JANUARY 2020

BC Parkway Corridor Design Guide

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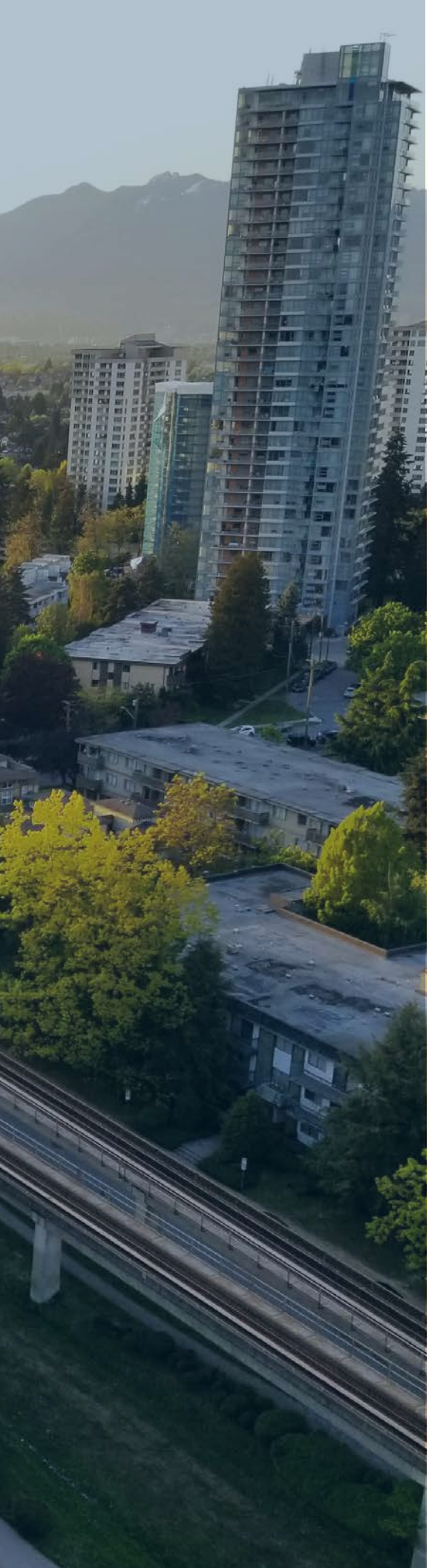

Design Highlights

Throughout this Design Guide, a yellow square on the top corner of the page indicates that detailed design guidance with examples is provided.

TRANSLINK

URBAN systems

Contents


Patterson Station
Transit Vehicles Only
KEEP
WARNING
HIGH PRESSURE
GAS PIPELINE

1.0 Introduction

1.1 About BC Parkway

The BC Parkway is an important regional multi-use pathway that extends for approximately 26 kilometres between Vancouver and Surrey along an alignment that roughly parallels the Expo SkyTrain Line. The BC Parkway was originally developed by BC Transit in conjunction with SkyTrain construction for Expo 86. The corridor runs through four municipalities in Metro Vancouver – the City of Vancouver, City of Burnaby, City of New Westminster, and City of Surrey.

TransLink currently has a licensing agreement in place with BC Hydro/Southern Rail for the use of the SkyTrain within their property right-of-way. As a result of this licensing agreement, TransLink has jurisdiction over some portions of the BC Parkway alignment. Where the BC Parkway runs along municipal rights-of-way, TransLink will have to work with the municipality to provide relevant upgrades. Additionally, some sections of the BC Parkway include on-street bicycle facilities. Where this occurs, TransLink will work with the municipality to provide high-quality, All Ages and Abilities (AAA) bicycle facilities.

The BC Parkway is an important component of TransLink's bicycle program and the regional major bikeway network. This includes ensuring that the BC Parkway is a continuous active transportation corridor that is comfortable for people of all ages and abilities and that it serves both recreational and utilitarian users. TransLink is particularly interested in ensuring that users travelling along the BC Parkway find it to be an intuitive and low stress experience, particularly when approaching and crossing intersections.

A 2016 survey of BC Parkway users found that most people (58%) use the parkway for commuting purposes. Other uses include social or entertainment travel (15%), personal business (8%), shopping (5%), and exercise or leisure (5%). The survey found that trip purposes for pedestrians and cyclists are typically similar.

In recent years, growth and development has impacted the way people use the BC Parkway. There has been a significant amount of residential and commercial development occurring adjacent to and within proximity of the BC Parkway. Additionally, TransLink has recently undertaken several SkyTrain station improvement projects (including the Joyce and Metrotown SkyTrain stations), which impact the way users interact and travel between the BC Parkway and these stations.

In 2009, TransLink developed a Conceptual Design Report for the BC Parkway that recommended significant upgrades to the off-street pathway alignment and at intersections. This 2020 guide is an update to that document and focuses on providing updated design guidance to ensure safe and consistent pathway and intersection treatments that reflect local, national, and international best practices.

1.2 Vision

The 2009 Conceptual Design Report outlined a vision statement for the BC Parkway, this vision statement has been revised slightly and updated to the 2020 context and builds off of the same themes. Below is the vision statement for the BC Parkway:

The BC Parkway is a high-quality active transportation facility for people of all ages and abilities forming the backbone of the regional bikeway and regional greenway network. It connects people across municipalities to destinations and transportation options and provides a cherished space for surrounding communities.

1.3 Purpose of the BC Parkway Design Guide

TransLink is committed to making walking and cycling safe, comfortable, and convenient mobility choices for people of all ages and abilities for all trip purposes, including both transportation and recreation. Improving and maintaining the BC Parkway is an important step for TransLink to achieve the long-term cycling and walking goals identified in the both the Regional Cycling Strategy and the Regional Transportation Strategy. This Design Guide will help to ensure that BC Parkway is:

- A high-quality active transportation facility that connects Regional City and Town Centres, transportation facilities, and key regional employment areas.
- A regional recreational greenway and an attractive linear green space.
- A destination in itself that is well-used and valued by the community.

The BC Parkway is intended to be used by all modes of active transportation, this includes any human powered travel mode and typically includes cycling, walking, rollerblading, skateboarding, and people using mobility aids. This guide considers the different travel speeds and operating space of each mode. Developing guidelines that create a consistent design for both pathway users and motor vehicle drivers will lead to a safer and more comfortable facility for all users.

1.4 Design Guide Basis

The BC Parkway Design Guide is intended to build upon existing pedestrian, bicycle facility, and, pathway design guidance provided at the national level in Canada by the Transportation Association of Canada (TAC) through a range of documents, including:

- *Pedestrian Crossing Control Guide* (2018)
- *Canadian Guide to Traffic Calming: Second Edition* (2018)
- *Geometric Design Guide for Canadian Roads* (2017)
- *Manual of Uniform Traffic Control Devices for Canada* (MUTCDC): *Fifth Edition* (2014)
- *Traffic Signal Guidelines for Bicycles* (2014)
- *Bikeway Traffic Control Guidelines* (2012)
- *Guide for the Design of Roadway Lighting* (2006)

The Design Guide also draws upon experience and lessons learned from other design guidelines and resources from Canada and around the world:

- *Alberta Bicycle Facilities Design Guide* (2019 – DRAFT)
- *B.C. Active Transportation Design Guide* (2019)
- *Canadian Standard Association (CSA): B651-18 – Accessible Design for Built Environment,* (2018)

- *City of Vancouver: Memo – Standard Curb between Cycle Track and Sidewalk* (Draft 2018 – not published)
- *City of Vancouver: Plaza Stewardship Engagement Summary* (2018)
- *City of Vancouver: Administrative report - Plaza Stewardship Strategy Update* (2018)
- *City of Vancouver: Research report – How do we fund the stewardship of public plazas?* (2017)
- *City of Vancouver: Arbutus Greenway Project Draft Schematic Concepts* (Draft 2017 – not published)
- *City of Edmonton: LRT Design Guidelines* (2017)
- *Netherlands CROW Design Manual for Bicycle Traffic* (2016)
- *National Association of City Transportation Officials (NACTO): Global Street Design Guide* (2016)
- *Canadian Landscape Standard* (2016)
- *City of Brampton: Parks Lighting Guidelines* (2015)
- *City of Hamilton: Co-ordinated Street Furniture Guidelines* (2015)
- *Federal Highway Administration (FHWA): Separated Bike Lane Planning and Design Guide* (2015)
- *Massachusetts Department of Transportation: Separated Bike Lane Planning & Design Guide* (2015)
- *James Corner Field Operations: The Underline – Framework Plan and Demonstration Projects* (2015)
- *Toronto Multi-use Trail Design Guidelines* (2015)
- *NACTO: Urban Bikeway Design Guide* (2014)
- *Los Angeles Country Metropolitan Transportation Authority: Metro Rail and Bus Facilities Lighting Design Criteria* (2014)
- *Ontario Traffic Manual (OTM) Book 18: Cycling Facilities* (2014)
- *The 606 (Bloomingdale trail) Framework Plan* (2013)
- *BC Ministry of Transportation and Infrastructure (MoTI) Electrical and Traffic Engineering Manual* (2013)
- *American Association of State Highway and Transportation Officials (AASHTO): Guide for the Development of Bicycle Facilities* (2012)
- *BC MoTI – BC Supplement to TAC; Bikeway Traffic Control Guidelines* (Draft 2011 – not published)
- *Santa Monica Urban Forest Master Plan – Guidelines for Parkway Landscaping* (2011)
- *VéloQuebec: Planning and Design for Pedestrians and Cyclists* (2010)
- *Accessible Pedestrian Signals: A Guide to Best Practices* (Workshop Edition 2010)
- *District of North Vancouver: Spirit Trail Route Planning Report* (2009)
- *City of North Vancouver: Spirit Trail – Creating Connections along North Vancouver's Waterfront* (2008)

A number of existing TransLink guidelines and resources were also reviewed as part of the creation of the Design Guide, including:

- *Bus Customer Amenity Program: Framework* (2019)
- *Shared Micromobility Guidelines* (2019)
- *Skytrain Design Manual – Upgrades, Volume 1: Architectural* (Draft 2018)
- *Bus Infrastructure Design Guidelines* (2018)
- *Public Art Policy* (2018)
- *BC Parkway Pedestrian & Cyclist Experience Survey and Counts Report* (2016)
- *Regulatory Signage and Pavement Marking Guidelines (2016)*
- *Landscape Design Guidelines Report – BC Parkway* (2016)
- *Transit Passenger Facility Design Guidelines* (2011)
- *BC Parkway Upgrades – Conceptual Design Report* (2009)

1.5 Document Overview

The BC Parkway Design Guide is divided into nine sections:

Section 1: Introduction introduces the BC Parkway Design Guide, outlining its purpose, the vision for BC Parkway, and the basis of the design guidance.

Section 2: Design Principles and Considerations describes off-street pathway design considerations, including safety and comfort, as well as motorist and cyclist operational and behavioural characteristics.

Section 3: Pathway Design provides overarching guidance on pathway design for the BC Parkway, outlining facility type, width, and surface material. It also outlines the space required for various amenities and includes a brief note regarding on-street bicycle facility design.

Section 4: BC Parkway Context dives into detail regarding the BC Parkway, outlining the various land use contexts along the corridor. This section also provides a framework to help designers determine prioritize pathway components in constrained rights-of-way. Finally, this section includes a design toolbox that provides guidance for each land use category, including urban, residential, industrial, open space, and SkyTrain stations.

Section 5: Amenities outlines the key considerations for providing pedestrian and cyclist amenities along the pathway and discusses which amenities are appropriate in the different land use contexts.. This section also discusses placemaking opportunities along the BC Parkway.

Section 6: Landscaping provides guidance for TransLink and BCRTC staff for the establishment of a cohesive, accessible, safe, functional, and expandable set of landscape elements along the BC Parkway.

Section 7: Intersection Design provides design principles, considerations, and guidance for intersection approaches, components, and geometric design. This section deals with areas of high potential user conflict and provides guidance pertaining to design treatments, signage, pavement markings, and various other intersection elements.

Section 8: Lighting provides design considerations and guidance for street lighting at intersections along the corridor.

Section 9: Signage and Pavement Markings describes the application and design dimensions of signage and pavement markings used along BC Parkway and at intersections. This section provides an overview of the key considerations for planning and designing BC Parkway.


MAXIMUM
30
km/h
ROUTE

2.0 Design Principles and Considerations

Off-street pathways such as the BC Parkway are physically separated from the street and are typically located at a higher elevation than the street resulting in grade separation. They are generally perceived as comfortable, low-stress, and attractive routes for people walking, cycling and using other forms of active transportation. This is especially true for people who prefer to avoid motor vehicle traffic. This separation from motor vehicle traffic – one of the most significant factors influencing the comfort and safety of people walking and cycling – makes off-street pathways feel safer and more attractive for people of all ages and abilities.

There are two types of off-street pathways:

Multi-use pathways which can be used by several types of users and is also referred to as shared use pathways.

Separated Bicycle and Pedestrian Pathways are intended for the exclusive use of bicyclists and pedestrians respectively.

2.1 Design Considerations

This section outlines some of the BC Parkway design considerations that should be considered and will influence the design of BC Parkway.

2.1.1 Existing Corridor Conditions

The physical context of the BC Parkway is influenced by the corridor condition through which it travels. The corridor condition primarily influences the available right-of-way, which impacts pathway width, buffer type, and lateral clearance from obstacles. There are three typical corridor conditions along the BC Parkway (adapted from 2009 *BC Parkway Upgrades Conceptual Design Report*):

Skytrain Stations and Major Plazas

- High activity areas with greater volumes and diversity of users, with different directions of movement.
- Typically located at major road intersections, requiring careful crossing considerations.
- Area surrounding station can be constrained by transit operations, parking, and pick up/drop off areas.

Guideway Corridor

- These are segments of the BC Parkway where the pathway is located directly under or adjacent to the guideway. These are typically sections of the Parkway that connect people to key destinations.
- The available corridor width varies but is typically generous.
- The presence of the guideway constrains available right-of-way in places, but also provides shade and rain protection.
- Some sections of corridor can be remote, with CPTED concerns.
- There is substantial existing landscaping in some sections.
- The grade varies along the corridor.

Road Rights of Way

Off-Street Adjacent to Road

- Road layout and right-of-way dictates pathway alignment and width.
- May result in relatively narrow pathway corridor.
- May be able to acquire additional right-of-way through dedications or re-development.
- Often have an established sidewalk (pedestrian route).
- May have greater levels of constraints and conflicts at intersections and conflict zones, such as driveways.

On-Street

- An off-street pathway is preferred, but in some constrained section the BC Parkway is located on-street (e.g. Vancouver).
- On-street sections of BC Parkway typically consist of shared streets and neighbourhood bikeways.
- Challenges related to wayfinding and intersections.

2.1.2 Safety and Comfort

Safety and comfort are key considerations when designing off-street pathway facilities such as the BC Parkway. A lack of safety – whether real or perceived – is a significant barrier to walking and cycling. The research on active transportation safety generally considers two types of safety:

Substantive safety, which refers to the number of walking and cycling injuries and fatalities at locations; and

Perceived safety, or measures of the reported levels of comfort among active transportation users.

While perceived and substantive safety have been found to be closely aligned when it comes to active transportation infrastructure , perceived safety can vary greatly on a person-to-person basis. In terms of active transportation, the largest factor in perceived and substantive safety is often related to walking or riding next to motor vehicles. In the BC Parkway context, this is especially relevant at intersections. Perceived and substantive safety can also be influenced by the potential for user conflict (e.g. between pedestrians and cyclists travelling at different speeds) and by inadequate sightlines, lighting, and pathway maintenance.

All Ages and Abilities ('AAA') facilities are designed to be safe, comfortable, and equitable, creating a welcoming transportation experience for a broad array of users, from children to seniors. BC Parkway is generally considered to be a AAA facility, although there are areas of the pathway in need of improvement. In addition to being comfortable for people of all ages and abilities, active transportation facilities should be safe and accessible through all seasons and at all times of day.

BC Parkway design should consider user safety more broadly by utilizing Crime Prevention Through Environmental Design (CPTED) strategies. Relevant CPTED strategies for off-street pathways include focusing on natural surveillance, access restriction, and territorial reinforcement.

In essence, the environmental design approach should provide a high level of visibility, casual monitoring of activity along the pathway, and communicate a clear sense of ownership and responsibility for appropriate pathway use.

In the context of the BC Parkway, universal design principles should be applied across all design elements, including surface condition and materials, pathway width, detectable separation between modes, intersection design, maintenance, landscaping, and amenities. Audible and visual navigation aids such as accessible pedestrian signals, signage, pavement markings, wayfinding, and contrasting materials are needed to ensure that people of all ages and abilities can safely and easily navigate the BC Parkway. Visual aids are especially important for people with hearing loss or cognitive impairments. Providing adequate lighting also enhances accessibility at intersections and along the corridor.

Additionally, the BC Parkway can be made more comfortable by providing amenities, landscaping, and placemaking. For example, benches and other seating are crucial for people with limited mobility who may need frequent rests. Furthermore, well-maintained landscaping and placemaking along the pathway, such as public art and plazas, can attract pathway users to gather, socialize, and play. Attracting users in turn creates safety in numbers and contributes to overall safety and comfort. Section 5 of the Design Guide discusses amenities, landscaping, and placemaking.

2.1.3 Accessibility

TransLink values all residents and visitors and strives to ensure that facilities such as the BC Parkway are safe, inclusive, and accessible for all, regardless of age or ability. As such, the BC Parkway must incorporate universal design features that consider and meet the needs of pathway users who may have vision loss, hearing loss, or limited mobility, strength, dexterity, and/or comprehension.

The 2017 *TAC Geometric Design Guide for Canadian Roads*, the 2018 CSA standard B651-18 – *Accessible Design for the Built Environment*, and the 2019 *B.C. Active Transportation Design Guide* each contain guidance about planning and designing accessible walking and cycling facilities. However, there are currently no national, provincial, or regional universal design standards. It is recognized that each municipality has their own practices and design guidance for providing facilities that are accessible to all. Wherever possible, design professionals should strive to provide consistency in design, including working with municipal partners to ensure users have a consistent experience along – and connecting to – the BC Parkway.

2.1.4 Types of Users

BC Parkway is designed to be used by a wide range of user types with varying operating speeds and dimensions, including people:

- Walking (including people jogging, walking dogs, pushing strollers, and using mobility aids);
- Rolling (using manual or motorized wheelchairs and electric mobility devices);
- Cycling (including a range of bicycle types, such as cargo bicycles, recumbent bicycles, and bicycles with trailers);
- In-line skating and roller skiing;
- Skateboarding and longboarding; and
- Using other emerging modes, such as small, one-person electric vehicles.






Intercept surveys along the BC Parkway have shown that the pathway is used primarily by pedestrians, with a 2016 study finding that 80% of BC Parkway users are pedestrians. Over three quarters of these pedestrians are using the BC Parkway to connect to the SkyTrain, which underlines the importance of providing seamless multi-modal connections and ensuring that the pedestrian pathway is comfortable, accessible, and sufficiently wide for expected user volumes.

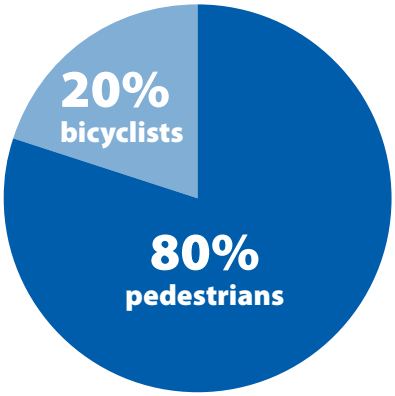

FIGURE 1 - BC PARKWAY MODE SHARE (SOURCE: INTERCEPT SURVEY)

Other than maintenance vehicles, the only motorized vehicles currently allowed on the BC Parkway are:

- Motorized wheelchairs and other electric mobility devices; and
- Electric-assist bicycles (e-bikes or "motor assisted cycles"), as defined in the British Columbia Motor Vehicle Act.

E-bikes require special consideration when mixing with other pathway users, as they are very quiet and accelerate and cruise at consistently fast speeds, meaning that they can sometimes surprise other users.

Additionally, small, one-person electric vehicles such as electric kick scooters (e-scooters), electric skateboards, segways, hoverboards, and self-balancing electric unicycles are a new and increasingly popular form of mobility.

