uni-directional or bi-directional travel. When considering a bi-directional facility, consider the challenges of contraflow bicycle movements. Uni-directional pathways should be placed on the same side of the street as the corresponding direction of traffic. Bi-directional pathways should have additional design elements such as signage and pavement markings at intersections and crossings to increase motorist awareness and mitigate the unpredictability of the contraflow movement.

A design consideration for mitigating potential conflicts may also include restriction on left turning movements at intersections and crossings.

WIDTH

The width of separated pathways is described in **Table 18**. A typical section of a separated pathway with desirable widths can be seen in **Figure 24 - Separated Pathway Typical Section**.

TABLE 18 - SEPARATED PATHWAY WIDTH GUIDANCE

Facility	Desirable (m)	Constrained (m)
Uni-directional Separated Pathway	2.0*	1.8
Bi-directional Separated Pathway	4.0	3.0
Street buffer (with no parking)	0.9	0.0**
Street buffer (with parking)	0.9	0.6
Sidewalk buffer	2.0	0.25

** If a uni-directional separated pathway has greater than 150 bicyclists per peak hour for bicycle traffic or there is a desire for side-by-side riding, then the pathway width should be 2.5m or greater*

***If vertical separation in the form of curb is provided between the street and pathway, then there does not need to be a street buffer for a constrained scenario (this does not apply if the pathway is adjacent parking). Note a street buffer is still desirable regardless of vertical separation between the pathway and the street.*

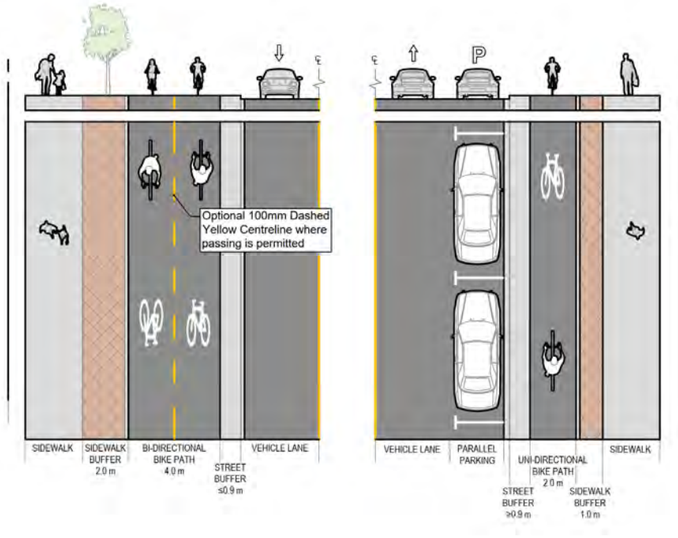


FIGURE 24 - SEPARATED PATHWAY TYPICAL SECTION

TYPES OF SEPARATION

Street Buffer Zone

The street buffer zone is the space between the separated pathway and the street, separating bicyclists and motorists. A standard vertical curb should be used to provide separation between the street and the pathway. While the vertical separation may be sufficient to separate the two modes, adding a wider horizontal buffer increases comfort for bicyclists riding adjacent traffic, creates space for snow storage, and removes bicyclist from the door zone when the pathway is adjacent to a parking lane.

Sidewalk Buffer Zone

The sidewalk buffer zone is the space between the separated pathway and sidewalk, separating bicyclists and pedestrians. As the separated pathway is located at sidewalk level, there should be a strong indication as to which space is designated for which user and that there is a buffer that separates the two spaces.

Sidewalk buffers should provide a detectable edge on the sidewalk side of the buffer. This allows pedestrians with limited vision to detect the edge of the pedestrian area and allow them to distinguish the sidewalk from the separated pathway. The detectable edge should be designed so it does not create an obstacle or tripping hazard for users.

The buffer zone can include use of grass/landscaping, textured pavement, directional tactile warning surface indicators, detectable concrete buffer curb and/or coloured surfaced materials to make this distinction between the two spaces. Vertical elements such as street furniture and trees also help differentiate between the two spaces. 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 pathway area when needed.

CROSS SLOPE, SIDE SLOPE, AND DRAINAGE

Separated pathways should be installed flush to the street buffer zone and sidewalk buffer zone to eliminate the hazard of having a drop off on the edge of the pathway. Cross slope should be within 1.0% and 2.0%.

Where possible, the street buffer zone, pathway, sidewalk buffer zone, and sidewalk should all cross slope towards the road. If this is not achievable, alternate drainage solutions such as back sloping the pathway and providing a gutter with catch basin systems in the sidewalk buffer zone should be explored, or consideration of capturing the stormwater flow in a low impact development and landscape feature.

4.5.3. Signage and Pavement Markings

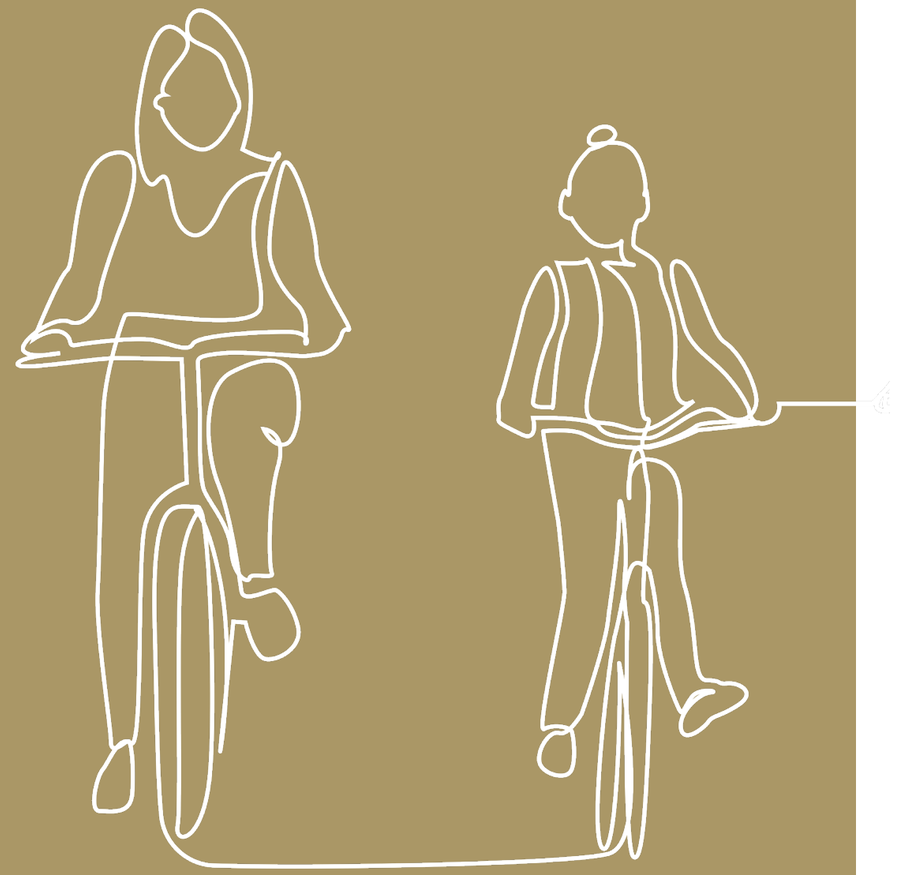
The Bicycle Pathway (IB-23 -1) sign indicates that bicyclists are permitted to use the pathway and should be used along the separated pathway. The Pedestrian Prohibited Sign (RB -66) can be used as in conjunction to deter pedestrian use on the bicycle pathway. If the bicycle pathway is situated close to the sidewalk then the Pathway Organization Signs (RB -94 R/L) can be used. If there are large bicyclist or pedestrian volumes in an area, then the Pathway Organization Sign is encouraged.

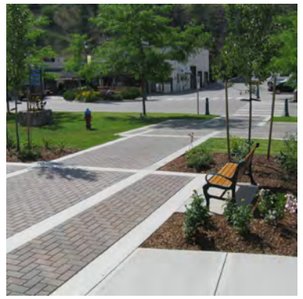
Separated pathways can be marked with the bicycle symbol to supplement signage. Arrows can be added to the bicycle symbols to denote the directionality of the pathway. Pedestrian symbols can be applied to the sidewalk to further distinguish the separation of the bicycle and pedestrian spaces.

4.5.4. Intersections and Crossings

At intersections bi-directional separated pathway should generally follow the design guidance for shared pathways at intersections as seen in **Section 4.4.4**. Uni-directional facilities should follow the design guidance of protected bicycle lanes as shown in **Section 4.3.4**, but the uni-directional pathway should ramp down in advance of the intersection and cross at street level, similar to protected bicycle lanes.

5. Facilities in Green Space





5.1. PATHWAYS (SHARED AND SEPARATED)

While bicycle facilities in parks generally share the same design elements as their counterpart facilities in-road-right-of-way, there are design considerations that are specific to in-park facilities. This section discusses specific design considerations for bicycle facilities in-park space.

5.1.1. GENERAL

Pathways are well suited for parks, greenspace, and greenway corridors. Typically, pathways in green space serve a recreational use, whereas other facilities serve utility and commuter uses. Specific concerns for pathways in green space include lighting, managing environmental impacts, and managing drainage and stormwater runoff.

5.1.2. FACILITY DESIGN ELEMENTS

The following section provides design guidance for shared pathways in green space, unless otherwise specified in this section, design guidance for pathways in road right-of-way may also be referenced.

SHARED PATH WIDTH

Table 19 provides direction on pathway width for regional connection and local or community connections. Regional pathway width may be increased for areas with higher anticipated activity levels and/or if the pathway is part of a greater extensive pathway system, such as the Trans Canada Trail.

TABLE 19 - SHARED PATHWAY WIDTH GUIDANCE

Facility Context	Desirable Width (m)	Constrained Width (m)
Regional Pathway Width	4.0	3.0
Local/Community Pathway Width	3.0	2.5

SEPARATING PATHWAY USERS

Separating bicyclists from other pathway users can help to enhance pathway safety and make the facility more comfortable for all users. The decision to separate pathway users is based on several factors including right-of-way width available, the total volume of current and anticipated pathway users, the function of the pathway and the adjacent spaces, and the ratio of pedestrians to daily pathway users.

For shared pathways that have already been constructed, the TAC Geometric Design Guide for Canadian Roads provides the following guidance for when to separate users:

- Where there is a high percentage of pedestrians (more than 20% of users) and total user volumes greater than 33 persons per hour per metre of pathway width; or,
- Where there is a low percentage of pedestrians (less than 20% of users) and a total user volume greater than 50 persons per hour per metre of pathway width.