At the time of writing this guide, these vehicles are not legally permitted on public roadways, sidewalks, or pathways in BC. However, with the growing popularity of these forms of mobility and potential amendments to the Motor Vehicle Act, designers should consider these vehicles as potential future users of the BC Parkway in the design process.

2.1.5 Separating Users

As noted, each active transportation mode has different operating speeds and dimensions, which can lead to conflict between pathway users along the BC Parkway. Currently, much of the BC Parkway is a multi-use pathway, where all types of users share the same space. This presents the potential for conflict when faster users attempt to pass slower users or where limited sightlines result in users unexpectedly encountering one another.

Where sufficient right-of-way exists, separated pathways are preferred over multi-use pathways along the BC Parkway. Multi-use pathways should only be considered where the right-of-way is constrained or in certain shared contexts such as plazas and SkyTrain stations. Section E of the *B.C. Active Transportation Design Guide* contains additional design guidance for multi-use and separated pathways, including the benefits and limitations of each pathway type.

2.1.6 Multi-Functional Corridor

The BC Parkway is a regionally significant active transportation corridor, serving the commuting and recreational needs of people living, working, and travelling along and connecting to the corridor. The BC Parkway's design, including landscaping and amenities, can help support its role as an important transportation corridor for people of all ages and abilities. In addition to this primary purpose, the BC Parkway is also a multi-functional space that serves a number of other important roles, including placemaking and ecology (see Figure 2).

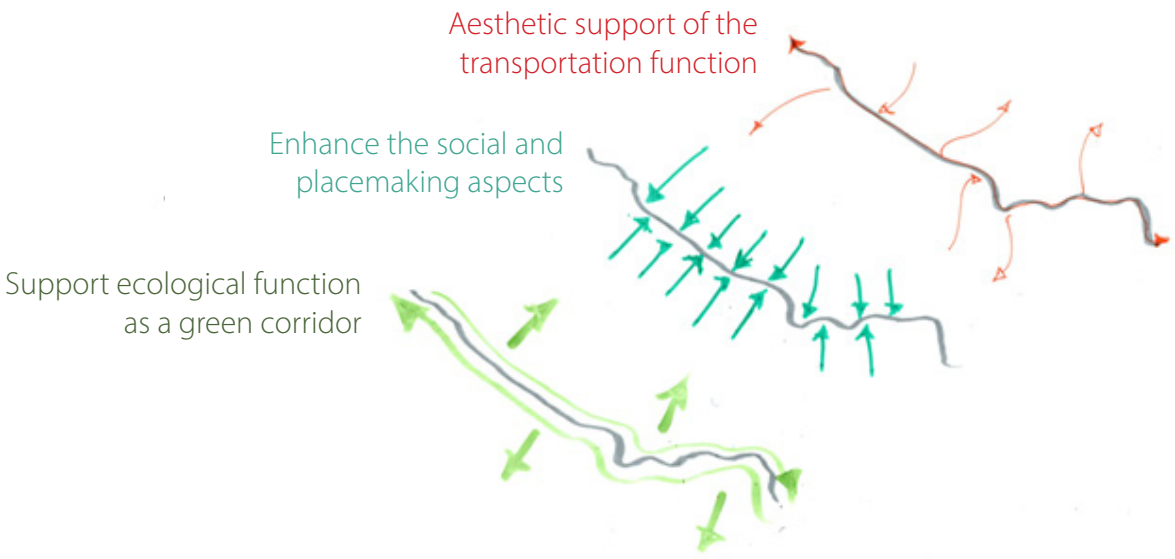

FIGURE 2 - MULTI-FUNCTIONAL CORRIDOR CONCEPT

The BC Parkway plays a role in supporting and enhancing the social and placemaking aspects of the communities through which it passes. Through public art, programming, plazas, and amenities the BC Parkway can encourage people to meet, interact, and relax in public space. The transportation function of the BC Parkway can then connect users from one community node to the next, connecting communities.

The BC Parkway also serves as a linear habitat, supporting ecological functions as a green corridor. The type and placement of landscaping elements can serve to connect local ecosystems and encourage urban biodiversity, thus providing the city with ecosystem services such as natural drainage, water retention, filtration, air purification, pollination, carbon storage, etc. The BC Parkway can also be integrated with other natural corridors to create a network of habitats, which is increasingly important as urban development intensifies.

2.2 Design Parameters

2.2.1 Operating Envelopes

Design parameters, sometimes referred to as the 'design user' or 'design vehicle,' are the user dimensions and speed potential that are used to dictate the minimum design requirements for a given facility. A range of design parameters, such as user type and volumes, must be considered when designing the BC Parkway. In addition to the guidance provided in this document, Section 6.2 of the *2017 TAC Geometric Design Guide for Canadian Roads* outlines the operating characteristics of people walking and using mobility devices and Section 5.2 outlines the operating characteristics of people cycling. Chapter B.4 of the *B.C. Active Transportation Design Guide* also provides guidance on operational and behavioural characteristics.

Pedestrian Operating Space

Figure 3 shows the typical horizontal and vertical operating envelopes for people walking, including walking single file, two abreast, three abreast, and with a young child. The vertical operating envelope for people walking is 2.1 metres, including lateral sway while walking. The horizontal operating envelope of a person walking is 0.75 metres, while two people walking abreast take up approximately 1.5 to 1.8 metres, with the latter value allowing for 0.8 metres of personal space. The horizontal operating envelope for someone walking with a child, suitcase, or dog is 1.2 metres. Figure 3 shows the dimensions of a typical wheelchair of 0.9. Two wheelchair users travelling side-by-side or passing one another requires a minimum width of 1.8 metres. Figure 4 also shows the physical space required for a human powered and motorized wheelchair to turn around.

Bicycle Operating Space and Design Vehicle

It is important to note that bicycles are not uniform in size or operating style. Standard bicycles, children's bicycles, bicycle-trailers and trail-a-bikes, cargo bicycles, recumbent bicycles, adult tricycles, electric assist bicycles, and other larger bicycles used by vendors and courier companies all have unique characteristics (Figure 5). Another crucial consideration is the person riding the bicycle – it is important to consider the wide range of user preferences, physical abilities, and level of training or experience that the user may have, as these attributes greatly impact the operation of a bicycle.

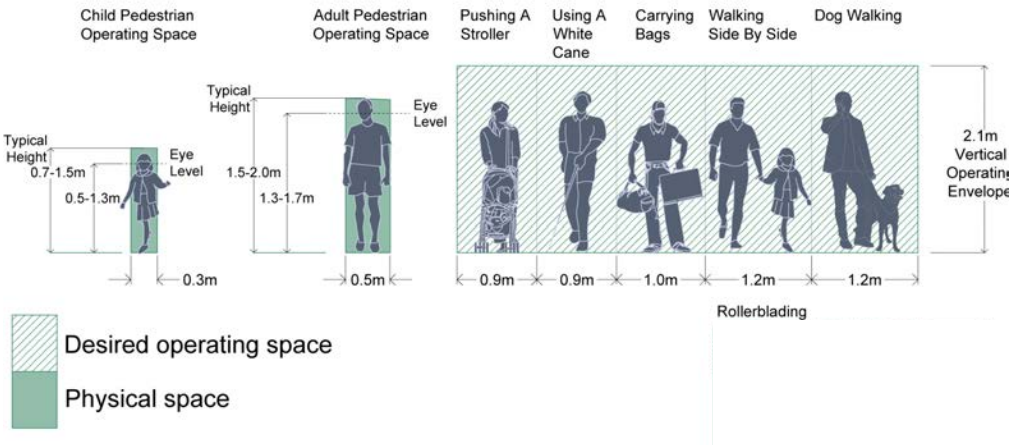

FIGURE 3 - TYPICAL DIMENSIONS FOR PEDESTRIANS
(SOURCE: ADAPTED FROM THE B.C. ACTIVE TRANSPORTATION DESIGN GUIDE)

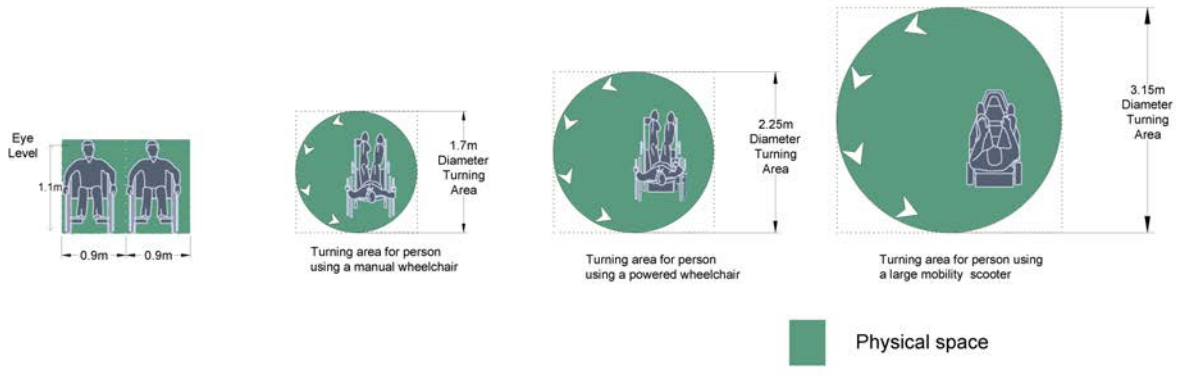

FIGURE 4 - TYPICAL WHEELCHAIR OPERATING SPACE
(SOURCE: ADAPTED FROM B.C. ACTIVE TRANSPORTATION DESIGN GUIDE)

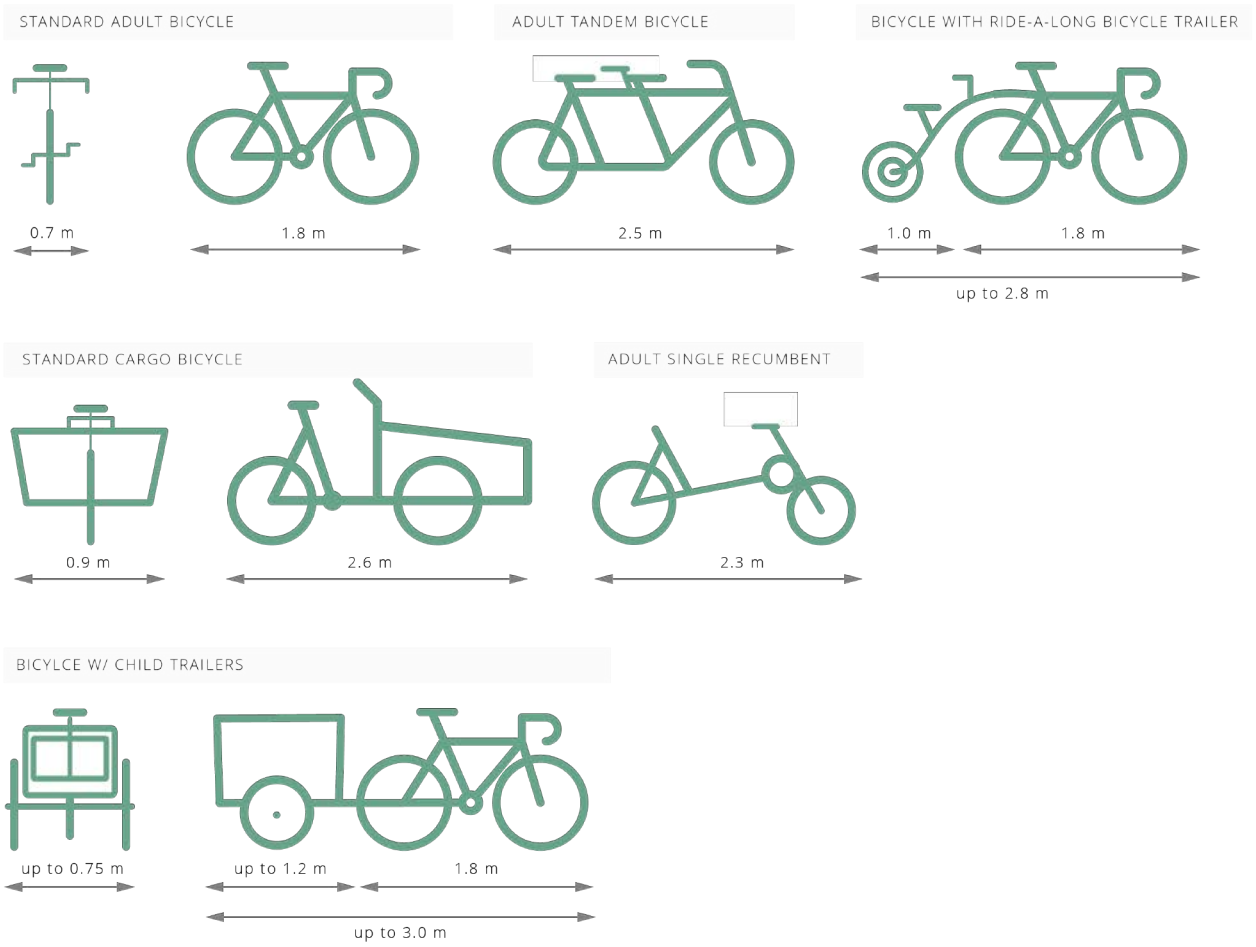

FIGURE 5 - TYPICAL BICYCLE USER DIMENSIONS
(SOURCE: ADAPTED FROM B.C. ACTIVE TRANSPORTATION DESIGN GUIDE)

Figure 6 shows typical bicycle operating space requirements. A single person cycling requires a horizontal operating envelope of 1.2 to 1.5 metres, which allows for variations in tracking (i.e. lateral movement, which is common when riding uphill and when moving at full speed). A bicycle with a trailer can be up to 3 metres long, which should be factored into the design of facilities such as median refuge islands.

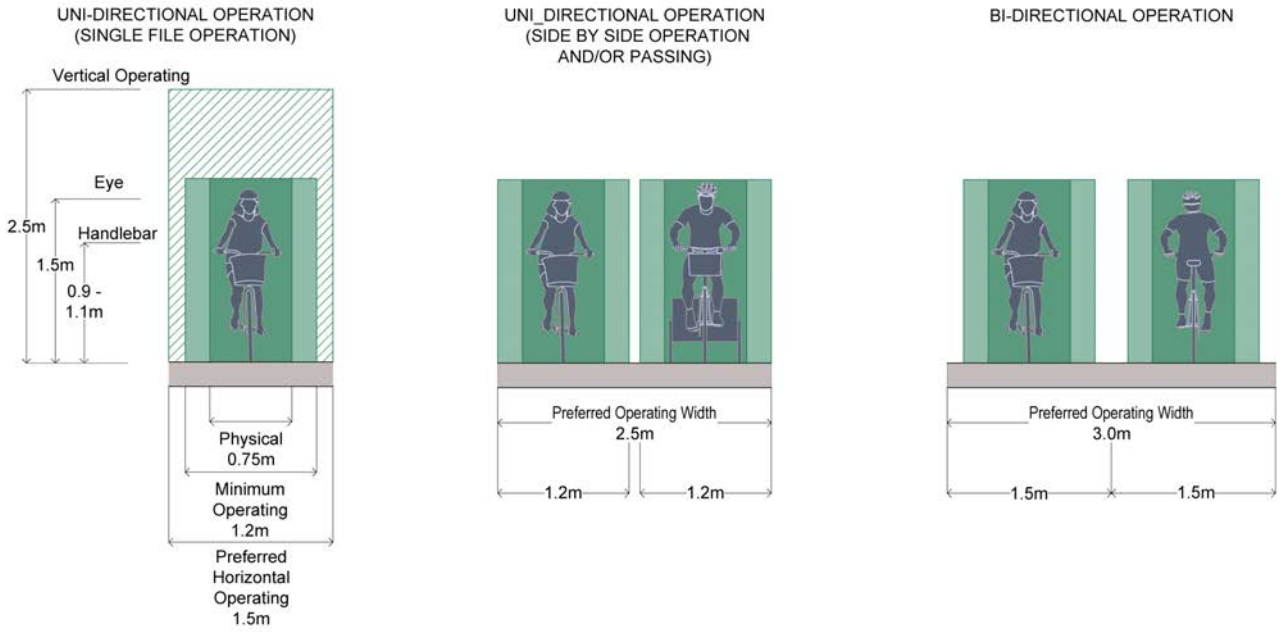

FIGURE 6 - TYPICAL BICYCLE USER OPERATING SPACE
(SOURCE: ADAPTED FROM B.C. ACTIVE TRANSPORTATION DESIGN GUIDE)

It is important to note the height of pedals and handlebars, as these can catch lateral objects if insufficient space is provided. Figure 7 shows the minimum horizontal clearance from curbs and lateral objects. The design of off-street pathway intersections must consider the human element; for example, family members may wish to ride side by side, either for social purposes or when a parent is helping to guide or teach a young child.

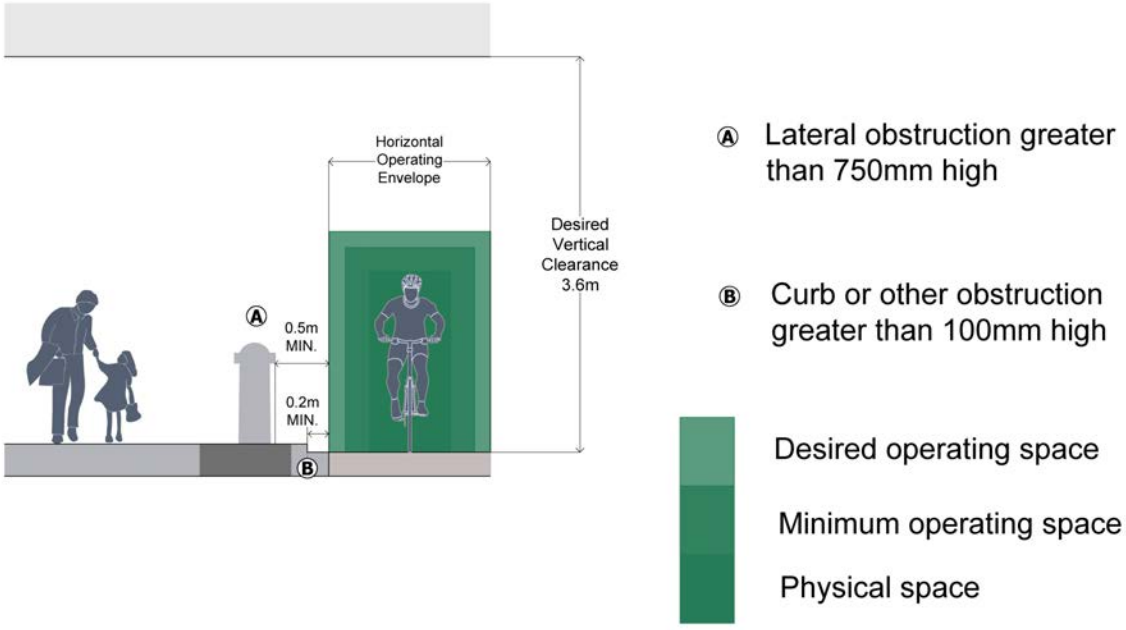

FIGURE 7 - MINIMUM HORIZONTAL AND VERTICAL CLEARANCES
(SOURCE: ADAPTED FROM B.C. ACTIVE TRANSPORTATION DESIGN GUIDE)

Other Users

Additional design users of the BC Parkway may include skateboarders, longboarders, in-line skaters and roller skaters. Figure 8 shows the horizontal operating envelope of an in-line skater, which requires 2.3 metres of operating space. Emerging technologies, both human-powered and electric, may require consideration in the future but likely would have a similar operating space.

Pathway user travel speed is important to consider when designing intersections, since pathway users traveling at high speeds require further stopping sight distance. A pathway user's speed is dependent on a number of factors, including the mode of transportation, the physical condition of the user, the type and condition of the user's equipment, the purpose of the trip, the number of users on the pathway, and the pathway condition and design.

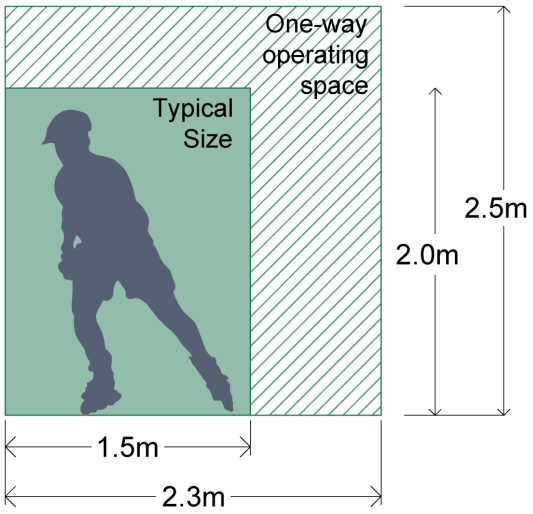

FIGURE 8 - TYPICAL DIMENSIONS FOR OTHER PATHWAY USERS

BC Parkway should be designed to accommodate the preferred speed of the fastest pathway users (cyclists), while also considering the need to control speeds in a multi-use setting.

2.2.2 Design Speed

BC Parkway should be designed to accommodate the preferred speed of the fastest pathway users (cyclists), while also considering the need to control speeds in a multi-use setting. This does not mean that the design speed should accommodate the fastest cyclist but instead represent the speed in which designs would prefer cyclists be travelling. There is no single design speed that works for all contexts. However, the following guidance can be used to determine the appropriate design speed for each intersection:

- For most off-street pathways in relatively flat areas with grades of less than 2%, a design speed of 30 km/h is generally sufficient for the common user. The minimum design speed is 20 km/h which may be appropriate through sections of BC Parkway where there are multiple conflict points such as driveways, intersections, and where there are high concentrations of users.
- In areas of hilly terrain and long steep grades, the design speed of off-street pathways should be based on the anticipated travel speed of cyclists traveling downhill. In most cases, 50 km/h is the maximum design speed that should be used.

2.2.3 Sight Distance

Providing appropriate sight distance allows pathway users to recognize obstructions such as debris, vegetation, or other pathway users, and react appropriately to avoid conflict. This section discusses three sight distances to consider for pathway design.

Stopping Sight Distance

Stopping sight distance provides adequate space for users to react to and make a fully controlled stop before encountering a conflict. Stopping sight distance can be calculated based on a user's speed, the coefficient of friction between a vehicle's tires and the pathway surface, and the vertical grade of the pathway. Refer to Section 5.5.2 of the *TAC Geometric Design Guide for Canadian Roads* for the stopping sight distance equation for multi-use pathways.

Sight Distance on Vertical Crest Curves

Vertical crest curves can make it difficult for pathway users to identify hazards and pose limitations on available sight distance. Refer to Section 5.5.4.2 of the *TAC Geometric Design Guide for Canadian Roads* for details and an equation for calculating the appropriate vertical crest curve on the BC Parkway. Note that for calculating the vertical crest curve, the height of the eye is taken to be 1.37 metres and the object height is taken to be zero metres. Along segments of the BC Parkway that are expected to have a significant number of users that are children, a lower eye height may be appropriate.

Horizontal Sightline Offset

The horizontal sightline offset (HSO) is the minimum lateral clearance that should be provided for line-of-sight obstructions at the inside of horizontal curves. Objects located between the centreline of the inside of a curve and the HSO limit are considered a sightline obstruction to pathway users and should be eliminated where feasible. These obstructions can include trees, vegetation, barriers, and bridges. On narrower pathway segments, users will likely travel closer to the centre of the pathway, creating a higher chance of collisions occurring on curves.

Refer to Section 5.5.3.2 of the *TAC Geometric Design Guide for Canadian Roads* for more details and an equation for determining the appropriate horizontal sightline offset, which is based on stopping sight distance for pathway users along a curve.

Intersection Sight Distance

Two types of clear sight triangles are considered in intersection design: the approach and departure sight triangles. Refer to the 2017 *TAC Geometric Design Guide for Canadian Roads* Section 9.9.2 for details on determining the appropriate sight distances and sight triangles to provide.

Approach Sight Triangle

The area bounded by the approach sight triangle should be free of obstructions (such as parked vehicles, railings/barriers) to provide users adequate opportunity to anticipate potential conflicts with crossing traffic. Figure 9 from the 2017 *TAC Geometric Design Guide for Canadian Roads* shows the typical clear sight triangles to the left and to the right for a motor vehicle approaching an uncontrolled or yield-controlled intersection. Refer to the TAC guide for details on determining the a1, a2, and b values. The decision point shown is the location where the user on the minor facility should brake in order to stop before conflicting with a user along the major road. This sight triangle can be applied at both an intersection or a mid-block crossing.

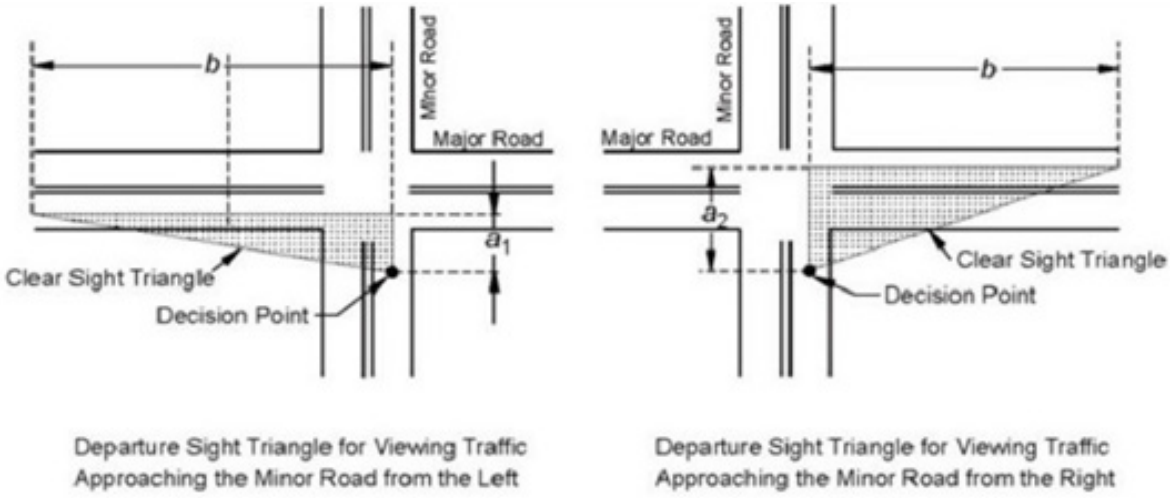

FIGURE 9 - APPROACH SIGHT TRIANGLE (UNCONTROLLED OR YIELD)
(SOURCE: 2017 TAC GEOMETRIC DESIGN GUIDE FOR CANADIAN ROADS, CHAPTER 9, FIGURE 9.9.1, SECTION 9.9, PAGE 61)

Departure Sight Triangle

The departure sight triangle provides sight distance sufficient for a user that is stopped on a minor approach to depart from the intersection and enter or cross the major road. The area bounded by the departure sight triangle should be free of obstructions (such as parked vehicles, railings/barriers) to provide users adequate opportunity to anticipate potential conflicts with crossing traffic. Figure 10 from the 2017 T*AC Geometric Design Guide for Canadian Roads* shows the typical departure sight triangles to the left and to the right of a motor vehicle stopped on the minor road/facility.

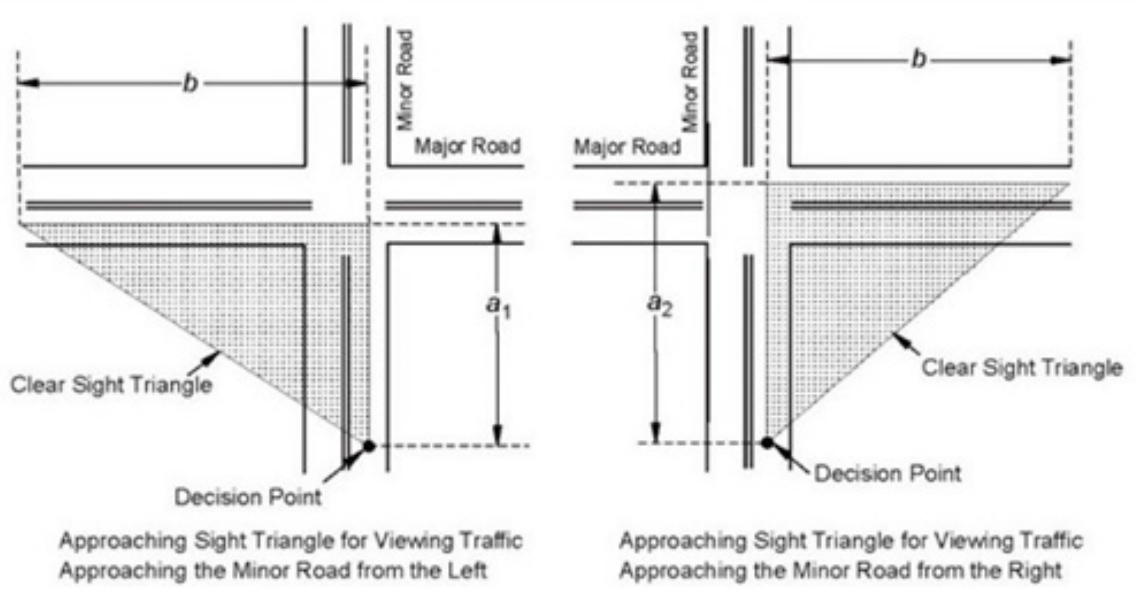

FIGURE 10 - DEPARTURE SIGHT TRIANGLE (STOP CONTROLLED) (SOURCE: 2017 TAC GEOMETRIC DESIGN GUIDE FOR CANADIAN ROADS, CHAPTER 9, FIGURE 9.9.2, SECTION 9.9, PAGE 62)

Sightline condition for who has right of way:

- Right turn motorist yields to through bicyclists: clear sightlines for the motorist to see the approaching person using BC Parkway.
- Through bicyclist yields to right turning motorist: clear sightlines for pathway users and motorists to see and react to each other
- For left turning or crossing motorists (far side) on a two-way road, provision of adequate sightlines will not typically mitigate the risk of motorists looking for gaps in the opposing traffic (not paying attention to a person approaching from the opposite direction). Additional measures need to be implemented to minimize conflict and can include signalization (protected only left turns or pathway phases), conflict markings and/or raised crossing.
- For motorists crossing from a minor street at a stop-controlled approach, the departure sight triangle to the BC Parkway users and motorists on the major street needs to be met. If the stopped motorist must go into the crossing path of the pathway facility in order to achieve the necessary sightline to cross the major road, then signalization should be considered.
- Areas that are more built out and have greater pedestrian presence should use an agreed upon design speed for determining sightlines, and consideration should be made to lower the posted speed limit if the target design speed is lower than posted. Implementing other measures to reduce speed will also support safety at intersections.
- Fixed objects such as tree, signs, street furniture, and buildings, can obstruct clear sightlines at intersections. Consideration should be made to implement other measures to increase awareness of pathway users approaching the intersection and/or install traffic controls to improve safety when fixed objects cannot be removed.

2.2.4 Longitudinal Grade

The recommended longitudinal grade along the BC Parkway is between 0.6% and 4.0%. A minimum grade of 0.6% is required to facilitate drainage. Flatter grades (as close as possible to 0.6%) offer increased accessibility for pathway users.

The recommended maximum longitudinal grade of the BC Parkway is 5.0%. Where grades steeper than 5% are unavoidable, flatter resting areas (3% grade or less) should be provided at set intervals, depending on the severity of the longitudinal grade. For segments with grades between 5% and 6%, a resting area should be provided every 100 metres. For segments with grades between 6% and 8%, a rest area should be provided every 50 metres. Where grades steeper than 8% exist, alternative pathway treatments should be explored, such as switch backs.

2.2.5 Cross Slope

The recommended minimum and maximum cross slope for the BC Parkway is 2%. This cross slope provides adequate drainage and ensures accessibility for people in wheelchairs or with other mobility challenges. The maximum cross slope is 5%, which should only be used for short distances, such as across driveways. Typically, the cross slope should angle in one direction, as this design is easier for maintenance and snow removal.

2.2.6 Side Slope

The BC Parkway should have a minimum of 0.6 metres of clear space on either side of the facility. Where the side slope reaches a certain slope percentage, it creates a drop off that can be hazardous to pathway users. Where this slope threshold is reached, the clear space should be increased to 1.5 metres. If 1.5 metres of clear space cannot be provided, a railing or barrier should be installed to help mitigate potential hazards. The threshold is based on the slope and the depth of the drop off. See Chapter E.2 of the *B.C. Active Transportation Design Guide.*

2.2.7 Drainage

Providing proper drainage is key for ensuring year-round accessibility, pathway durability, and reduced maintenance costs. The BC Parkway pathway should be sloped or crowned to allow water to drain off. Consideration of whether to crown or slope the pathway depends on the longitudinal grade, the horizontal curvature of the pathway, construction costs, and the adjacent landscape condition and site challenges. Accommodating drainage on both sides of the pathway can make crown construction challenging. Where crowned construction is not feasible, a sloped pathway may be appropriate.

In all cases, side slopes should be angled down and away from the edge of the pathway to ensure that surface water flows away from the pathway. At bridge approaches, the pathway should be graded to ensure positive drainage away from the abutments.

If drainage grates are required, they should be placed outside of the travel path. If site constraints necessitate placing drainage grates on the pathway, they should have a wheel-friendly design that prevents bicycle tires and assistive devices from falling through the vertical slats. For more information on the selection of drainage grates, refer to Section 5.1.
Catch basins should be regularly cleared of debris so that drainage is not compromised.
Culverts are to be avoided where possible. However, if needed, they should be utilized to accommodate an existing or proposed drainage swale, or where the pathway will impede runoff resulting in flooding of the pathway surface, and they should conform to the *Canadian Landscape Standard,* Chapter 4.

Whenever possible, divert runoff from pipelines and manage using water best management practices (BMPs), low impact development strategies (LIDs) and green infrastructure (GI) elements such as rain gardens, porous pavements, infiltration trenches, tree boxes, etc. Further drainage considerations, including ditches and subsoil drainage, can be found in Chapter E.2 of the *B.C. Active Transportation Design Guide*.

2.2.8 Surface Condition and Materials

Providing smooth, firm, and slip-resistance surfaces on all pathways ensures that people with reduced mobility, including those using wheelchairs, canes, walkers, and other mobility devices, can safely navigate the BC Parkway. Where the BC Parkway is separated into dedicated pathways for walking and cycling, different surface materials may be used to reinforce the difference between the pathways. Asphalt is preferred for multi-use and dedicated cycling facilities, while concrete may be used for dedicated walking facilities (see Section 3 for more details). No unpaved surfaces should be used along the BC Parkway.

Where the BC Parkway cuts through special areas such as plazas or SkyTrain stations, special pavement materials may be considered for short distances. This helps to create a unique character for the area while also providing a visual and tactile warning of potential user conflict. Concrete may be coloured, stained, or stamped to provide a unique appearance. Smooth surfaced paving stones may also be considered for special areas, but only where the subsurface is reinforced to ensure that the pavers do not shift and can easily be maintained over time.

Special surface treatments may be challenging for those with vision loss, limited mobility, and people using mobility aids and can cause discomfort for people cycling by creating additional vibrations. Careful consideration must also be given to providing a consistent user experience that is accessible for all users, including people using mobility devices.

All sections of the BC Parkway should be clear of any tripping hazards or obstructions. Year-round monitoring and maintenance are important for ensuring that walking and cycling facilities are safe at all times and are cleared of debris, standing water, ice, and snow.

2.2.9 Landscaping and Amenities

The landscaping and amenities along the BC Parkway play an important role in creating an inviting, accessible, and convenient space for pathway users of all ages and abilities. The thoughtful and consistent application of street furniture, pedestrian and cyclist amenities, various plant species, and other landscaping elements can create a sense of place along the corridor, aiding wayfinding and ensuring that the BC Parkway has a unique and coordinated look and feel. Section 5 contains detailed guidance on landscaping and amenities. Section 7 (lighting), Section 8 (signage and branding), and Section 10 (arts and programming) are also related to the application of landscaping and amenities.

3.0 Pathway Design

This section reviews the core components of BC Parkway pathway design, including facility type, width, and surface material. There are two types of off-street pathway: multi-use pathways and separated bicycle and pedestrian pathways. As noted above, where sufficient right-of-way exists, separated pathways are preferred over multi-use pathways along the BC Parkway.

3.1 Separated Bicycle and Pedestrian Pathways

Compared to multi-use facilities, separated bicycle and pedestrian pathways create a more comfortable environment for all pathways users and are recommended wherever feasible along the BC Parkway. Separating users helps to minimize potential safety conflicts between people walking and faster-moving active transportation users, such as people cycling, in-line skaters, and other modes. Separated pathway width, surface material, and separation types are discussed below.

3.1.1 Types of Separation

There are varying levels of separation between users, each with a different cost and degree of separation between users. Separation can range from a painted line to a buffer with elevated curbs, landscaping, and/or amenities. A buffer width of 0.5 to 1.0 metres is recommended, although more width may be required for certain amenities. The range of separation types, from least amount of separation to greatest, is shown and described below:

Guideway Separation

- Provides highest degree of separation between users; in certain sections of the BC Parkway, it may be possible to provide bicycle and pedestrian pathways on either side of the guideway.
- Width can vary depending on guideway configuration.
- Space between the pathways may include landscaping and amenities, as long as it maintains access to the guideway for maintenance and operations.

Median and Furniture Separation

- Provides a high degree of separation between users and the most inviting environment.
- Provides space to for enhanced landscaping, furniture, lighting, and other amenities that can increase the character of the facility.
- Requires the largest amount of right-of-way. Recommended width is ≥1.75 metres. The available width will determine which amenities are able to be placed in the buffer space (see Section 3.3, Table 3).
- Detectable by foot and cane.

Boulevard Separation

- Provides a greater degree of buffer space between users.
- Detectable by foot and cane.
- Creates space for landscaping and vegetation.
- Facilitates drainage and natural infiltration, if permeable surface or vegetation used.
- May require increased maintenance to ensure upkeep and prevent overgrown vegetation.

Curb Separation

- Provides physical separation between facilities that is detectable by foot and cane.
- Takes up relatively little space, with a recommended curb width of 0.5 metres.
- Can restrict crossing opportunities and impact pathway drainage.
- Can present an obstruction for pathway users, especially when visibility is limited due to weather conditions or lighting.

Grade Separation with Mountable Beveled Curb

- In constrained locations where a bicycle facility is planned directly adjacent to a concrete sidewalk, a mountable beveled curb may be used to separate users.
- Research conducted by the City of Vancouver and accessibility consultants has shown that a curb ratio of 1V:3H (50 millimetres tall by 150 millimetres wide) is both detectable by people with vision loss using a cane and is also accessible for people using wheelchairs, allowing them to enter and exit the bicycle facility when needed.
- This configuration requires special drainage and constructibility considerations, as it requires constructing the bicycle facility at a lower grade than the pedestrian facility.

Paint Separation

- Provides visual separation between users.
- Recommended line width is 100-200 millimetres.
- Relatively low cost and has a minimal impact on the overall facility width.
- Can be applied to existing pathway with minimal service interruption.
- Lack of physical separation can lead to encroachment of users into both spaces, and separation is not detectable by people with vision loss.

No Separation

- See Section 3.2 for details on multi-use pathways.

Where landscaped separation is used, designated crossing locations should be provided, with gaps in the separation to allow users to cross over the respective facilities. Additionally, people with vision loss should be able to differentiate between walking and cycling facilities. This can include both visual and tactile separation.

Detectable forms of separation include softscape (i.e. grass or other landscaping), grade separation, tactile walking surface indicators, or a detectable change in surface material. Contrasting paving surfaces such as coloured or stamped asphalt or concrete may be used to provide visual contrast, but this is insufficient for people who are legally blind. Exposed aggregate is typically detectable under cane but is not always detectable underfoot or by guide dog.

The detectable edge must also accommodate those with limited or restricted mobility and should not present a tripping hazard to any users. In areas with constrained right-of-way, beveled curbs have been shown to be an effective design for separating users. See Chapter D.3 of the *B.C. Active Transportation Design Guide* for more details.