In locations where no pathway is currently in place, existing and future use of the adjacent spaces should be considered as well as ridership numbers on existing facilities within a similar context to obtain an understanding of projected volumes. The width of the pathway is also another important consideration for separating users, as indicated in **Table 20.** This table applies the guidance described above from the TAC Geometric Design Guide for Canadian Roads and summarizes when separation is recommended based on pathway width.

More generally, communities such as the City of Vancouver and guidance from Australia suggest that if there are 1,500 combined users on a facility that is between 3.0 to 4.0 metres in width, and if space is available, separation of people walking and bicycling is recommended.

If separation is recommended, a separated pathway should be provided for bicyclists and an adjacent pedestrian pathway should be provided for pedestrians.

TABLE 20 - GUIDANCE ON SEPARATION OF USERS ON PATHWAY

User Rate	Daily anticipated user volume for various pathways widths for seperation (users)		
	3.0m	3.5m	4.0m
More than 20% of users are pedestrians	1,000	1,200	1,400
Less than 20% of users are pedestrians	1,500	1,750	2,000

SEPARATED PATHWAY WIDTH

When separating pathway users, the following design guidance for pathway width should be used.

TABLE 21 - SEPARATED PATHWAY WIDTH GUIDANCE IN GREEN SPACE

Facility	Desirable (m)	Constrained (m)
Separated (Bicycle) Pathway	4.0	3.0
Pedestrian Pathway	2.4 – 3.0*	1.8

** 2.4m should only be used in retrofit and constrained locations where 3.0m cannot be achieved.*

SEPARATION TYPES

This section provides guidance on the space or treatment that can be used to separate bicycle users from other pathway users. Separating pathway users can be done by providing visual or physical separation between users and some of the considerations associated with each are described in **Table 22**.

TABLE 22 - TYPES OF PATHWAY SEPARATION

Separation Type	Design Considerations
Paint Separation	Provides visual cue to pathway users a separate space is designated for each type. Can be difficult to detect separation, users may encroach into each others space. Minimal impact to the overall width of the facility.
Detectable Concrete Buffer or Curb Separation	Provides physical and detectable separation between facilities. Can make width of both facilities feel more constrained with less room for passing. Can create a tripping hazard if visibility of the curb is limited due to poor lighting or weather conditions. Curbs/detectable edge should be designed at an angle that is traversable for those with limited mobility while cane detectable. Can impact cross slope pathway drainage and crossing opportunities. However, when designed property can be used to aide in directing drainage along the pathway.
Boulevard Separation	Provides buffer space between facilities creating a greater degree of separation. Creates space for landscaping and opportunities to facilitate drainage. Increased maintenance may be required to maintain vegetation in green space. Requires more land to implement.
Median and Furniture Separation	Provides highest degree of separation between users. Opportunities to add amenities for pathway users. Creates inviting environment. Requires more land to implement

The following figure illustrates the different types of pathway separation noted in **Table 22**.

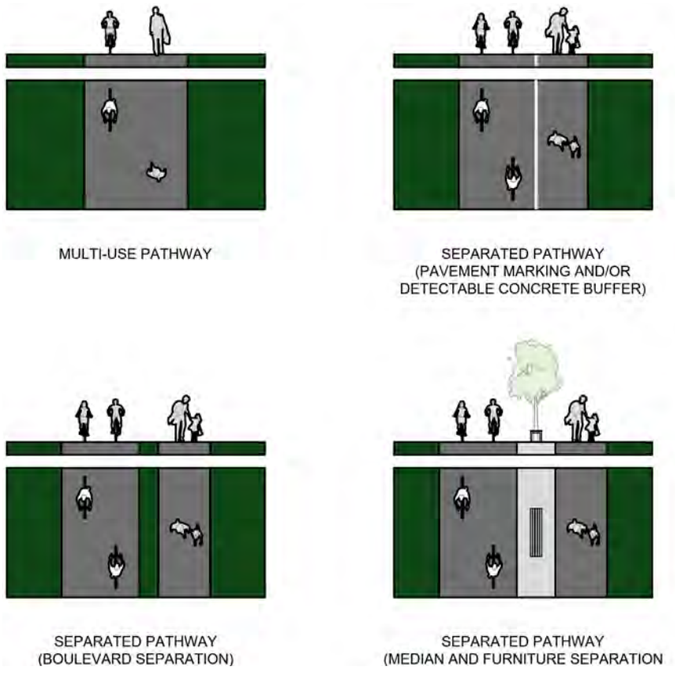


FIGURE 25 - TYPES OF PATHWAY SEPARATION

For separated pathways with a buffer between the bicycle and pedestrian pathway, the recommended buffer width is 0.5 to 1.0m. Buffers adjacent a pedestrian facility should have a detectable edge to allow people with limited vision to distinguish between the bicycle and pedestrian pathway. At crossing locations, gaps in the separations should be provided to allow users to cross over the respective facilities.

LONGITUDINAL GRADE

Longitudinal grade is an important consideration for accessibility and drainage. A minimum grade of 0.6% is required to facilitate drainage and the desired maximum grade is 4.0% or less. For pathways with grades of 5.0% or greater, flatter resting areas of 3.0% or less should be provided at regular intervals. Guidance for the frequency of resting areas is provided in **Table 23** below.