One possible temporary treatment for separating bicycles and pedestrians is to install flexible posts or bollards. This treatment provides physical and vertical separation between facilities, but it less aesthetically pleasing and can present an obstruction for pathway users, especially when visibility is limited due to weather conditions or lighting. If used, reflective materials should be applied to improve visibility. This type of separation may also present maintenance challenges with degrading materials and creating obstructions for clearing snow and pathway debris.

3.1.2 Pathway Land Use/Right-of-Way Transitions

Design professionals may find that there are locations along the corridor where the land use context or width of available right-of-way may change or transition mid-block. Design professionals may be challenged to decide what pathway configuration and width is most appropriate and ensure the pathway transitions are intuitive for all users. For example, if the pathway segment is 100 metres in length and 75 metres has an unconstrained right-of-way where the desired separated bicycle and pedestrian pathway facility could be accommodated. However, the last 25 metres may have an encroaching property line or physical constraint which constrains the width of the pathway and a combined bicycle and pedestrian pathway is all that can fit. These situations are context specific and there are several factors that should be considered when determining the appropriate treatment and transition.

- Is the current context intended to stay the same over the long term?
- Is there an opportunity for redevelopment or property acquisition?
- What is the cost to remove or relocate the constraint?
- Who are the intended users? Will there be more pedestrians compared to cyclists?
- What is the anticipated volume of users?
- What are the existing bicycle and pedestrian facilities?

Generally, it is recommended that designers plan for the ultimate/preferred design wherever possible and use signage or pavement markings to ensure pathway users are aware of any geometric design changes. For example, if the pathway width is narrowing or the facility is transitioning from separated to shared there is information provided to ensure this is clear. More information about treatments that can be used in transition areas in Section 4.3.5 and 7.3.4.

3.1.3 Width

The recommended separated pathway width along the BC Parkway is shown in Table 1. These widths are meant as a general guide and will vary based on context. For example, in certain contexts along the BC Parkway where more users are expected, the constrained width should be wider where possible. These details are described in Section 4.

TABLE 1 - SEPARATED PATHWAY WIDTH

Element	Desirable (m)	Constrained (m)
Pedestrian Pathway*	3.0 - 4.0	2.4
Bicycle Pathway (Bi-Directional)**	4.0	3.0
Lateral Clearance (Pedestrian and Bicycle Pathways)***	0.6	0.5

* The absolute minimum width of a pedestrian pathway is 1.8 metres.
** The absolute minimum width of a bi-directional bicycle pathway is 2.4 metres and should only be used for segments of the pathway that are less than 100 metres in length.
*** Desirable lateral clearance increases depending on side slope (see Section 2.2.6). When adjacent to a street, additional lateral clearance is recommended (≥1.5 metres for local streets and ≥2.0 metres for arterial/collector streets).

3.1.4 Surface Material

Pathway surfaces along the BC Parkway should be smooth, firm, and slip-resistant in order to accommodate people of all ages and abilities. No unpaved surfaces should be used. Using different surface materials on the separate bicycle and pedestrian pathways can help reinforce that the pathways have different purposes and user groups. The preferred surface material for bicycle pathways is asphalt, as this provides a smooth, continuous surface. The preferred pathway surface materials for pedestrian pathways is concrete. As described in Section 2.2.9, special surface materials may be considered where users are expected to mix, such as plazas and SkyTrain Stations.

3.2 Multi-Use Pathways

Multi-use pathways should only be considered where the right-of-way is constrained. Additionally, mixing zones where all users share the space may be considered in certain contexts, such as plazas and SkyTrain stations.

3.2.1 Width

The recommended multi-use pathway width along the BC Parkway is shown in Table 2. Multi-use pathways attract a variety of users, some of which may operate at slower speeds. Therefore, sufficient width should be provided to allow users to pass one another. Planning for pathway maintenance and considering the size of maintenance vehicles is also important when selecting a pathway width. These widths are meant as a general guide and will vary based on context (see Section 4 for more details). Where more than 6.5 metres of right-of-way is available, providing separation between users is recommended.

TABLE 2 - MULTI-USE PATHWAY WIDTH

Element	Desirable (m)	Constrained (m)
Pathway Width	6.0	3.0
Lateral Clearance*	0.6	0.5

* Desirable lateral clearance increases depending on side slope. When adjacent to a street, additional lateral clearance is recommended (≥1.5 metres for local streets and ≥2.0 metres for arterial/collector streets).

3.2.2 Surface Material

Asphalt is the preferred surface material for multi-use pathways, as it accommodates a wide range of users and trip purposes. Asphalt surface treatments provides a smooth continuous surface that is accessible for all users at a relatively modest cost. It is a flexible and resilient material that can last a decade or longer if installed properly.

3.3 Amenity Space Requirements

In addition to the pathway and lateral clearance width requirements discussed above, it is necessary to note the specific spacing requirements of the amenities installed along the BC Parkway. This is especially relevant if amenities such as benches, lighting, or trees are installed within the pathway right-of-way in the buffer between bicycles and pedestrians. These widths guarantee that the amenity element is located outside of the pathway clear zone. For example, a clear space of 1.6 metres wide and 3.2 metres long would ensure both the bench structure, and the person sitting on the bench, are outside of the pathway clear zone. This also provides additional length to allow a stroller, mobility aid device, wheelchair etc. to be placed beside the bench. Table 3 shows the desirable and constrained requirements for certain key amenities. More detail regarding the type and placement of landscaping elements and amenities can be found in Section 5.

TABLE 3 - AMENITY SPACE REQUIREMENTS

Element	Desirable (m)	Constrained (m)
Lighting/utility poles	1.0	0.9
Medium Trees	1.5	1.5
Small Trees	1.2	1.2
Bench	1.6 (x 3.2 length)	1.4 (x 2.8 length)
Single Stream Litter Receptacle	1.2	0.9
Bicycle Rack	1.5 (x 2.0 length)	1.2 (x 1.8 length)

3.4 On-Street Bicycle Facility Types

In the BC Parkway context, off-street facilities are preferred. Where off-street facilities are not feasible, on-street bicycle facilities may be required. Any on-street bicycle facility serving as a portion of the BC Parkway should be suitable for people of all ages and abilities. On-street AAA facility types include neighbourhood bikeways and protected bicycle lanes. For guidance regarding on-street bicycle facilities, refer to the *B.C. Active Transportation Design Guide*.


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4.0 BC Parkway Context

4.1 Land Use Context

The land use surrounding each section of the BC Parkway impacts the look, feel, and design of the pathway and landscaping. Land use may impact user volumes (including the proportion of pedestrians, cyclists, and other active users) and the way in which users utilize and interact with the BC Parkway. As such, different pathway treatments, types of separation, and amenities may be more appropriate in certain areas than others.

There are five general land use contexts along the BC Parkway. They are classified as:


Urban


Residential


Industrial


Open Space


SkyTrain Station

Considering the land use context can help to prioritize which elements are essential, recommended, or an opportunity. The 2009 BC Parkway Upgrades Conceptual Design Report classified the existing land uses surrounding the BC Parkway corridor. This classification should be revisited and confirmed when conceptual design occurs, as development in some areas may have altered land uses over the past decade. In addition to land use context, the existing corridor conditions (as described in Section 2.1.1) may influence certain pathway and landscaping elements.

4.2 Prioritizing Pathway Design Elements

Where the BC Parkway right-of-way is constrained, trade-offs must be made between pathway width, the type of separation between users, and other geometric design and landscaping elements. The prioritization framework below can be used to help guide designers navigate these trade-offs to create a context-sensitive pathway design. The framework is intended to provide high-level guidance only – context-specific elements should be considered in every design.

In general, the design criteria below should be satisfied in the following order:

1. Always achieve minimums design widths, including pathway width, lateral clearance, and buffer from motor vehicles where applicable (as outlined in Section 3).
2. Maintain user separation wherever feasible.
3. Maximize pathway width to create a comfortable space for people walking and cycling.

4. Provide physical separation between people walking and cycling that is detectable, durable, easy to maintain, and aesthetically pleasing. Where physical separation is not feasible, visual (painted separation) may be considered.
5. Ensure there is adequate space along the pathway for amenities.
6. Maintain equal bicycle and pedestrian pathway widths.

The following section utilizes this prioritization framework to provide design guidance for each of the five land use contexts along the BC Parkway.

4.3 Design Toolbox

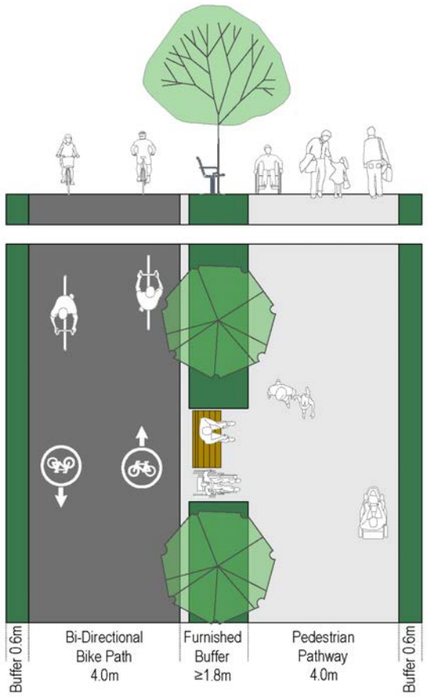
There are a number of basic design parameters, landscaping elements, and amenities that are recommended in all contexts along the BC Parkway, as discussed in the other sections of this Design Guide. However, there are also certain elements, including pathway width, type of separation, landscaping, and amenities, that may vary depending on the context.

The following section outlines design guidance for each of the five land use contexts identified along the BC Parkway: urban, residential, industrial, open space, and SkyTrain Station. Each one- to two-page design toolbox provides an overview of opportunities, constraints, and design considerations, including pathway design, landscaping, and amenities. The ideal, unconstrained pathway design is showcased, followed by recommended configurations for pathways in constrained rights-of-way.

Pathway Configurations

Unconstrained Pathway

The recommended BC Parkway configuration in an unconstrained urban context is shown in Figure 7. This cross section requires at least 11.0 metres of right-of-way. Recommended design elements include:

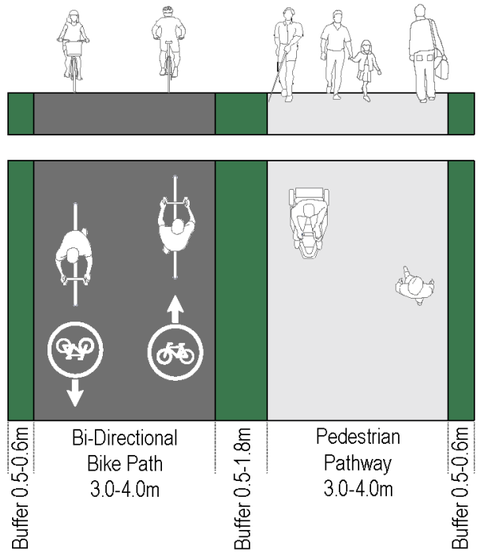


- A wide, 4.0-metre pedestrian pathway which provides space for groups of pedestrians to travel comfortably, including walking side by side. As indicated in Section 2.1.4, pedestrians make up the majority of BC Parkway users, so providing ample pathway width is important, especially in urban areas.
- A 4.0-metre bicycle pathway which allows for comfortable riding even with high user volumes. It also allows for passing slower cyclists, which is especially important as more and more people start to ride electric bicycles.
- A landscaped buffer is recommended. A buffer width of at least 1.8 metres provides enough space for landscaping and amenities such as lighting, benches, small trees, and shrubs. If right-of-way is available, these amenities and landscaping features may be placed along the side of the pathway.

FIGURE 7 - UNCONSTRAINED PATHWAY

Constrained with Physical Separation

Figure 8 shows the recommended pathway configuration where 7.6 to 11.0 metres of right-of-way is available. The following design alterations may be considered in this context:

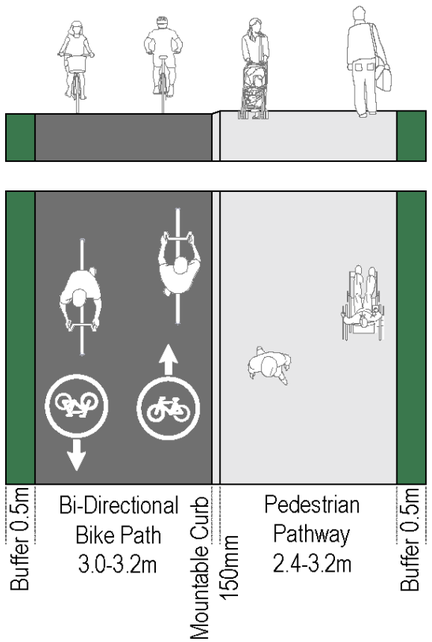


- Consider reducing the lateral clearance to 0.5 metres on either side.
- Consider reducing the buffer to 1.0 metres, while maintaining physical separation between users. This could include softscape, a strip of detectable exposed aggregate, or other detectable buffers (see Section 3.1.1).
- Consider reducing the pedestrian pathway and bicycle pathway widths to 3.0 metres each.
- If further constrained, consider reducing the buffer to 0.5 metres, while maintaining physical(detectable) separation between users.

FIGURE 8 - CONSTRAINED PATHWAY WITH PHYSICAL SEPARATION

Constrained with Grade Separation

Figure 9 shows the recommended pathway configuration where 6.6 to 7.5 metres of right-of-way is available. The following design alterations may be considered in this context:

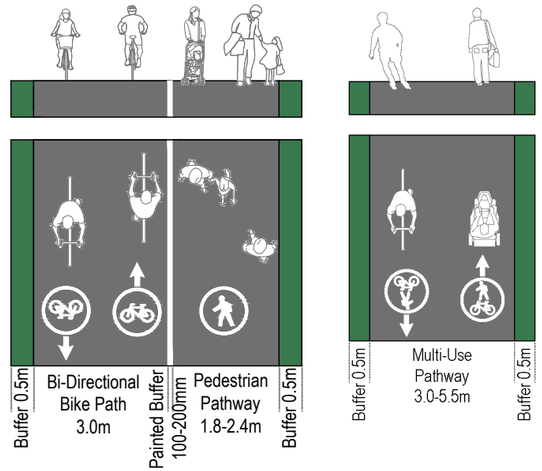


- Consider reducing the buffer to 150 millimetres and providing grade separation between people walking and cycling in the form of a mountable beveled curb. This design is an accessible alternative to painted separation. Grade separation of this type has drainage and construction impacts and may only feasible in certain contexts (see Section 3.1.1).
- Consider further reducing the pedestrian pathway to 2.4 to 3.2 metres.

FIGURE 9 - CONSTRAINED PATHWAY WITH GRADE SEPARATION

Constrained with Painted Separation or Multi-Use Pathway

In constrained areas where there is less than 6.6 metres of right-of-way available, alternative pathway configurations that are not universally accessible may be required.



- Figure 10 shows a pathway with paint separation. It is important to note that this treatment is not fully accessible, as it does not provide detectable separation between users.
- Where multi-use pathways are required (Figure 11), consideration should be given to providing additional signage, pavement markings, and speed reduction elements to improve safety for pathway users.
- AAA on-street bicycle facilities may be considered as an alternative to multi-use pathways. Where less than 4.0 metres of right-of-way is available, the bicycle facility should be moved on-street or an alternate route should be considered.

FIGURE 10 - CONSTRAINED PATHWAY WITH PAINT SEPARATION (LEFT)
FIGURE 11 - MULTI-USE PATHWAY (RIGHT)

4.3.1 Urban Context

Overview

The urban context is typically a high-density area that includes a mix of commercial, retail, and residential uses. The BC Parkway in this context is characterized by high user volumes and a variety of trip types, including commuting, recreation, and local convenience trips. Design professionals should seek to enable through movements with minimal multi-modal conflicts while also creating a comfortable, inviting environment to stop, rest, and socialize. This includes providing a wide range of amenities that attract a variety of users. This could also include the provision of interactive elements and public spaces, such as public art and plazas.

Opportunities

- Provides access to key destinations such as urban centres, employment areas, transportation hubs, and gathering places.
- Higher intensity of use can result in greater local ownership.
- Redevelopment opportunities provide potential for even greater integration of the BC Parkway into new urban streetscapes.

Constraints

- High volumes of pathway users can increase the risk of conflict between modes.
- Limited space available for the pathway in some areas due to existing streetscape and building frontages.
- Complex and busy intersections and crossings require special attention.

Amenities

- Contains all basic amenities that are common across all contexts (benches, information, and lighting).
- Also includes a range of additional amenities, with a focus on multi-modal integration and placemaking.
- See Section 5 for additional details.

Landscape Treatments

- Landscape Classification Level 1 (refer to *Landscape Design Guidelines Report - BC Parkway* (2016)).

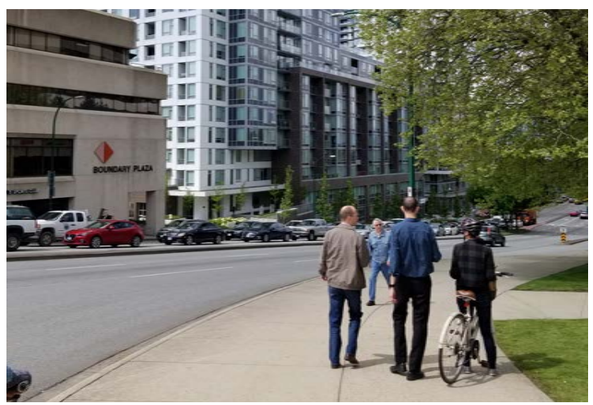
Design Guidance

Figure 12 shows the proposed urban context pathway design. In the urban context, the BC Parkway should be wide enough to accommodate high expected user volumes. The recommended range of urban pathway widths is provided in Table 4. These widths can vary based on context and the available right-of-way. Design guidance for a range of available rights-of-way is provided on the previous page. Design professionals are encouraged to maintain physical separation between bicycles and pedestrians wherever possible in order to increase user comfort, mitigate multi-modal conflict, and provide a detectable surface for people with vision loss.

TABLE 4 - URBAN CONTEXT PATHWAY WIDTH

Element	Desirable (m)	Constrained (m)*
Pedestrian Pathway	3.0 - 4.0	3.0
Bicycle Pathway (Bi-Directional)	3.0 - 4.0	3.0
Buffer (between pedestrian and bicycle pathways)	≥ 1.75	1.0
Lateral Clearance**	0.6	0.5

* See Section 3 for details on absolute minimum dimensions.
** Desirable lateral clearance increases depending on side slope (see Section 2.2.6). When adjacent to a street, additional lateral clearance is recommended (≥1.5 metres for local streets and ≥2.0 metres for arterial/collector streets).



Urban Context

FIGURE 12 - URBAN CONTEXT PATHWAY RENDERING

4.3.2 Residential Context

Overview

The residential context contains predominantly residential land uses, including low density (single family) and medium density (mid-rise and multi-family) housing types. The BC Parkway in this context is characterized by moderate user volumes, with fewer trip types than in the urban area, predominantly focused on commuting and recreation. The pathway design, landscaping, and amenities should suit these trip types while attracting nearby residents to spend time along the corridor.

Opportunities

- Lower user volumes than in urban context, resulting in less busy streets and crossings and fewer conflicts.
- Potential to provide high quality community spaces and amenities that attract local residents.
- Potential for local residents to participate in and take ownership of certain programs and amenities (e.g. community gardens), where appropriate.

Constraints

- Certain areas have a constrained right-of-way, with narrow existing sidewalks and pathways along some segments.
- Less available space for amenities, greenspace, and placemaking in some segments.
- Potential for personal safety issues where along segments with lower user volumes.

Amenities:

- Contains all basic amenities that are common across all contexts (benches, information, and lighting).
- No additional amenities are recommended.
- See Section 5 for additional details.

Landscape Treatments:

- Landscape Classification Level 1 to Level 2, depending on context (refer to *Landscape Design Guidelines Report - BC Parkway* (2016)).

Design Guidance

Figure 13 shows the proposed residential context pathway design. The recommended range of residential pathway widths is provided in Table 5. These widths can vary based on context and the available right-of-way. In general, the same pathway configurations described in the Urban Context (Section 4.3.1) also apply in this context.

The key difference between the urban and residential contexts is that the lower limit of the pedestrian width is narrower, based on the lower user volumes. Additionally, an enhanced buffer (with seating, trees, etc.) between users is not as important in this context, so the buffer width may be reduced sooner. Some type of basic physical separation should be maintained wherever possible.

TABLE 5 - RESIDENTIAL CONTEXT PATHWAY WIDTH

Element	Desirable (m)	Constrained (m)*
Pedestrian Pathway	2.4 – 4.0	2.4
Bicycle Pathway	3.0 - 4.0	3.0
Buffer (between pedestrian and bicycle pathways)	0.5 - 1.0	0.5 or Beveled Curb
Lateral Clearance**	0.6	0.5

* See Section 3 for details on absolute minimum dimensions.
** Desirable lateral clearance increases depending on side slope (see Section 2.2.6). When adjacent to a street, additional lateral clearance is recommended (≥1.5 metres for local streets and ≥2.0 metres for arterial/collector streets).

Residential Context

FIGURE 13 - RESIDENTIAL CONTEXT PATHWAY RENDERING

4.3.3 Industrial Context

Overview

The industrial context contains a predominantly industrial land uses, with little to no residential, commercial, or retail spaces. These segments of the BC Parkway have the lowest volume of anticipated users. Trip types include commuter and longer distance recreation trips, with users typically passing through the industrial areas as part of a longer journey. Basic amenities that serve these trip types should be considered.

Opportunities

- Pathway improvements, including lighting, landscaping, and amenities, could encourage greater use, thus improving potential personal safety concerns.
- Provides access to employment areas.
- Potential for streetscape improvements along areas adjacent to streets.

Constraints

- Some sections are relatively remote and have low user volumes, resulting in potential personal safety issues.
- Constrained right-of-way in some sections due to close proximity of pathway to building frontages and roadway, limiting available space for pathway or amenities.
- Some sections are adjacent to busy streets with large vehicles, creating potential for conflicts with motor vehicles (especially at crossings).

Amenities

- Contains all basic amenities that are common across all contexts (benches, information, and lighting).
- Additionally, emergency phones are recommended due to the sometimes isolated nature of the BC Parkway through industrial contexts.
- See Section 5 for additional details.

Landscape Treatments

- Landscape Classification Level 3 (refer to *Landscape Design Guidelines Report - BC Parkway* (2016)).

Design Guidance

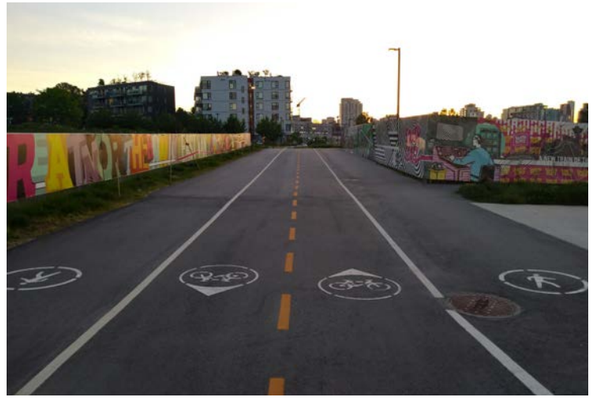
Figure 14 shows the proposed industrial context pathway design. The recommended range of industrial pathway widths is provided in Table 6. These widths can vary based on context and the available right-of-way.

The key differences between the industrial context and the residential and urban contexts is an even narrower constrained pedestrian pathway width and a narrower buffer. These changes are based on lower user volumes and less need for amenities along the corridor due to the industrial land use.

TABLE 6 - INDUSTRIAL CONTEXT PATHWAY WIDTH

Element	Desirable (m)	Constrained (m)*
Pedestrian Pathway	2.4 – 4.0	1.8
Bicycle Pathway	3.0 - 4.0	3.0
Buffer (between pedestrian and bicycle pathways)	0.5 - 1.0	0.5 or Beveled Curb
Lateral Clearance**	0.6	0.5

* See Section 3 for details on absolute minimum dimensions.
** Desirable lateral clearance increases depending on side slope (see Section 2.2.6). When adjacent to a street, additional lateral clearance is recommended (≥1.5 metres for local streets and ≥2.0 metres for arterial/collector streets).



Industrial Context

FIGURE 14 - INDUSTRIAL CONTEXT PATHWAY RENDERING

4.3.4 Open Space Context

Overview

The open space context includes sections of pathway through parks, undeveloped open spaces, and along the waterfront in New Westminster. The volume of BC Parkway users through these contexts can vary depending on size and type of open space. For example, highly programmed urban parks may generate larger user volumes, whereas smaller parks and open spaces may generate moderate user volumes. These parks and open spaces are often already strongly connected with the community, serving as destinations along the BC Parkway. Trip types in the open space context include recreation and commuting. This area should contain a larger suite of amenities than in the industrial or residential contexts, including opportunities for seating and social interaction that will bring users into the park and encourage them to explore the corridor.

Opportunities

- Typically, more available space and flexibility in pathway alignment.
- Potential to provide park improvements through pathway development, including improving circulation within open spaces and building on existing amenities.
- Potential for gateway or entrance features that frame the open space and announce to pathway users that they are entering a new environment – one that encourages stopping, relaxing, and interacting with nature.
- Typically, higher use in park areas results in fewer personal safety concerns.

Constraints

- The pathway may conflict with other park uses and with general circulation. Pedestrian traffic may be irregular and less defined, creating the potential for multi-modal conflicts.
- Potential conflicts with existing vegetation, such as tree roots that can damage the pathway.
- Typically, there is a greater range of grade and topography challenges through these areas.
- Some open space areas may be remote, resulting in personal safety concerns.
- Potential jurisdictional complexity where the BC Parkway runs through or along multi-jurisdictional areas.

Amenities

- Contains all basic amenities that are common across all contexts (benches, information, and lighting).
- Additionally, emergency phones, community gardens, and sport and recreation areas can be considered.
- See Section 5 for additional details.

Landscape Treatments:

- Landscape Classification Level 1 (plaza and major parks), Level 3 (open space), or Level 4 (natural areas) (refer to *Landscape Design Guidelines Report - BC Parkway* (2016)).

Design Guidance

Figure 15 shows the proposed open space context pathway design. The recommended range of open space pathway widths is provided in Table 7. These widths can vary based on context and the available right-of-way. In general, the same pathway configurations described in the Urban Context (Section 4.3.1) also apply in this context.

The open space context has similar pathway widths to the urban context, only with a narrower constrained pedestrian pathway due to lower user volumes. However, higher volumes are expected in the open space context than in the industrial or residential contexts, so open space maintains a higher desirable pedestrian pathway width. Buffer widths are treated the same as in the industrial context, with a preference for softscape where the pathway is running through a park setting.

TABLE 7 - OPEN SPACE CONTEXT PATHWAY WIDTH

Element	Desirable (m)	Constrained (m)*
Pedestrian Pathway	3.0 – 4.0	2.4
Bicycle Pathway	3.0 - 4.0	3.0
Buffer (between pedestrian and bicycle pathways)	≥ 1.75	0.5
Lateral Clearance**	0.6	0.5

* See Section 3 for details on absolute minimum dimensions.
** Desirable lateral clearance increases depending on side slope (see Section 2.2.6). When adjacent to a street, additional lateral clearance is recommended (≥1.5 metres for local streets and ≥2.0 metres for arterial/collector streets).

Open Space Context

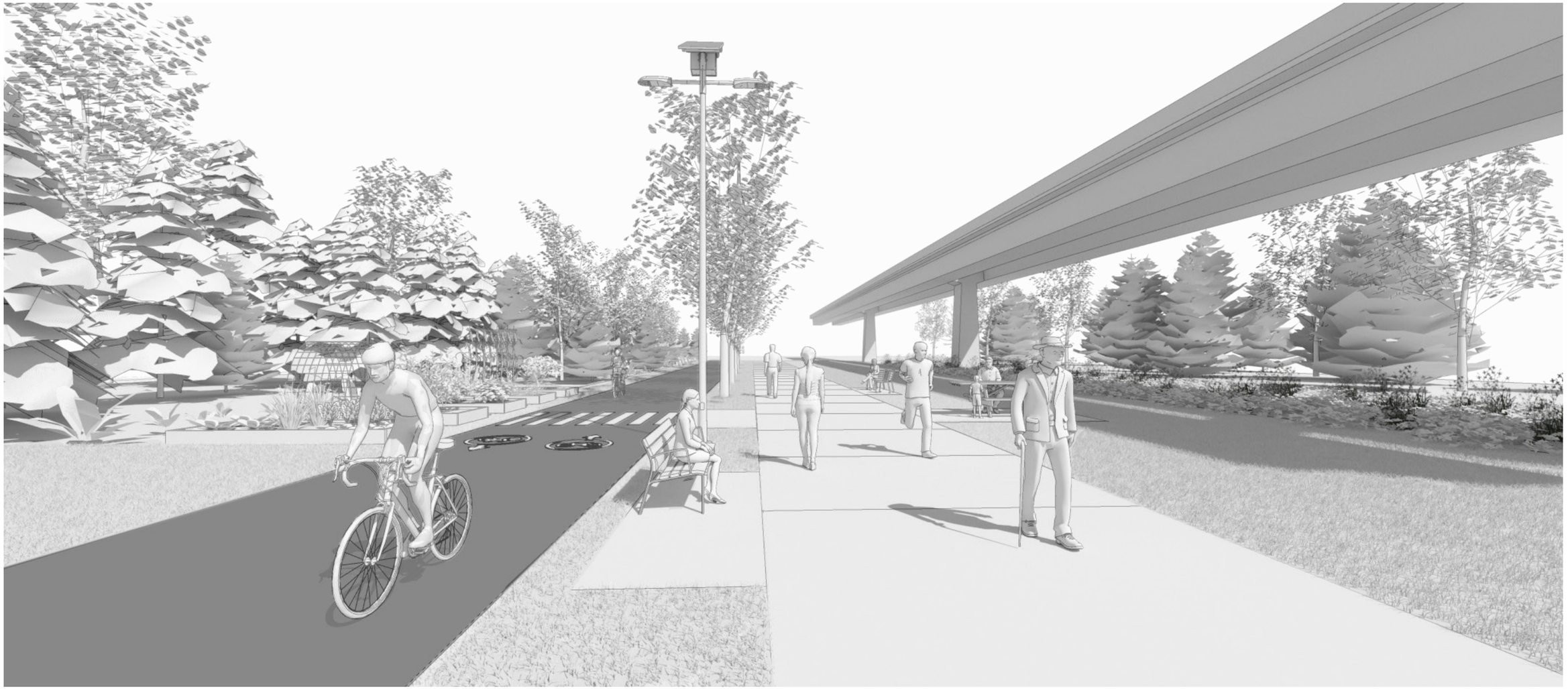


FIGURE 15 - OPEN SPACE CONTEXT PATHWAY RENDERING

4.3.5 SkyTrain Station Context

Overview

SkyTrain stations are a unique and important land use along the BC Parkway, and they include a number of contextual elements that necessitate special consideration. SkyTrain stations can be located in different urban contexts and have unique plaza configurations. They are often located at main road intersections and may include connections to bus service, pick up/drop off zones, and motor vehicle parking. In all cases, SkyTrain stations bring together a diversity of users and create a high degree of user interaction, resulting in potential conflict between cyclists and pedestrians.

A range of amenities should be provided in the area surrounding and approaching a SkyTrain station. Some example amenities are listed below. For a full description of transit-related amenities, refer to the *Skytrain Design Manual - Upgrades, Volume 1: Architectural* (Draft 2018), the *Bus Infrastructure Design Guidelines* (2018), and the *Bus Customer Amenity Program: Framework* (2019).

Opportunities

- SkyTrain stations act as a focal point for multi-modal transportation and interaction.
- High potential for creating social spaces with landscaping, amenities, public art, and placemaking.
- BC Parkway users may utilize a number of existing amenities at SkyTrain stations, including seating, bicycle parking, and other multi-modal amenities.

Constraints

- High potential for user conflict. High volumes of pedestrian traffic, including surges when buses and trains arrive at the station.
- Busy crossings and intersections, with potential for multi-modal conflicts.
- Pathway may be constrained by existing buildings, Skytrain columns, and amenities.

Amenities

- Contains all basic amenities (benches, information, and lighting).
- Also includes a range of additional amenities, with a focus on services (e.g. Wi-Fi, public washrooms), additional furniture, and multi-modal integration.
- See Section 5 for additional details.

Landscape Treatments:

- Landscape Classification Level 1 (refer to *Landscape Design Guidelines Report - BC Parkway (*2016)).

Design Guidance

Figure 16 shows the proposed SkyTrain station context pathway design. In general, BC Parkway pathway design around SkyTrain stations is similar to the urban context in terms of width, buffer spacing, and amenities. Where the BC Parkway approaches and travels through a SkyTrain station plaza, a few different configurations may be considered:

Pedestrian and Bike Pathway Bypass

- Designers should, where feasible, continue the separated bicycle and pedestrian pathways and create a bypass around the outside of the SkyTrain station plaza. This would allow through travelling pathway users to avoid potential conflicts with individuals entering and exiting the station and areas with the highest volume of people.
- Pathway widths in this context should match those shown in Figure 12 and Table 4 for the urban context.
- Design professionals should carefully consider areas where pedestrians will be crossing the bicycle pathway.
- It is important to note that cyclists will want to exit the pathway to access the SkyTrain station plaza. The pathway design should provide adequate space for slowing and turning cyclists. Different surface materials for the plaza space and the bicycle and pedestrian pathways can help to demarcate these spaces.

Mixing Zone

- Where space is constrained, and a pathway bypass is not feasible a mixing zone may be required.
- Mixing zones require a number of visual, tactile, and geometric design cues to alert users that they are approaching a busy and unique space with a greater volume of users, and that they should slow travel speeds. These treatments are also discussed in more detail in Section 7.
- Approaches and can include:
  - » Narrowing the pathway width to the minimum standard
  - » Changing the grade (elevation) of the pathway
  - » Arrange planters, benches, and other landscaping and amenities to create traffic calming
  - » Warning of the transition should be marked every 20 metres in advance to warn cyclists of the mixing zone ahead. Consider increasing the frequency of the markings upon approach to the transition. These markings can include:
    - Parallel lines showing the travelled way
    - Some kind of green paint application
    - Solid lines and stencils
- An intuitive layout and clear wayfinding should be provided to assist pedestrians and cyclists in finding the continuation of the BC Parkway.

SkyTrain Station Context

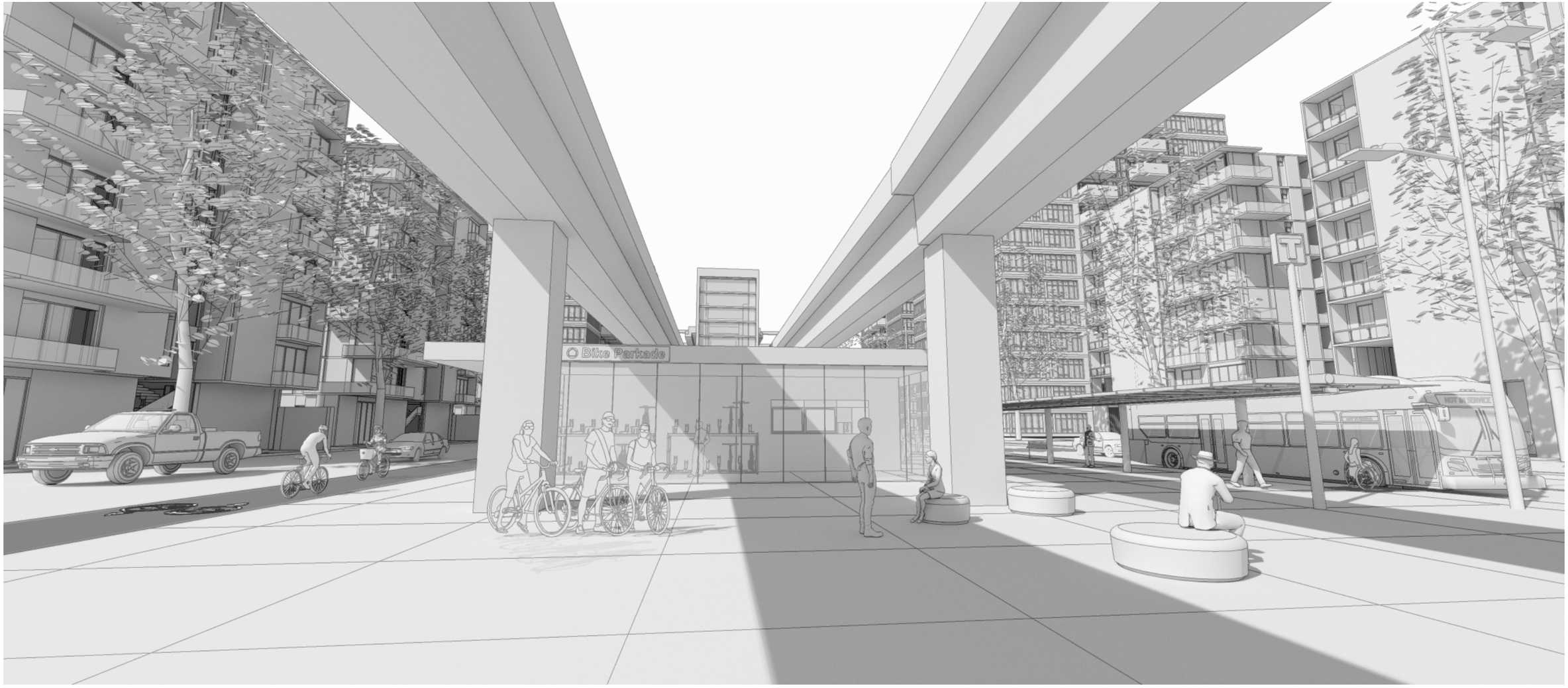


FIGURE 16 - SKYTRAIN STATION CONTEXT RENDERING


COLLINGWOOD
EAST VAN

5.0 Amenities

The placement of any type of amenity along the BC Parkway corridor should not restrict access to the SkyTrain guideway. BCRTC should be consulted when considering any amenities that would be located below or adjacent to the guideway structure.

5.1 Accessible Amenity Design

The design and placement of amenities along the BC Parkway should consider the accessibility needs and personal safety of all pathway users. Amenities should not protrude into or obstruct any part of the pathway and should be installed with enough clear space to allow pathway users to pass by comfortably. Additionally, amenities and other landscaping elements should be cane detectable and should be colour-contrasted with the surroundings (see Section 6 for more information on landscaping).

Where users are expected to interact with the amenities, such as benches, litter/multi-stream receptacles, or map stands, the amenity should be placed adjacent or connected to the pathway. Enough clear space must be provided around amenities to ensure that people using mobility devices are able to use the amenity and comfortably manoeuvre around it.

The location of amenities should consider the needs and preferences of users of all ages and abilities. For example, frequent seating should be provided along the BC Parkway, especially in areas with steep topography, so that people with limited mobility are able to rest. Additionally, amenities should ideally be located in areas that are sheltered from rain and wind.

5.2 Amenity Type and Placement

When properly designed, placed, and maintained, amenities can help provide a more comfortable, convenient, and enjoyable experience for BC Parkway users. Table 8 outlines and categorizes the amenities that are recommended along the BC Parkway. While some amenities are required in all areas to provide baseline functionality, others are context dependent and have been assigned to different land use contexts. These recommendations are based on the type and number of expected users in each particular context.

The following sections outline specific design guidance for choosing and installing various amenities along the BC Parkway. For additional amenities that are applicable at station areas, bus exchanges, and transit stops, please refer to *TransLink's Bus Customer Amenity Program: Framework* (BCAP) and the *SkyTrain Design Manual*.