TABLE 23 - FREQUENCY OF RESTING AREAS FOR PATHWAYS WITH GRADES OF 5.0% OR GREATER

Grade	Resting Area Frequency
5.0% to 6.0%	Provide a resting area of 3.0% or less every 100 meters
6.0% to 8.0%	Provide a resting area of 3.0% or less every 50 meters
8.0% or greater	Explore alternatives such as switch backs or alternate routing to reduce the longitudinal grade

CROSS SLOPE

The desired cross slope is between 1.0% to 2.0%. Cross slopes less than 1.0% will have reduced drainage and may lead to ponding or icing on the pathway. Cross slopes greater than 2.0% may be inaccessible to pedestrians using mobility aids such as non motorized wheelchairs. Pathways are also recommended to be crowned to mitigate drainage concerns on the pathways.

SIDE SLOPE

The side slope is the slope of the drop-off on the edge of the pathway. A drop-off may be created when the elevation of the pathway must be raised above the existing surface to provide a smooth longitudinal grade in areas with steeper grades or inconsistent elevation. Where possible, pathway design should avoid drop-offs and match the pathway elevation to existing surface elevation.

Side slopes can create hazards as pathway users may "fall" off the edge of the pathway when there is a large drop-off or steep slope. Where a drop-off exists, the desirable side slope is 3:1 or shallower. Side slopes should not be steeper than 1:1. In all situations, a minimum of 0.6 m of clear space should be provided on both sides of the pathway to mitigate the hazard of the side slope. A minimum of 1.5 m of clear space should be provided under the following conditions also shown in **Figure 27**.

- Side slope of 1:1 and a drop-off greater or equal to 0.3 metres
- Side slope of 2:1 or steeper and a drop-off greater or equal to 1.2 metres
- Side slope of 3:1 or steeper and a drop-off greater than 1.8 metres

If the 1.5 metres of clear space can not be provided under the above conditions, then railing or barrier should be used at the edge of the pathway to mitigate the hazard. The railing should have a minimum height of 1.4 metres.

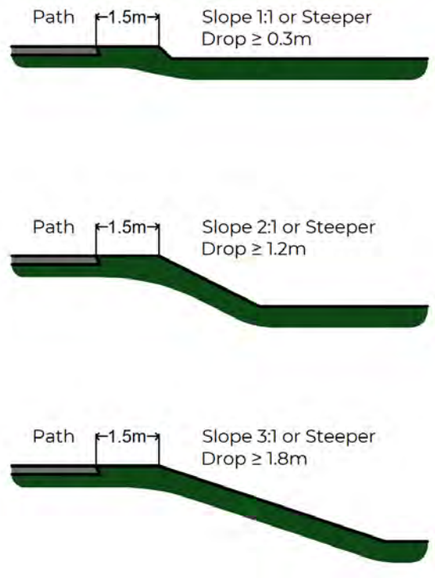


FIGURE 27 - TYPES OF PATHWAY SEPARATION

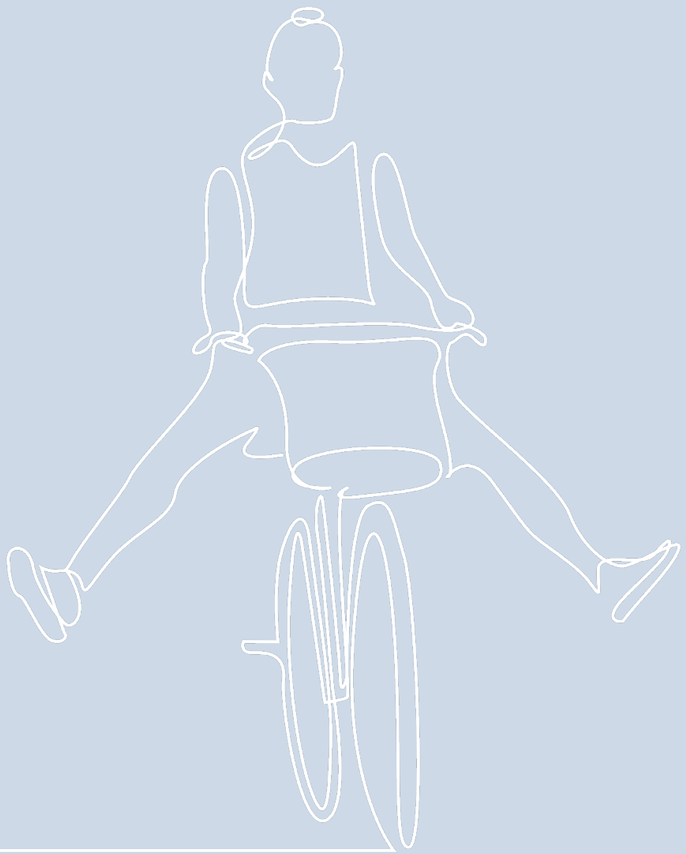
5.1.3. SIGNAGE AND PAVEMENT MARKINGS

Design guidance for signage and pavement markings of pathways in green space should follow the guidance for shared pathways and separated pathways in road right-of-way in Section 4.4 and Section 4.5 as well as Signage and Wayfinding in **Section 2.2** and **Section 2.4**.

5.1.4. INTERSECTIONS AND CROSSINGS

Design guidance for intersections and crossings of pathways in green space should follow the guidance for shared pathways and separated pathways in road right-of-way in **Section 4.4** and **Section 4.5**.

6. Specialized Areas



6.1. Protected Intersections

Protected intersections provide a high level of comfort and safety for bicyclist interactions at intersections. They establish predictable movements, indicate clear right-of-way, and add protected design elements to the intersections.

Protected intersections should create intuitive, low-stress movements for bicyclists in all directions. Conflicts between right-turning vehicles and through bicyclists are eliminated and conflicts between bicyclists and pedestrians are minimized by separating users.

6.1.1. Typical Application

Protected intersections are appropriate to apply under the following conditions.

- At signalized or multi-way stop-controlled intersections,
- At large intersections with multi-lane streets and complex signal phasing
- At smaller, simpler intersections
- Typically used with protected bicycle lanes, but can also be used for neighbourhood bikeways and unprotected bicycle lanes, where those facilities are transitioned into short segments of protected bicycle lane before the intersections

6.1.2. Design Guidance

The following design elements are key components in a protected intersection. The elements are shown in **Figure 28**. Further design guidance for protected intersections can be found in TAC Design Guide.

Corner Refuge Islands

Raised area that creates a protected queuing space for bicyclists. Use raised curb to prevent motor vehicle encroachment on the queuing space.

Setback Bicycle and Pedestrian Crossings

Crossings are setback to improve the visibility of crossing pedestrians and bicyclists to turning vehicles and increase the time and space users have to react to potential conflicts.

Tapered Approaches to Intersections

The bicycle lane may have to shift away from the motor vehicle lane to align with the setback crossing. The tapered approach also slows bicyclists as they approach the intersection and the pedestrian crossing across the bicycle lane.

Forward Bicycle Queuing Areas

Allowing bicyclists to wait in a forward queuing area shortens the crossing distance and increases the visibility of bicyclists to right-turning motorists.

Pedestrian Crosswalks over Bicycle Facility

Bicyclists must yield to pedestrians crossing the bicycle facility to wait in the pedestrian refuge area. The crosswalk should be marked with a zebra crosswalk pavement markings and additional yield pavement marking may be placed in advance of the crosswalk. Tactile strips should be used before and after the bicycle lane.

Pedestrian Refuge Islands

Similar to the forward bicycle queuing areas, the pedestrian refuge islands shorten the crossing distance and increases the visibility for pedestrians crossings the street. Tactile strips should be provided on both sides of the refuge islands.

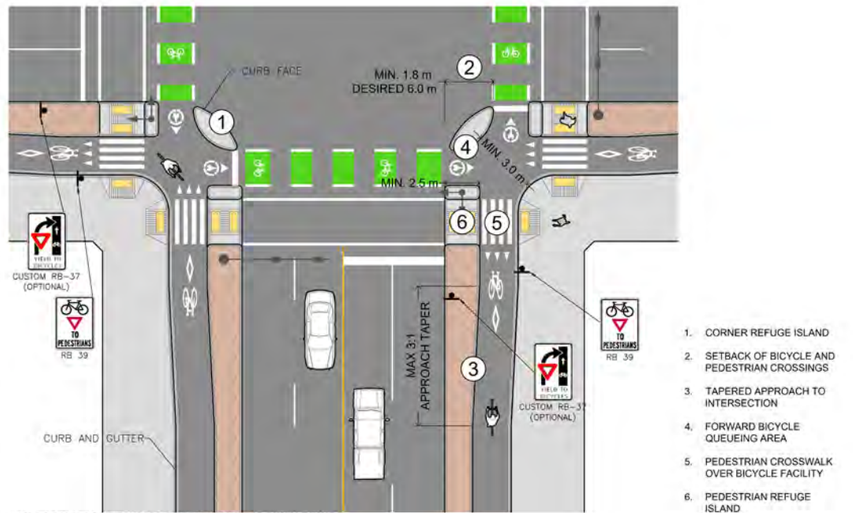


FIGURE 28 - PROTECTED INTERSECTION

6.2. Roundabouts

A roundabout is a circular intersection in which traffic travel counterclockwise, and where vehicles entering the roundabout must yield to circulating traffic. Roundabouts should not be confused with traffic circles, which are a type of traffic calming treatment discussed earlier in the guide. Roundabouts are typically implemented on higher classification streets.

DESIGN GUIDANCE

This section provides general design considerations for roundabouts with bicycle facilities. Detailed design guidance for roundabouts can be found in the Canadian Roundabout Design Guide.

- On-street bicycle facilities should transition to off-street bicycle facilities in advance of the roundabout. On-street bicycle facilities should not continue through a roundabout.
- Bicycle crossing should be parallel to pedestrian crossing and at-grade across the splitter island. The splitter island should provide adequate width for a bicycle to queue on the island.
- Where possible, use single lane exits for motor vehicles to improve safety for crossing bicyclists, as it minimizes the number of potential conflicts. Where multi-lane exits are required, use additional measure to increase yielding compliances like bicycle actuated signal devices (ie. RRFBs) or raised crosswalks.
- The space at the exit and entrance lane between the outer edge of the roundabout lane and the inner edge of the bicycle and crossing area should provide enough room for a motor vehicle to queue. This allows motor vehicles to stop before the crossing when exiting the roundabout and stop after the crossing when entering the roundabout, discouraging motorists from stopping in the crossing itself.
- Bicycle and pedestrian crossings should be separated with the bicycle crossing closer to the roundabout
- Crossings should be marked similar to crossings at channelized right turns.