TABLE 8 - AMENITY CLASSIFICATION

Amenity	Applicable Context
Furniture	
Benches	Urban, Residential, Industrial, Open Space, SkyTrain Station
Picnic Tables	Open Space, SkyTrain Station
Drinking Fountains	SkyTrain Station
Litter and Multi-stream Receptacles	SkyTrain Station
Fencing	Urban, Residential, Industrial, Open Space, SkyTrain Station
Handrails & Guards	Urban, Residential, Industrial, Open Space, SkyTrain Station
Information	
Cycling Wayfinding	Urban, Residential, Industrial, Open Space, SkyTrain Station
Pedestrian Wayfinding	Urban, Residential, Industrial, Open Space, SkyTrain Station
Additional Wayfinding Considerations	Urban, Residential, Industrial, Open Space, SkyTrain Station
Services	
Public Washrooms	SkyTrain Station
Wi-Fi	SkyTrain Station

Amenity	Applicable Context
Security	
Lighting	Urban, Residential, Industrial, Open Space, SkyTrain Station
Emergency Phone	Industrial, Open Space, SkyTrain Station
Multi-modal Integration	
Bicycle Racks	Urban, Industrial, SkyTrain Station
Bicycle Repair Stands	Urban, SkyTrain Station
Bicycle Footrests	Urban, Residential, Industrial, Open Space, SkyTrain Station
Bike Share Docking Stations	Urban, Residential, Industrial, Open Space, SkyTrain Station
Dockless Micromobility Parking	Urban, Residential, Industrial, Open Space, SkyTrain Station
Placemaking	
Public Art	Urban, Residential, Industrial, Open Space, SkyTrain Station
Community Gardens	Open Space
Sport and Recreation Areas	Urban, Open Space

Land Use Context

Urban, Residential, Industrial, Open Space, SkyTrain Station

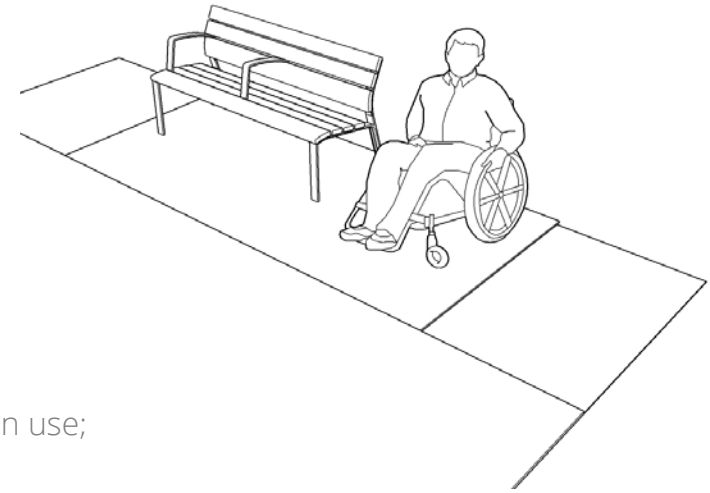
5.3 Furniture

In general, furniture along the BC Parkway should meet the following requirements:

- Does not obstruct or encroach into the pathway's clear space;
- Is adjacent to and accessible from the BC Parkway;
- Is consistently and intuitively located. If space is available, designers are encouraged to create an amenity zone that runs along the BC Parkway, either in the buffer between people walking and cycling or outside of the clear space;
- Is cane detectable;
- Has a surface texture and colour that contrasts with the surrounding area to make it visible.

The following section outlines design considerations for the different types of furnishings that may be considered along the BC Parkway.

5.3.1 Benches



Benches are a foundational pathway amenity that provide users with a place to rest, socialize, people watch, and take in the surrounding environment. Benches and other resting spots are crucial for people with reduced mobility, who require frequent resting spots. Appropriate bench design will help to maintain a cohesive image along the BC Parkway while providing users with a safe and comfortable space. Benches along the BC Parkway should be:

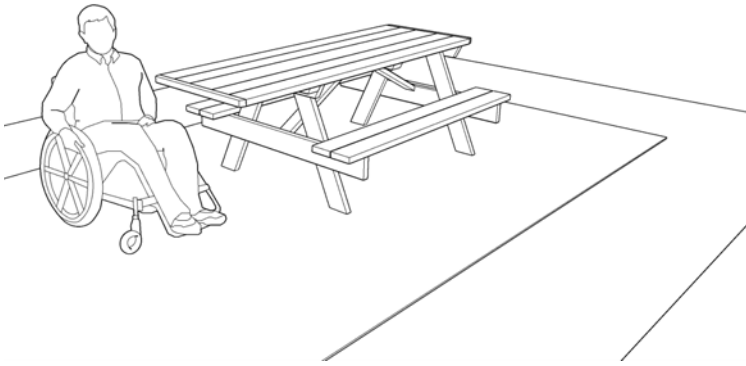
- Stable, ergonomic in design, and comfortable in use;
- Accessible to all users; this includes:
  - » Full back rests;
  - » Arm rests, on one side only, to allow for wheelchair transfers;
  - » Kick space underneath benches; and
  - » Cane stops at the base of bench.
- Equipped with arm rests that divide sitting positions;
- Contemporary in design and style to suit station aesthetic and system-wide landscape elements;
- Easy to maintain, durable, and vandal resistant; and
- Equipped with stainless steel bench frames.

Multi-level seating options can also be considered, including leaning benches, as the typical bench design may not be accessible for all users.

Bench placement along the BC Parkway should meet the following requirements:

- Benches should be placed:
  - » Next to an accessible route and with a surface that is connected and continuous with the pathway surface.
  - » In areas with leveled and firm surfaces;
  - » Where the use of that space is encouraged and the safety of users can be promoted; and
  - » Out of the way of station entrance areas to deter impeding station access.
- Seating areas should have an adjacent level and firm area at least 850 x 1350 millimetres that is not part of the route of travel, which allows a person in a wheelchair to rest beside the bench;
- CPTED principles should be followed by locating seating in highly visible and strongly lit areas that also provide sightlines while reducing blind spots. Benches should not be placed in areas where customers/public can be approached from behind;
- Prioritize the placement of benches in areas where the BC Parkway opens to a notable view for the enjoyment of the user. View should be away from, not into, private property; and
- Where possible, integrate seating into the landscaping.

5.3.2 Picnic tables



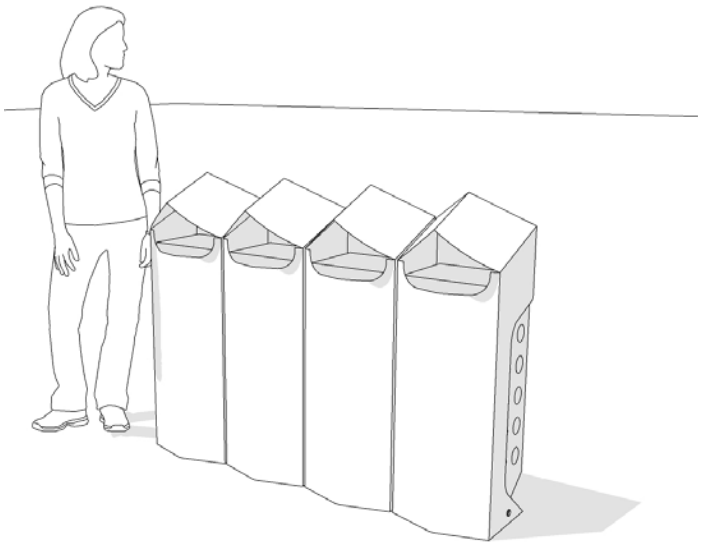
Picnic tables accommodate a greater number of individual and social uses than benches but require a greater amount of space. This makes them most appropriate in open space contexts. Although much less frequent than the bench, the picnic table design can function as a repetitive element to create a cohesive image along the BC Parkway. In order to increase the use of picnic tables throughout the year, some form of weather protection, such as a canopy or placement under the guideway, can be provided where feasible. Picnic tables should be:

- Placed on a stable, firm, and leveled surface;
- Ergonomic in design and comfortable in use;
- Accessible to all users;
- Located in both sunny and shady areas;
- Contemporary in design to suit system-wide landscape elements;
- Easy to maintain, durable, and vandal resistant; and
- Made of a stainless-steel frame.

5.3.3 Drinking Fountains

Drinking fountains are appropriate near SkyTrain stations and station plazas with an available water connection. All drinking fountains should be dual with high (965mm -1100mm above surface) and low (max 915mm above surface) drinking fountain spouts to make the water accessible for people in wheelchairs and children. The design should ensure that two people using the high and low spouts simultaneously do not conflict with each other. The water stream should allow for a cup to be placed under an be filled with water.

5.3.4 Litter and Multi-stream Receptacles

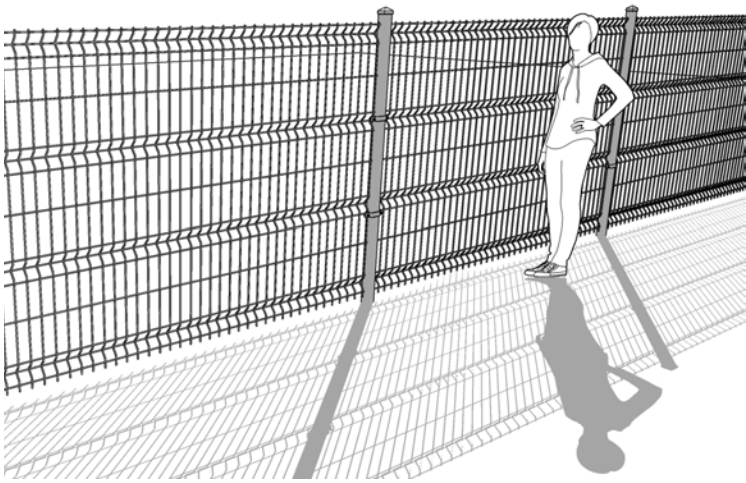


Along BC Parkway, litter and multi-stream receptacles should only be placed in station areas where maintenance is under BCRTC's jurisdiction. Litter and multi-stream receptacles should be:

- Designed to ensure contents from receptacles are easily removable, while preventing unwanted access by way of a secure top;
- Allow for the use of removable liners that fully conceal waste bags from customer/ public view;
- Fully anchored to the ground to prevent tipping;
- Durable, vandal/graffiti resistant, and preferably constructed of a rough and/or mesh material;
- Contemporary in design to suit station aesthetic and system-wide landscape elements;
- Easy to maintain, with standardized design for ease of system-wide maintenance;
- Designed to conform to WorkSafe BC regulations;
- Designed with an opening or lid not higher than 1060 millimetres from the ground;
- Designed to have a clear ground area of at least 800 millimetres x 1350 millimetres at the opening or lid;
- Cane detectable from the ground; and
- Colour-contrasted with the surroundings.

Multi-stream litter receptacles (including separate slots for landfill garbage, clean mixed paper, mixed containers, and organic waste) are preferred in order to cut down on waste, but the location should be approved by BCRTC. Single-stream litter receptacles should be proposed as a secondary option when proper maintenance and waste collection cannot be arranged with BCRTC.

5.3.5 Fencing

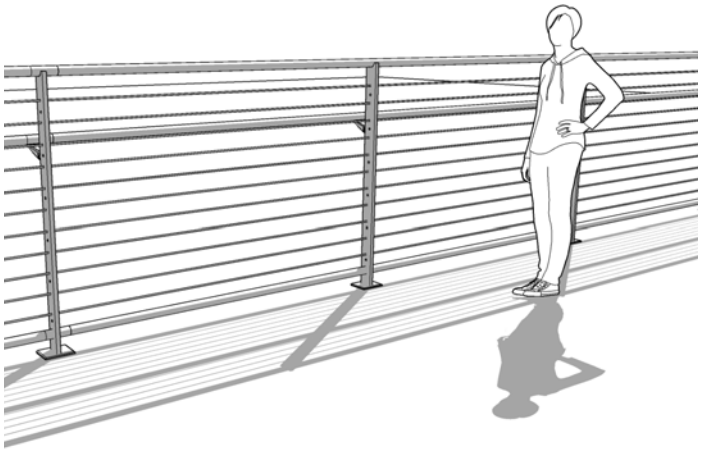


Fences are necessary to prevent people or animals from entering an area that is not safe or intended for public access or is temporarily restricted. They can also aid in separating spaces when needed. Fencing is most commonly used on BC Parkway where there is a change of grade adjacent to the pathway. Fencing along BC Parkway should be:

- Contemporary in design to suit station aesthetic and system-wide landscape elements;
- Made of stainless steel; painted or powder coated steel is acceptable;
- Designed to consider vertically oriented elements to deter climbing
- Designed to deter bicycle lock up (bicycle racks should be used instead);
- Made of strong and secure elements, including structural elements;
- Easy to maintain, durable, and vandal resistant;
- Sourced from a local product distributor or custom fabricator if possible;
- Designed, constructed, and implemented to conform to Building Code and municipal bylaws;
- Designed to avoid creating a safety hazard for cyclists, including avoiding potential conflicts with bicycle handlebars; and
- Designed and placed to follow CPTED principles by providing strong sightlines and avoiding blind spots (see section 11.0 of the *SkyTrain Design Manual*).

Where the installation of a fence is necessary, Omega Fencing will be the preferred option. Fencing made of chain link, especially in combination with barbed wire, should be avoided in public-facing areas of BC Parkway. Where chain link fencing is the only economical option in isolated non-public areas, black vinyl coated chain link fencing should be considered . Planting of non-invasive, suitable evergreen vines should be considered as screening.

5.3.6 Handrails and Guards



Handrails and guards should be used to separate and protect users from grade changes, and to limit and discourage access to certain areas such as swales or ditches. They should also be installed in the presence of stairs and ramps when the Building Code requires them and to provide universal accessibility.

The design of handrails and guards should complement the overall design of the BC Parkway, open spaces, and plazas, minimizing the sense of obstruction and enclosure. Given the length of the site, railings should be easy to install, repair, and replace. Railings should also be as transparent as possible to maximize the openness of the site. The design of handrail and guard for landscaping should follow design standards found in Section 3 of the *Design Principles & Standards manual and the Building Code*. Handrails and guards should be:

- Constructed to be vandal resistant;
- Easy to maintain and be standardized for system-wide maintenance;
- Constructed with handrail brackets and station at entrances made of stainless steel;
- Sourced from local product distributor or custom fabricator if possible;
- Designed not to create a safety hazard for cyclists and avoid creating potential conflicts with bicycle handlebars;
- Constructed and installed based on Building Code and municipal bylaws; and
- Placed to follow CPTED principles by providing strong sightlines and avoiding blind spots (see Section 11.0 of the *SkyTrain Design Manual*).

5.4 Wayfinding and Information

Wayfinding should be used to provide simple, clear, and consistently branded information to help people navigate spaces effectively and intuitively. TransLink has existing wayfinding guidelines for the Metro Vancouver Region (see *Getting There by Bike! – Wayfinding Guidelines for Utility Cycling in Metro Vancouver*); however, this guidance was bicycle-specific, so other active modes should be considered. TransLink has also developed the BC Parkway Regulatory Signage and Pavement Marking Guidelines, which provides some guidance on the placement of wayfinding and etiquette signage.

This section outlines high-level considerations for wayfinding, branding, and other techniques for sharing information along BC Parkway. TransLink staff should work with their wayfinding and marketing team to determine a standard approach for providing wayfinding and information along BC Parkway.

5.4.1 Cycling Wayfinding

The *Wayfinding Guidelines for Utility Cycling* in Metro Vancouver provides detailed guidance on the preferred layout and information that should be included on signage. It also includes information on the different types of signs and where they should be located. Cycling wayfinding on the BC Parkway should:

- Be simple and easy to follow with information that is structured and presented to the intended audience in a clear and logical form;
- Identify destinations based on a hierarchy that is based on distance, the importance of destinations, and the significance of the location;
- Be predictable and consistent so that it is easily recognized and understood;
- Be installed facing both directions of travel where the BC Parkway transitions into a SkyTrain station;
- Be used to highlight transit connections and provide information about distance to local amenities and destinations such as schools and community centres; and
- Be used to identify adjacent and connecting bicycle facilities.

5.4.2 Pedestrian Wayfinding

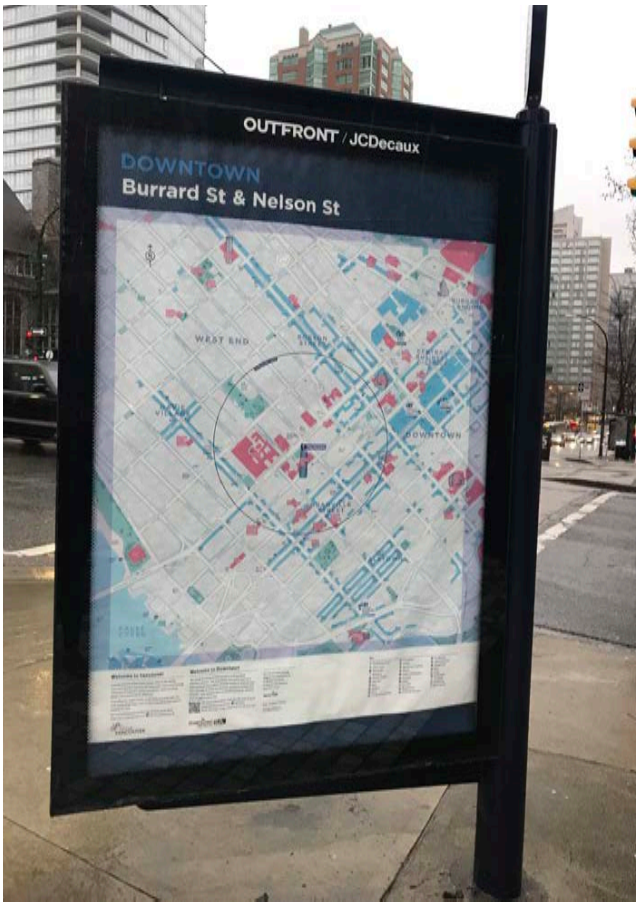
People walking and people cycling have different wayfinding needs and experience wayfinding differently due largely to travel speeds. The information on signage for pedestrians can often be more detailed, as people walking or rolling may be more willing to stop and study information. Destinations identified on pedestrian wayfinding need to be within a reasonable travel distance based on the mode of travel. Wayfinding for pedestrians and other BC Parkway users should:

- Consider the different types of users, and consider accessibility challenges including comprehension and vision;
- Include different types of signage depending on land use context, including pedestrian monoliths (large and small), pedestrian fingerposts, and digital/interactive hubs;
- Be installed in all land use contexts along the corridor;
- Be installed at major intersections or junction points to help with route decision making;
- Ensure consistency of wayfinding elements, graphics, style, location, and distribution throughout the BC Parkway; and
- Be installed where there is lighting to ensure the information is readable after dark and in winter conditions.

5.4.3 Additional Wayfinding Considerations

This section outlines some additional wayfinding considerations.

- **Location and Placement:** Signs should be installed 0.6 to 1.2 metres from the edge of the path. Signs should be installed at 1.5 metres height from the finished grade to the bottom of the sign. Signs should not be installed on trees.
- **Etiquette:** Signage may be installed that communicates the appropriate travel direction and pathway user.
- **Placemaking and Community Based Signage:** Wayfinding can integrate temporal, community-based signage such as community message boards, as well as information about the site that might facilitate self-guided tours.
- **Historical Context:** Wayfinding along the BC Parkway could provide information about the history and identity of the surrounding communities.
- **Branding:** There are opportunities to provide BC Parkway-specific branding along the length of the corridor. 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 network. It also helps to build brand recognition.



5.5 Services

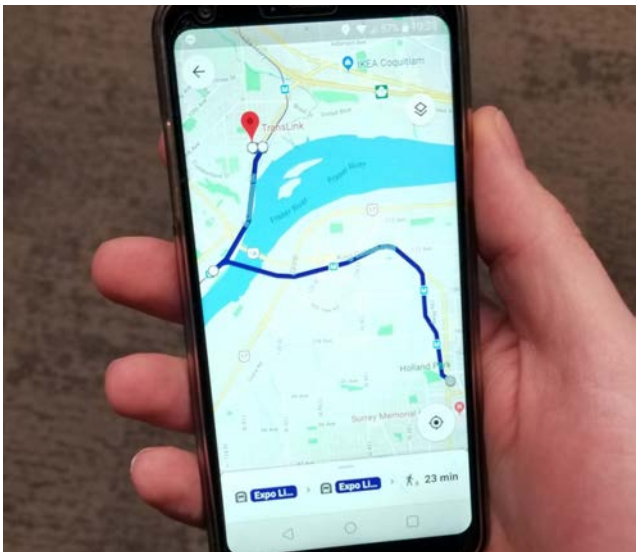
Services such as public washrooms and Wi-Fi can be provided to enhance the user experience and better accommodate people of all ages and abilities.

5.5.1 Public Washrooms

Locating public washrooms in SkyTrain stations along the BC Parkway will enable more people to use the BC Parkway and other nearby spaces. TransLink has adopted a policy to increase the availability of public washrooms along the regional transit system. According to the policy, "customer washrooms along the network should be provided in a manner that makes facilities available to the greatest number of persons at key points along their transit journey, while balancing the need for coverage and finite budget resources."

5.5.2 Wi-Fi

There are opportunities to provide Wi-Fi access at SkyTrain station areas in the future. Free Wi-Fi will support user convenience, wayfinding, and safety, by providing more options to contact emergency services if needed.



5.6 Security

The safety and security of BC Parkway users should always prevail over other design considerations. The application of Crime Prevention Through Environmental Design (CPTED) principles will greatly improve the safety of the users along the Parkway. CPTED principles and safe pathway design encourage a diversity of users by helping more people feel safe and welcome.

The design and layout of spaces along the BC Parkway should strive to maintain straight and open sightlines wherever feasible, while eliminating hiding places. Clear views to and from the BC Parkway should be maximized.

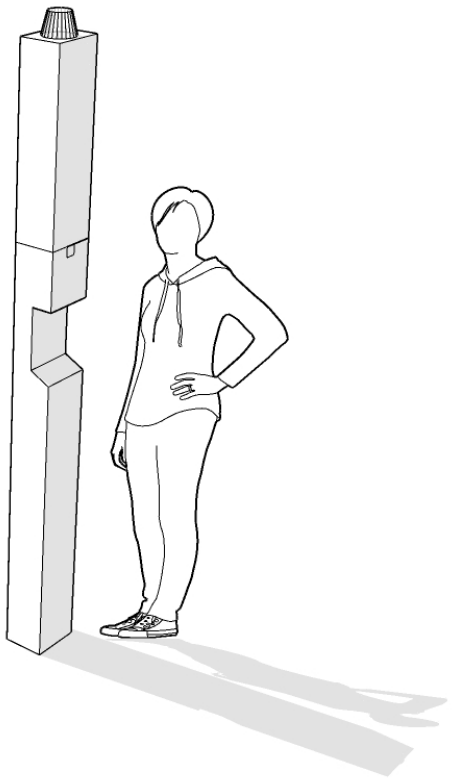
5.6.1 Lighting

Lighting is an important factor in security and will enable people use the BC Parkway at more times throughout the day and night. Choosing the appropriate lighting design will help the user to feel comfortable, oriented, and safe. It recommended that the BC Parkway should be fully lit. Light should never invite users into isolated areas or other dangerous situations. More detailed design guidance for lighting can be found in Section 8.

5.6.2 Emergency Phone

The strategic location of emergency phones will help in delivering reliable emergency assistance when most needed. These phones can be installed at SkyTrain stations or on free-standing poles in isolated areas long the BC Parkway. They are intended to improve real and perceived safety and comfort, while extending the use of the Parkway for more hours. Emergency phones can also be used to deliver information and assist by giving directions, thus helping the user to navigate and feel oriented if necessary. Emergency phones should be:

- Placed in areas where the user may experience a real or perceived threat;
- Highly visible and easy to identify;
- Simple to operate under stress;
- Designed for people of all ages and abilities, with features such as one-touch operation and hand-free communication;
- Vandal resistant and easy to maintain; and
- Installed in a hard surface that is continuous with the finished surface of the BC Parkway.
  - » The surface where the amenity is installed should be cane-detectable, and its colour and material should be easy to identify.
  - » The distance from the edge of the path should maintain the same lateral clearance as the rest of the amenities to avoid conflict and obstruction of the BC Parkway.



5.7 Bicycle Parking and Micromobility

The provision of bicycle parking and the integration of bike share and other mobility options is crucial for enabling seamless multi-modal transportation. These amenities should be considered and accommodated where possible, but typically in the urban and SkyTrain station area contexts.

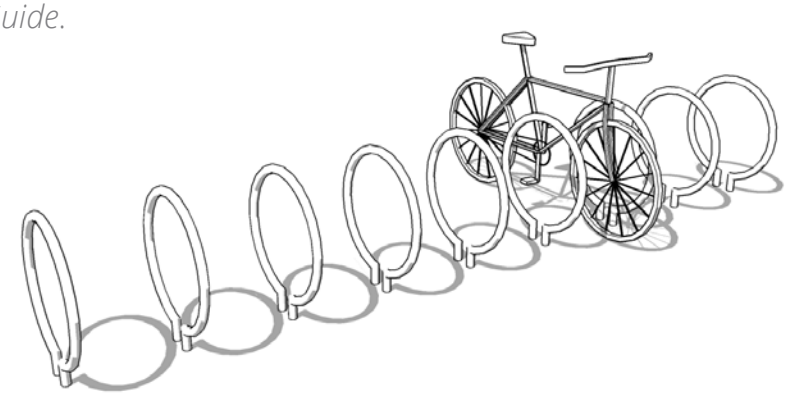
5.7.1 Bicycle Racks

Bicycle racks allow for short-term bicycle parking. The design, installation, and location should all be carefully considered to ensure their effectiveness. The preferred location for bicycle racks is at transit stations and in urban areas. They may also be appropriate within the industrial land use context to allow connections to employment areas. The number of racks at each location will be determined based on anticipated demand and the availability of space.

Bicycle racks should be:

- Located outside of the pathway clear zone and the lateral clearance distances to prevent any obstruction of other users;
- Cane-detectable, with a colour, material, and edges that are easy to identify;
- Installed in a hard surface such as a concrete slab that is continuous with the finished surface of the BC Parkway, and fastened with tamper-proof anchors;
- Either inverted 'U' or 'O-ring' type configuration;
- Appropriately sized to support an entire bicycle and frame in two locations;
- Design to allow the frame and wheel to be easily locked;
- Made of stainless-steel tubing;
- Located within open view to allow for passive surveillance opportunities;
- Placed under weather protection whenever possible;
- Located to provide a minimum 600mm clearance between two rack units; and
- Placed to allow for access and usability from all sides.

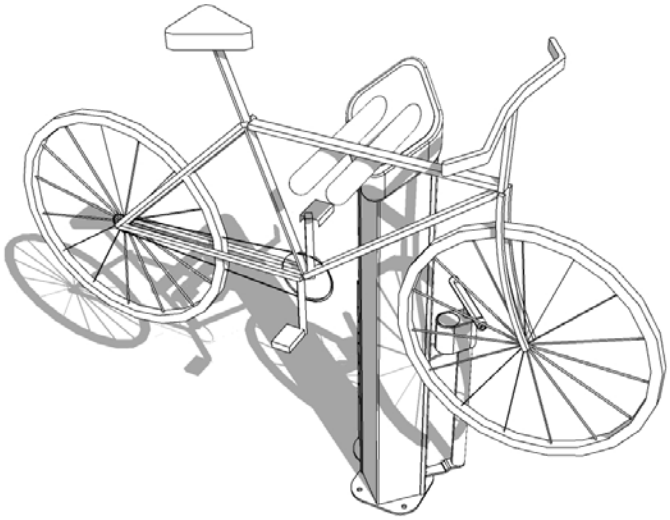
At select locations SkyTrain stations along the BC Parkway, bicycle lockers and bicycle parkades are also available for users. TransLink has guidance established for the placement and design of these amenities. For additional bicycle parking guidance, see Chapter H.2 of the *B.C. Active Transportation Design Guide*.



5.7.2 Bicycle Repair Stands

Bicycle repair stands typically include a stand, repair tools, and a tire pump, allowing people to fix minor issue for free. Anti-theft versions where the repair tools are connected to cables can be provided on-street and in other public places such as parks, transit stations, and places near high-density bicycle parking. Bicycle repair stands should be:

- Sited in locations that are within proximity to commercial or shopping districts; residential neighbourhoods; parks; destinations and attractions; community facilities and amenities; event venues; and SkyTrain stations;
- Located outside of the pathway clear zone to prevent any obstruction of other users;
- Intuitive and easy to use;
- Installed in a hard surface that is continuous with the finished surface of the BC Parkway; the surface should also be cane-detectable, and its colour, material, and edges should be easy to identify; and
- Fastened to a concrete slab with tamper-proof anchors.



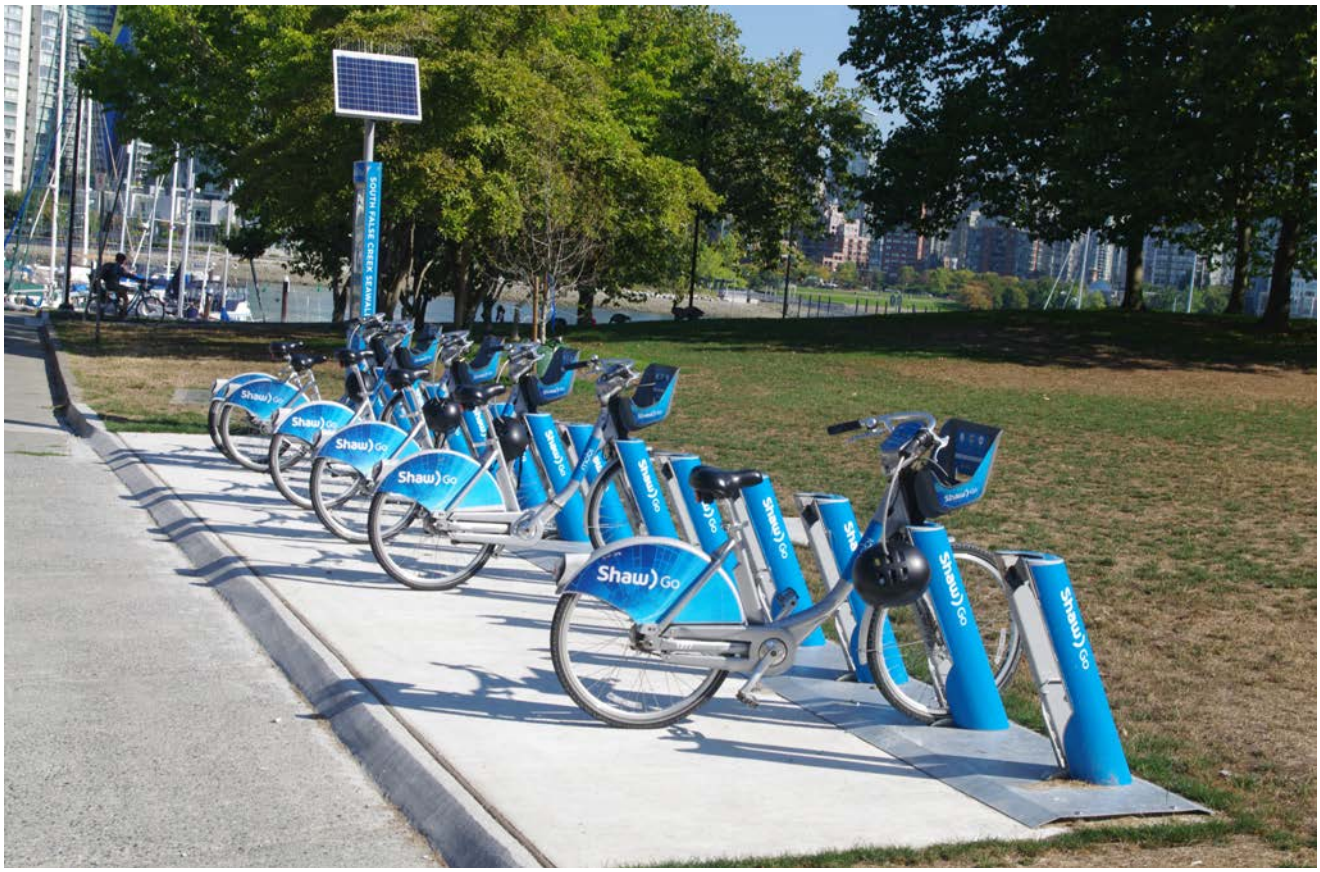
5.7.3 Bicycle Footrests

Bicycle footrests currently exist at select intersections along the BC Parkway. Bicycle footrests allow cyclists who are waiting to cross an intersection to rest while remaining in a seated position, without having to dismount or put their foot on the ground. Bicycle footrests are placed adjacent to the pathway outside of the clear zone. They should not create an obstruction for any pathway users. Bicycle footrests are typically placed at intersections where cyclist queuing is anticipated. TransLink has existing specs and designs for bicycle footrests.

5.7.4 Bike Share Docking Stations

Docked or station-based bike share systems, including the City of Vancouver's Mobi Bikeshare system, may be installed adjacent to the BC Parkway to allow users to access the pathway. Bike share docking stations should:

- Be sited in locations that are within proximity to commercial or shopping districts; residential neighbourhoods; parks; destinations and attractions; community facilities and amenities; event venues; and SkyTrain stations;
- Clearly visible to the public with 24/7 public access and easy access to the street and BC Parkway;
- Located outside of the pathway clear zone and the lateral clearance distances to prevent any obstruction of other users;
- Installed in a hard surface that is continuous with the finished surface of the BC Parkway; the surface should also be cane-detectable, and its colour, material and edges should be easy to identify;
- Fastened to a concrete slab with tamper-proof anchors; and
- Be located to ensure sun exposure if the station or bikes operates using solar power.

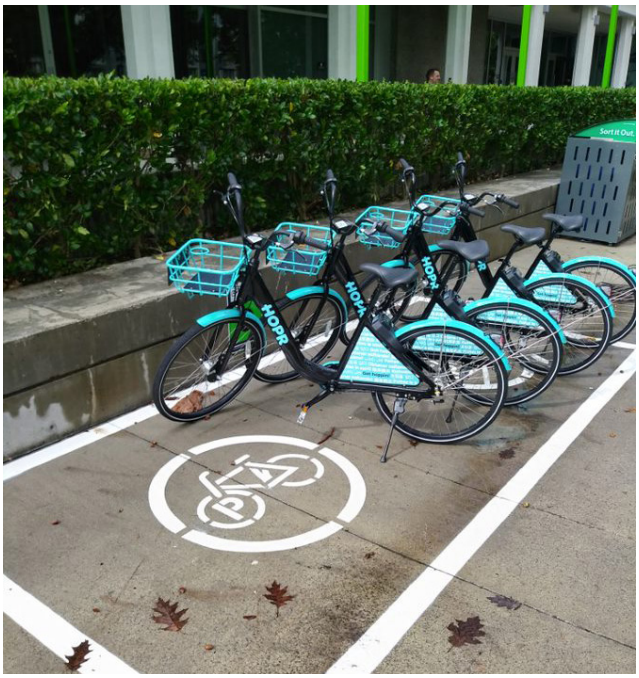


5.7.5 Dockless Micromobility Parking

Dockless bike, e-bike, and e-scooter share operate under the assumption that public space is available for parking small shared vehicles between uses. Unlike docked bike share, where trips can only be ended at defined docking stations, dockless small vehicle sharing technically permits users to end their trips anywhere within a defined service area.

Allocating designated space for dockless shared mobility services will help to mitigate negative externalities, such as bicycles or scooters blocking pathways and sidewalks. The Institute for Transportation and Development Policy (ITDP) Bike Share Planning Guide provides guidelines to manage public space with the introduction of bike share services. Dockless micromobility parking areas should:

- Be sited and installed by the municipality for use by all dockless services. Municipal staff will need to work with operators to ensure the GPS technology on their small vehicles is accurate enough to recognize vehicles parked within the designated areas as complying, that parking areas are clearly defined across all real-time service maps, and that incentives are built in to trip fee structures to encourage parking at designated locations;
- Be clearly and consistently signed or marked on the pavement;
- Be located so they are visible to small shared vehicle users, pedestrians, and other roadway users, including motor vehicles; and
- Accommodate locking to bicycle racks if required.



5.8 Placemaking

There are numerous opportunities to incorporate placemaking components into the BC Parkway. An overview of placemaking opportunities is provided below.

5.8.1 Public Art

Public art can be used to enhance the identity and character of a space. Art can be used to create easily identifiable visual reference points along the BC Parkway that will help the user to navigate, while creating an enhanced sense of place. It is recommended that public art should aim to serve multiple purposes. For example, this may include something that provides both aesthetic benefits in addition to seating, weather protection, context awareness, wayfinding, or environmental enhancement.

The installation of public art in strategic locations such as stations, nodes, and access points should be prioritized. The integration of public art should always consider the safety of the users of BC Parkway. The dimensions of any piece of public art should always be kept within the limits of the established lateral or vertical clearances. The art should not obstruct user sightlines, lighting poles, or wayfinding signage. It should also avoid blocking user movement along the BC Parkway and should consider the access and operations of maintenance vehicles and/or personnel.

TransLink has an existing public art program. Any opportunities to provide public art along BC Parkway should be considered within the context of that program, as well as the operations and maintenance of the BC Parkway.

5.8.2 Community Gardens

Community gardens promote food security, sustainability, environmental stewardship, and community building. They are becoming more commonplace on city-owned land across Metro Vancouver. There are currently existing community gardens adjacent to the BC Parkway. The placement and appropriateness of community gardens needs to be reviewed on a case-by-case basis. Community garden placement should not obstruct access to the SkyTrain guiderail.

Typically, the primary requirement for a community garden on city land is that potential users organize themselves into a Society under the Societies Act. The Society then assumes liability and responsibility for the organization and the maintenance of the garden. The minimum number of people required to start the Society varies with the municipality (typically 12-15 people). The ownership of the land the garden is located on does not change, but the Society assumes the liability for the property while it is under its care. The Society is typically required to carry $2 million dollars of liability insurance. Most municipalities do not stipulate a timeline for the lease of the garden space, but Vancouver requires the Society to update their license every five years.

5.8.3 Sport and Recreation Areas

There may be opportunities, where space permits, to locate sport and recreation areas in open spaces and urban areas adjacent to BC Parkway. This can include basketball courts, skateparks and skate dots, outdoor fitness areas, or outdoor bouldering areas. TransLink and designers should work with the municipality where the facility would be located to determine the location and appropriateness of the facility, as well as an agreement on ownership and ongoing operations.

5.8.4 Programming

There may be opportunities to incorporate some types of programming, temporary art installations, or scheduled events along the BC Parkway. This programming would help to attract visitors and create a destination for people to visit, stay, and explore. TransLink should consider developing a Programming Strategy if there is interest in exploring this opportunity.

Through the design process, there are opportunities to identify locations where programming may be appropriate. Below are some of the general considerations for programming, including the possibility of incorporating programing into existing infrastructure.

- Benches, fences, and access ramps, and stairways could be opportunities for artistic design and fabrication.
- Art and programming can be used to strengthen local stewardship of the BC Parkway.
- New concrete construction could incorporate designs/molds created by artists or anticipate opportunities for future public art.
- There are opportunities to develop programming coordination with schools and local community agencies to identify fundable partnership opportunities.
- Effort should be made to anticipate digital media as an increasingly varied, complex, and popular forum for artistry and communication.

5.8.5 Plazas

While transportation and movement are important functions of the BC Parkway, there is also opportunity to designated spaces for people to gather, socialize, and interact without creating conflicts with moving users. Plazas can help provide these types of spaces; however, they come with long-term operations and maintenance challenges. Generally, there are two types of plazas found along or adjacent to BC Parkway:

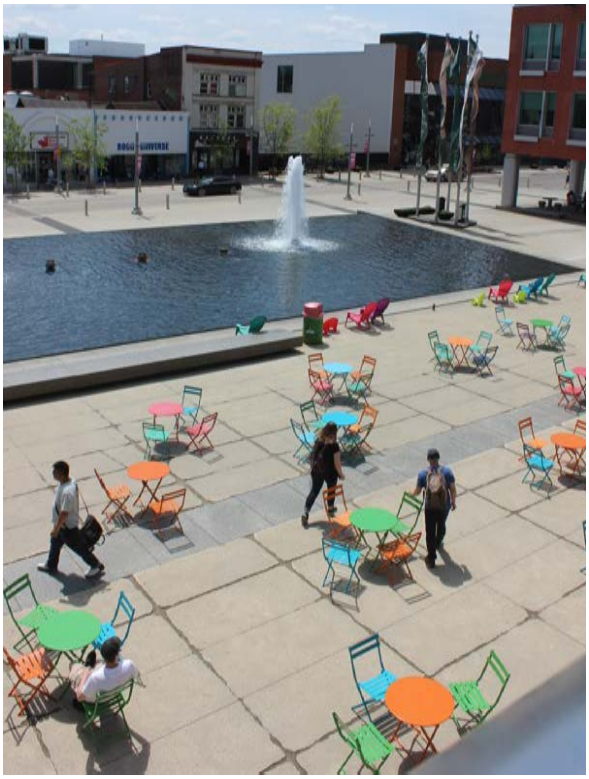
- Smaller scale plazas, which are located at various points along the BC Parkway. In many cases, these plazas had been part of the original BC Parkway design and are located on property that is included within TransLink's agreement with BC Hydro/Southern Rail. The BC Parkway may travel through or adjacent to these plazas, which are maintained by BCRTC.
- Larger scale plazas, which are located at SkyTrain stations and are part of the station area design. BC Parkway may travel through or adjacent to these plazas.