6.3. Transit Stops

Transit stops are high-conflict zones when adjacent to bicycle facilities. On-street facilities may create conflicts between bicyclists and stopped transit vehicles and/or off-street facilities may create conflicts between bicyclists and transit users who are waiting, boarding, or alighting. Poor bicycle facility design around transit stops can create barriers for transit users and potentially limit access to transit, as pedestrians must interact with a higher speed mode when stopping on and off the bus. It is critical that bicycle facility around transit stops considers transit users in addition to bicyclists.

This section provides general design considerations for bicyclists' facility adjacent bus stops. Additional background and further design guidance can be found in the BC and Translink Design Guide for Bus stops Adjacent to Cycling Infrastructure, 2024.

6.3.1. Design Guidance

Where possible, conflicts between bicyclists on the bicycle facilities and passengers at the transit stops should be removed entirely. Bicycle routes should avoid major transit routes and bi-directional facilities should be placed on the side of the street with the lower amount of bus stops. Alternatively, bus stops should be relocated to side streets or other areas off the bicycle route. Relocation should be done without compromising the connectivity or accessibility for users of both modes.

As bicycle facilities approach bus stops, they should be transitioned off street and/or ramped up to match the elevation of the bus pad and sidewalk. Bicycle facilities should be routed behind the bus stop to create an 'island' for transit users waiting for the bus. This treatment removes potential conflicts between bicyclists and transit users by moving bicyclists out of the boarding/alighting zone as they pass the transit stop.

Key features that are common in transit stops adjacent bicycle facilities are shown in **Figure 29** and generally include:

1. Island platform where transit users wait to board and alight the bus. This area is generally where amenities such as transit shelters, benches and transit wayfinding signage are located.
2. Wheelchair pad to allow transit users using mobility devices to board and alight using a mechanical ramp deployed from the bus. A typical minimum width of transit islands is 2.5m wide to provide sufficient space for the ramp deployment.
3. Bikeway is the area where bicyclists are guided through the bus stop. The bikeway should be raised to sidewalk elevation and can be narrowed to slow down bicyclists as they pass through the bus stop.
4. Marked pedestrian crossing provides a clear location for pedestrians to cross the bikeway and indicates to bicyclists that they should yield to pedestrians crossing to or from the bus stop.
5. Edge treatment should be detectable by people with sight loss and be provided between the bikeway and sidewalk and bikeway and island platform.
6. Tactile attention indicators mark crossing locations for people with sight loss.

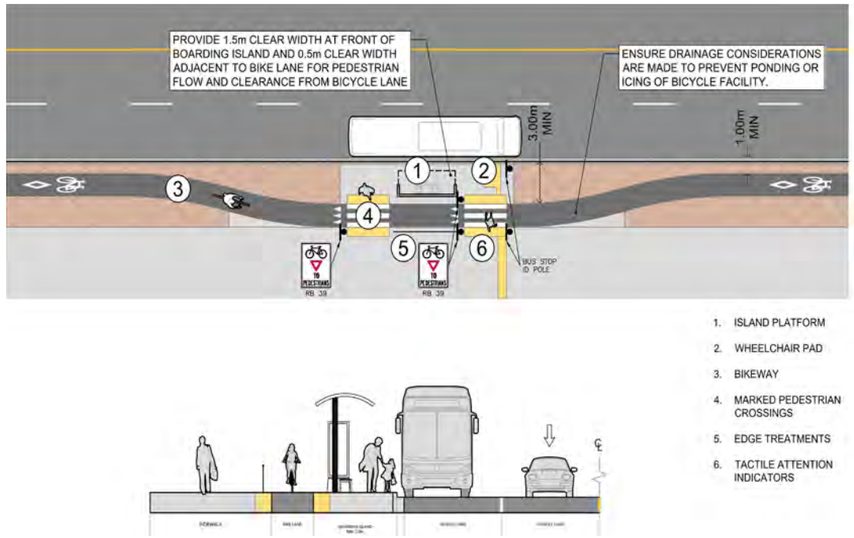
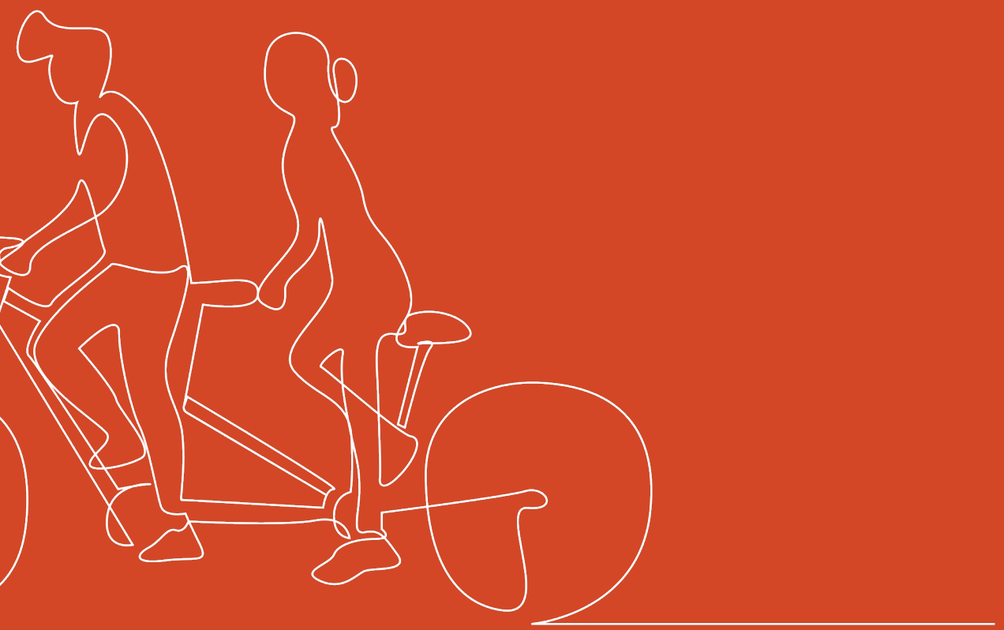


FIGURE 29 - BUS STOP ADJACENT A BIKE FACILITY

7. Maintenance



7.1. ANNUAL MAINTENANCE PROGRAM AND LIFE CYCLE REPLACEMENT

Regularly scheduled maintenance is important to ensure that bicycle facilities are safe and comfortable for all users at all times of the year. At minimum, semi-annual maintenance should be conducted in the spring and fall to clean up debris and repair any damage that has occurred due to seasonal changes. A regular bicycle facility maintenance program should include:

- Sweeping of on- and off-street bicycle facilities;
- Maintaining a smooth riding surface;
- Ensuring that the gutter-to-pavement transition remains relatively flat;
- Installing bicycle-friendly drainage grates;
- Performing seasonal vegetation management; and,
- Inspecting signage, pavement markings, and lighting, and replacing them as necessary.

Bicycle facilities should be regularly assessed for surface damage, debris, and vegetation hazards. Creating and maintaining an inventory of maintenance issues helps track maintenance concerns and identify problem areas that may require additional mitigation or more frequent maintenance. Creating a scheduled maintenance program can also help track annual operational costs by facility type, aid in establishing future operation and maintenance budgets, and inform future design choices. Bicycle facilities should be considered part of the Town assets, and it is important to appropriately manage them. It is recommended that the Town:

- Track the assets.
- Proactively schedule maintenance, repair and preservation activities.
- Develop maintenance targets (for things such as signage, pavement surface quality, pavement marking replacement timeframes, or snow clearance time).
- Inspect assets and track against maintenance targets; and
- Set and adjust maintenance budgets to meet maintenance targets

Life cycle cost accounting should also include assessing other components of bicycle facilities, such as bollards, ramps, planters, pavement markings, lighting, and surface materials. This information can then be used to compare different materials, installation techniques, and maintenance practices. Understanding the total cost of an asset enhances financial planning and decision-making by helping the Town select the most cost-effective infrastructure when evaluating design options.

7.2. FACILITY SWEEPING

Bicycle facilities should be kept free of debris as bicyclists may choose to avoid using designated bicycle facilities if there is debris present. Instead, bicyclists may choose to ride in the street or on the sidewalk potentially causing conflicts with other road users. Recommended guidance for street sweeping includes:

- Incorporate bicycle facilities into established street sweeping programs; and/or establish a seasonal sweeping schedule that prioritizes bicycle facilities.
- Sweep bicycle facilities whenever there is an accumulation of debris on the facility.
- Pave gravel driveway approaches to minimize loose gravel on paved street shoulders.
- Perform additional sweeping in the spring to remove loose gravel and other debris accumulated over winter.
- Perform additional sweeping in the fall in areas where leaves accumulate.

7.3. SIGNAGE AND PAVEMENT MARKING MAINTENANCE

Signage and pavement markings must remain visible along bicycle routes, as they help to identify the facility type to all street users, allow or restrict certain types of vehicles, warn users of potential conflict zones, and provide wayfinding for bicyclists. Regular inspection of signage and pavement markings is necessary to ensure they are kept in good condition. Pavement markings with paint should be refreshed annually, or twice a year if needed. Pavement markings using thermoplastic last longer and may not need to be refreshed annually. Reapplication of pavement markings also varies depending on the location of the marking.

Typically, markings under motor vehicle wheel path wear out faster than other markings. It is recommended that symbol markings be placed outside of wheel path where possible to minimize the wear and tear on it. Markings on streets with higher motor vehicle traffic also wear out faster than those on lower traffic volume streets. Snow clearing or removal equipment can also impact the longevity of the pavement marking.

The choice of material for pavement markings is important. The material used should be durable, highly visible, and should provide adequate traction in all street conditions. As comparison of the benefits and limitations of various pavement marking materials are shown in **Table 25**.

TABLE 25 - BENEFITS AND LIMITATIONS OF PAVEMENT MARKING MATERIALS

Type of Pavement Marking	Lifespan	Retro-reflectivity	Slip Resistance	Cost
Paint	Low Lifespan (12 to 48 months)	Low	Can become slippery	Low cost
Epoxy (includes: DLPM and MMA)	Low Lifespan (12 to 48 months)	Medium	Combined with abrasive material to reduce slip	Low to medium cost
Thermoplastic	Medium Lifespan (48 to 72 months) *	Medium	Combined with abrasive material to reduce slip	Medium to high cost

** All pavement marking materials may have shortened lifespans depending on the amount of snow and ice control and the volume of motor vehicle traffic traveling over the markings.*

7.4. WINTER MAINTENANCE

People will be more willing to bicycle year-round if high-quality bicycle facilities are built and maintained through the winter.

7.4.1. SNOW AND ICE CONTROL PRIORITIZATION

The Town currently clears snow on streets once three centimetres of snow has accumulated and removes snow from streets once accumulation impacts traffic flow. Publicly maintained sidewalks and pathways are operational by separate business units and cleared within 48 hours of a snowfall. Snow and ice control on the bicycle network should be prioritized like the rest of street network, with the highest demand bicycle facilities receiving the highest priority treatment, followed by treatment on other routes in order of their demand and network importance. Prioritization should consider network connectivity such that the high-priority snow and ice control routes create a connected network of cleared bicycle facilities. Each subsequently cleared route will then fill out the network.

The desired pavement condition after plowing and de-icing should be identified for each priority level and facility type. Three facility priority levels are recommended for snow clearing purposes along bicycle routes. Note that these recommendations are subject to the Town's Snow & Ice Removal Policy.

Priority 1

- Priority 1 routes should include all bicycle facilities that have high daily bicycle traffic volumes and provide important connections to destinations like schools, transit, high density neighbourhoods, and business districts. Priority 1 routes should be cleared within 24 hours of the end of a snowfall and should be cleared to bare pavement. When possible, high priority routes should be cleared in time for people commuting as to increase the reliability of the winter bicycle network for bicyclists commuting to work and/or school.

Priority 2

- Priority 2 routes should include routes with medium daily bicycle traffic volumes and should be cleared with 48 hours of the end of a snowfall to bare pavement.

Priority 3

- Priority 3 routes should include routes with low daily bicycle traffic volumes and should be cleared with 72 hours of the end of a snowfall to bare pavement.

Where high priority winter maintenance bicycle routes exist, consideration should be made to clear the sidewalk adjacent the bicycle route as quickly as the bicycle facility itself. If a bicycle facility is cleared and an adjacent sidewalk is not cleared, pedestrians may choose to walk in the bicycle facility instead of the sidewalk. This can cause additional conflicts along the bicycle facility between bicyclists and pedestrians.

7.4.2. FACILITY DESIGN FOR EFFICIENT SNOW STORAGE

Snow storage can present a significant challenge along bicycle facilities. Unprotected bicycle lanes often become the area for snow storage on the street, making the bicycle facility unusable. In addition, the snow often covers the bicycle lane, making the lane difficult to identify or too narrow to be used comfortably. One of the most effective ways to mitigate snow storage and clearing is through careful consideration of maintenance during the planning and design process. There are several design elements that can be considered to create efficient snow storage:

Plan streets with sufficient right of way: New streets or retrofit projects should provide enough space for the desired width of the bicycle lane and buffer space (as opposed to the constrained width). A desired buffer width allows for snow storage to occur without impacting the bicycle lane. Further, a desired bicycle lane width allows some narrowing of the lane to occur due to snow build up while maintaining the functionality of the facility.

Provide a wide bicycle lane buffer: A minimum 0.6m buffer is recommended to accommodate snow storage from a moderate snowfall with minimum encroachment into the bicycle lane. Gaps should be provided in the snow piles/windrows to allow for drainage to get through during snow melt.

Provide a wide buffer on sidewalk: Buffer space should be provided along the street amenity zone of the sidewalk so snow cleared from the pedestrian through zone can be stored on the sidewalk and is not pushed into the bicycle facility. Similar to snow piles/windrows on streets, gaps should be provided to allow for drainage from snow melt to get to the street and minimize ponding and icing on the adjacent sidewalks.

7.4.3. BICYCLE ROUTE DE-ICING CONSIDERATIONS

An overview of the common types of de-icing materials used on streets and bicycle facilities, including their advantages and disadvantages and considerations of how they may impact bicyclists, are provided in the table below.

TABLE 26 - COMPARISON OF COMMON DE-ICING MATERIALS

Material	Application	Advantages	Disadvantages
Salt	Salt is applied to the street Traffic crushes the salt to dissolve it and create a brine Brine prevents ice from bonding to the street	Easy application Readily available	Highly corrosive Stormwater runoff can cause environmental damage Bikes not heavy enough to crush salt
Pre-Wetted Salt	Street salt is sprayed down with a brine solution either before or during applications to improve the dissolution of the salt	Quicker reaction time, less material, and more uniform application than dry salt	Require special equipment and additional labour to prepare Highly corrosive Stormwater runoff can cause environmental damage
Sand and Gravel	Abrasive used to provide street traction Usually applied in conjunction with salt or other de-icing treatments		Sand can create a mechanical hazard for bicyclists Larger aggregate can create a loose surface for bicyclists
Beat Juice Additive	Used In combination with salt and/or salt brine Improves adherence of salt and sand to street Lowers freezing temperature of ice	Less corrosive than road salt Can be used to reduce number of de-icing applications required	Stormwater runoff can cause environmental damage
Cheese Brine Additive	Used In combination with salt and/or salt brine Improves adherence of salt and sand to street Lowers freezing temperature of ice	Less corrosive than road salt Can be used to reduce number of de-icing applications required More environmentally friendly than beet juice additives	Cost savings vary depending on proximity to local production source
Warm Wetted Sand	Applied using a specialized truck with a water tank, water heater, and sand storage Sand and water mixed and applied to street to provide traction	Wet sand provides better traction than dry sand and reduces overall amount of sand needed	Require special equipment and additional labour to prepare Sand can create a mechanical hazard for bicyclists Larger aggregate can create a loose surface for bicyclists