The lack of a comprehensive stewardship model has made the ongoing maintenance and operations of the existing smaller scale plazas challenging. If TransLink is interested in providing additional, or updating existing, plazas along BC Parkway, the development of a plaza stewardship model should be considered. A plaza stewardship model enables an organization or municipality to partner with the community to develop, program, and maintain the spaces. Partners include community groups, neighbourhood houses, non-profit organizations, business improvement associations, institutions, and others.

Ownership and governance are important considerations. There are four different models sited in literature:

- Community Partnership model
- Grassroots model
- Institution-based model; and
- Privately-owned public spaces model.

The City of Vancouver is currently working on updating their Plaza Stewardship Strategy, which clearly identifies ownership, governance, and funding for various plazas throughout the City. These three components are key to ensure a plaza is managed, programmed, and maintained over time.



6.0 Landscaping

This section outlines the landscaping recommendations for the BC Parkway. The landscaping recommendations consider resource conservation and look for opportunities to enhance the existing urban ecosystems. Landscaping features can be used to enhance the image, identity, and multifunctionality of the BC Parkway. Attractive and well-maintained landscaping can help to make the BC Parkway a more comfortable and enjoyable space. This chapter provides some high level guidance on landscaping for BC Parkway. More detailed guidance on species and siting can be found in the document titled, the *BC Parkway Landscape Design Guidelines - Report*.

6.1 Landscaping Overview

The BC Parkway should be landscaped using a mixture of permeable paving and climate-appropriate plants. Landscaping on the BC Parkway should require no irrigation and produce no runoff. Whenever possible, the landscaped areas should be utilized as opportunities for managing the water on-site. The function of the landscape should contribute to the site's overall water management through the infiltration, retention, detention, or evapotranspiration of water. Details for each aspect of landscaping, including vegetation types and the growth, protection, and management of vegetation, is described below.

6.1.1 Vegetation

For a suitable plant palette and species selection along the BC Parkway, refer to the *Landscape Design Guidelines Report* (2009). All plants should comply with the Canadian Standards for Nursery Stock and the Canadian Landscape Standard, except as and when modified by the requirements of this guideline. The following overarching principles should be considered when selecting vegetation along BC Parkway.

Vegetation should:

✓ Create an opportunity to engage with nature
✓ Include species that are suited for local site conditions
✓ Require no irrigation
✓ Provide continuity

Vegetation should not:

× Obstruct views and sightlines
× Exceed heights that block sightlines (see text)
× Encroach into the pathway
× Have thorns or be poisonous
× Endanger the health of other types of vegetation
× Consist of invasive species

For a suitable plant palette and species selection along the BC Parkway, refer to the *Landscape Design Guidelines Report* (2009). All plants should comply with the Canadian Standards for Nursery Stock and the Canadian Landscape Standard, except as and when modified by the requirements of this guideline. The following overarching principles should be considered when selecting vegetation along BC Parkway.

- Plantings should be selected and placed to suit the BC Parkway aesthetic and system-wide landscape elements and should contribute to an open and airy environment;
- Plantings should create the opportunity to engage with nature;
- Planting design should mimic local habitats that support the establishment and growth of native species and suitable vegetation;
- Plantings should be drought tolerant, hardy, and disease and pest resistant (especially aphid resistant). Native plants that require no irrigation are preferred;
- Placement of vegetation should maintain open views at eye level. This can be done by selecting understory shrub species that are predominately low growing cultivars. In addition, species selection should consider seasonal interest, wildlife benefit, and salt tolerance;
- Shrubs and groundcovers should not exceed 860 millimetres in height at maturity to ensure sightlines to the street for vehicles and pedestrians. Within 1500 millimetres of a driveway, alleyway, or access ramp, plants should be a maximum of 600 millimetres;
- Species should be selected to be well suited to the local site conditions, including soil moisture levels and sun availability. Both evergreen and deciduous species should be selected to provide seasonal interest and year-round structure;
- Provide continuity across the landscape through the use of understory perennials and grass species. Criteria for inclusion should include persistent winter foliage, showy spring flowers, and wildlife benefits, among others. Species should be hardy, salt tolerant, and low maintenance;
- Special consideration should be given to plant species that will attract and provide habitat for birds and beneficial insects, while also providing seasonal colour and interest;
- Plant material should not present a danger to public egress. Plants with sharp, pointy protrusions such as needles and thorns, or plants that are poisonous, are not allowed. Vines and other plant material that grow onto a street tree or presents a tripping hazard are not allowed;
- Plantings must be designed in a manner that does not endanger the health or stability of existing trees. Particular attention must be paid to landscaping within the Critical Root Zone (CRZ) of the tree. Avoid planting shrubs and flowers or any other plant material within 750 millimetres of the base of a tree trunk;
- Use planted areas to screen adjacent private property; and
- Landscaped areas must be kept free of weeds.

The main elements that conform the vegetation aspect of the landscape are trees, shrubs, groundcovers, and grass. These elements are described below. Ornamental grasses and vines are generally discouraged in parks, buffers, medians, and entry feature beds, and may only be used selectively, in limited quantities, as a visual accent.

The minimum plant material sizes should be:

- Deciduous Trees: minimum caliper of 70 millimetres
- Coniferous Trees: 1.8 to 3.0 metres tall
- Shrubs: 600 1000 millimetres tall
- Groundcovers/Perennials: 1 gallon potted/container grown

Trees

Trees play a significant role in the aesthetic appeal along the BC Parkway and surrounding walkways. Utilizing finely textured trees in the predominant foreground provides an open and airy environment on plazas and corridors, and the mass of surrounding architecture is softened. Trees should be selected by the landscape designers in response to the BC Parkway-specific design requirements.

Trees should meet the following recommendations:

- Trees should be installed to adhere to an applied 3-7 Rule– i.e., foliage should not grow above 900 millimetres and/or below 2100 millimetres, as outlined in Figure 17. This preserves sightlines through the BC Parkway;
- Tree variety should be suitable for tough urban conditions;
- Consider prioritizing larger and more mature trees – this reduces the cost of replacement, as young trees are susceptible to vandalism;
- Consider small-leafed tree species, as fallen foliage causes less of a slipping hazard and are easier to clean up;
- Consider tree varieties that do not drop fruit, sap, pollen, or honeydew;
- Tree variety and placement should follow CPTED principles by preserving sightlines through the BC Parkway and by avoiding placement in front of station/facility glazing (See section 11.0 of the SkyTrain Design Manual);
- Materials and installation should follow with joint BCSLA/BCLNA Landscape Standard; and
- Trees can be placed strategically to discourage public access if there are any areas where public access may be prohibited.

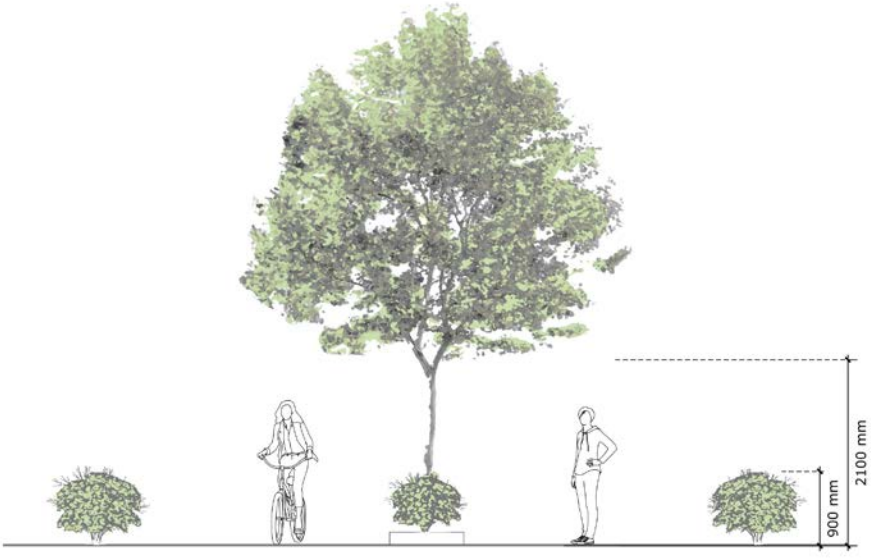


FIGURE 17 - TREES

- To ensure the long term health of trees, an accredited arborist should be consulted prior to proposing new trees or performing work around existing trees;
- Trees planted next to paved surfaces are to be provided with soil cells or structural soil, to ensure that there is sufficient soil volume available for the roots; and
- The use of tree barriers is not recommended unless proper installation can be ensured.

Shrubs

Shrubs should:

✓ Adhere to the 3-7 Rule
✓ Be indigenous plant species
✓ Consider seasonal interest
✓ Be arranged with contrast and layering

Shrubs should not:

× Have strong fragrances
× Grow above 600mm (2')
× Provide areas of concealment

Shrubs should be selected by the landscape designers in response to BC Parkway specific design requirements. Shrub plantings should:

- Consider contrast and layering in shrub planting arrangement;
- Incorporate indigenous plant species where possible;
- Adhere to an applied 3-7 Rule (as shown in Figure 17);
- Be kept away from station entrances, maintenance access doors, station/facilities glazing window and lighting devices;
- Be suitable for tough urban conditions;
- Consider seasonal interest and/or a sequence of seasonal change, specifically evergreen material which should be incorporated extensively for winter 'green';
- Consider shrub plantings with minimal fragrances;
- Be placed to follow CPTED principles including preserving sightlines through the BC Parkway, and avoiding placement in front of station/facility glazing (See section 11.0 of the *SkyTrain Design Manual*);
- Conform with joint BCSLA/BSLNA Landscape Standard;
- Not grow above 600 millimetres to keep sightlines clear for those in a sitting position; and
- Not provide areas of concealment for unlawful activity. Gaps in planting or creating a 'screen' of shrubs should be avoided.

Groundcovers

Groundcovers should be selected by the landscape designers in response to BC Parkway specific design requirements. Groundcover should meet the following requirements:

- Consider using groundcover to cover blank walls (to deter graffiti) and chain link fencing;
- Prioritize groundcover species indigenous to the local environment;
- Aggressive groundcover species should be avoided;
- Groundcover should be suitable for tough urban conditions;
- Consider groundcover with minimal fragrances;
- Consider groundcover with minimal maintenance requirements;
- Consider groundcover with seasonal interest and/or sequence of seasonal change, specifically evergreen material which should be incorporated extensively for winter 'green';
- The installation of new artificial turf or the replacement of existing artificial turf with new artificial turf in any portion of the parkway is not permitted;
- Consider contrast and layering in groundcover planting arrangement, and;
- Materials and installation should conform with joint BCSLA/BCLNA Landscape Standard.

6.1.2 Growing Medium

Growing medium is an essential component of a successful planting. The depth, volume, and properties of the growing medium necessary for a planting bed or lawn area will depend on maintenance level, application, and the species proposed by the designer. It is important that all growing medium imported for upgrades to the BC Parkway is free of pollutants, pathogens and unwanted seeds. In order to ensure the quality of the imported growing medium, all material should be tested by an accredited commercial laboratory. In all cases, growing medium should comply with the Canadian Landscape Standard.

When construction or disturbance of a planted area occurs, it is important to keep and properly store the existing topsoil as it represents a valuable resource. Refer to the Canadian Landscape Standard for information about the correct handling of existing topsoil or growing medium. The recommended minimum depths for growing medium are outlined in Table 9.

TABLE 9 - MINIMUM DEPTHS OF GROWING MEDIA (SOURCE: CANADIAN LANDSCAPE STANDARD TABLE T-6.3.5.5

Application	Over prepared subgrade (which retails "A" horizon)	Over prepared subgrade where the subsoil drains rapidly	Over structures or where where the subsoil drains poorly
Low Traffic Lawn Areas			
Irrigated	100mm (4")	150mm (6")	150mm (6")
Not irrigated	100mm (4")	150mm (6")	225mm (9")
High Traffic Lawn Areas	100mm (4")	150mm (6")	
Planting Areas and Planters			
Ground cover areas	150mm (6")	300mm (12")	225mm (9")
Small shrubs	300mm (12")	450mm (18")	300-500mm (12-20")
Large shrubs	450mm (18")	600mm (24")	500-900mm (20-36")
Tree Planting Areas			
At each tree	600 (24in) deep for as large as an area as possible around each tree. Recommended area 10m^2 or greater. The soil volume should reflect the severity of compaction and grading at the planting site. Where the area availablea t a tree exceeds 13m^2 (140ft the depth may be reduced to 45cm (18in) for tha area a soil volume of 6m^3 (212ft^3) is achieved.		

6.1.3 Mulch

All the plantings along BC Parkway should use mulching products and materials as per the Canadian Landscape Standards, as summarized below

- A 50 to 100 millimetre layer of organic mulch is recommended in planting beds and under trees. No more than 100 millimetres depth mulch should be used in any case.
- To avoid harm of trees, no mulch should be placed within 100 millimetres of the base of the tree trunk.
- To avoid harm of shrubs and perennials, no mulch should be placed within 50 millimetres of the base of the stems.
- A minimum of 50 millimetre layer of mulch should be applied on all exposed soil surfaces, except in areas within 100 millimetres from the base of tree trunks or areas planted with groundcovers.
- Mulch should not runoff into the path or street.
- Gravel or stone mulches, apart from decomposed granite, can cause damage to the road surface during street cleaning and are strongly discouraged. If using stone mulches, ensure that the stone is no less than 150 millimetre wide and no greater than 200 millimetres wide. Boulders or any other rock material greater than 200 millimetres in vertical clearance from the finished grade should not be installed.

6.1.4 Tree Protection

The following section outlines treatments that can be used to protect trees, including tree guards and grates. It is critical to ensure that the design of these treatments do not create obstructions or tripping hazards.

Tree guards should comply with the Canadian Landscape Standards. Where a tree guard is provided, it should be cane detectable.

Tree grates are recommended for trees in hardscape and plaza conditions. Trench grates are recommended for high-volume customer-facing plaza areas and circulation paths. Tree grates and trench grates should meet the following requirements:

- Grates should be a contrasting colour to the adjacent materials, adhering to TransLink accessibility requirements, to allow people with vision loss to differentiate between the grate and adjacent materials;
- Tree grate openings should be designed to accommodate mature tree species to avoid collaring of trees/damage and/or restriction of tree trunks;
- Root channels and structural soil should be considered;
- Grates should be designed with a maximum 9 millimetre opening to provide a safe walking surface and to help deter litter accumulation and permit rainwater infiltration;
- Grate materials and patterns should be contemporary in design to suit the aesthetic and system-wide landscape elements;

- Be made of durable cast metal, with vandal resistant construction;
- Be strong and secure, and include a cast-in-place angle iron frame;
- Be locally sourced if possible;
- Be arranged in linear or geometric patterns;
- Be slip resistant; and
- Have edge protection at the tree opening (minimum 100 millimetres in height).

6.1.5 Vegetation Removal

Vegetation removal should be undertaken using the following considerations:

- When removing plant material like grass, there should be no damage to existing tree roots;
- Replace the grass with mulch or replant the area immediately so that tree roots are not exposed to undo harm;
- Trees that need ample or regular water can be adversely affected by a sudden lack of water; and
- No street tree roots larger than 50 millimetres should be pruned under any circumstances.

6.1.6 Invasive Species Management

For information on the control of weeds and invasive species, refer to the Maintenance Specifications appendix on the BC Parkway Landscape Design Guidelines Report (2009).

6.2 Retaining Walls

Retaining walls are utilized to accommodate grade changes and retain soil and other materials. When placed in a suitable location, a retaining wall can also serve as opportunity seating by incorporating a seating edge, which represents an economic way to provide additional seating. Retaining walls and seating edges should meet the following requirements:

- Retaining walls/seating edges should be contemporary in design to suit station aesthetic and system-wide landscape elements;
- Retaining walls higher than 600 millimetres should have an appropriate safety barrier, be designed by a certified structural engineer, and comply with the requirements of the Building Code;
- Seating edges should be constructed to deter vandalism from skateboarding by incorporating anti-skateboarding elements (avoiding a continuous, smooth surface);
- Seating edges should be equipped with armrests dividing sitting positions;
- Retaining walls identified for sitting should follow typical seating standard (nominally 400 to 500 millimetres high; max 600 millimetres), following the Building Code;

- CPTED principles should be followed by locating seating in highly visible and well-lit areas that provide sightlines, while reducing blind spots (see Section 11.0 of Design Principles & Standards manual for CPTED principles). Seating should not be placed in areas where people can be approached from behind;
- Seating edges should be constructed of durable metal or wood composite, with vandal resistant construction. Non-durable materials (i.e. wood) should be avoided;
- An anti-graffiti coating should be applied to all vertical surfaces (product should be confirmed by TransLink);
- Retaining walls should be constructed using cast-in-place concrete with sandblasted finish;
- Retaining walls/seating edges should be easy to maintain, with standardized elements for simplified system-wide maintenance;
- Adequate drainage should be provided behind retaining walls; and
- Retaining wall planters should be waterproofed.


Stanley Park
Prospect Pt
Ferguson Pt
EXIT

7.0 Intersection Design

Intersections require careful design consideration as they present a location for potential conflict between off-street pathway users and motor vehicles and tend to be where a higher number of collisions occur. In this Design Guide, the term 'intersection' is used broadly to refer to a range of scenarios where users interact with one another, including locations where the BC Parkway crosses the roadway at a signalized intersection, unsignalized intersection, or at mid-block locations. Additionally, this includes other areas where conflicts between motor vehicles and off- street pathway users may occur, such as where the BC Parkway crosses driveways and alleyways. This section also covers other related areas, including rail crossings, grade-separated crossings, and transitions between different facility types.

7.1 Intersection Design Principles

The following key design principles should be applied in order to provide safe and accessible intersections between the BC Parkway and roadways for all users.

Design for all users and people of all ages and abilities

Design for all users and people of all ages and abilities to ensure that people of all ages and abilities should be able to safely and comfortably navigate an intersection, crossing, or transition area. Design elements that facilitate access for all people should be included, including pathway users who may have vision loss, hearing loss, or limited mobility, strength, dexterity, and/or comprehension. Elements such as detectable surfaces, audible cues, curb ramps, smooth surfaces, and other accessibility features can ensure that all people can safely navigate an intersection or crossing.

Ensure clarity of right-of-way

Ensure Clarity of Right-Of-Way by providing clear and consistent traffic control devices and visual cues that indicate which user is expected to yield and/or stop ensures clarity of right-of-way. Priority of right-of-way needs to align with municipal bylaws and provincial laws under the BC MVA and associated regulations. Right-of-way at intersections and crossings should be intuitive for all users.

Minimize conflicts between users

Minimize conflicts between users by separating different users in space and/or time. Providing dedicated spaces and/or protected phasing for active modes through intersections and crossings increases the predictability of movements and supports more compliant behaviour. Minimizing exposure between active transportation users and motor vehicle traffic can also help to reduce conflicts.

Ensure a clear line of sight

Ensure a clear line of sight for the intersection approaches and crossing areas is provided for all users. Providing clear sightlines ensures that street users have sufficient decision and reaction time to stop or yield to conflicting traffic.

Reduce speed at conflict points for all users

Reduce speed at conflict points for all users by minimizing the differential speeds between the types of users, through separation and speed reduction measures at intersections. This will help reduce the potential for collision and severity of injury when collisions occur.

Make intersections as compact as possible

Make intersections as compact as possible to enhance safety for active transportation users by increasing visibility for all modes, reducing pedestrian and bicyclist exposure to motor vehicles, and slowing motor vehicle speeds at conflict points. Intersections can be made more compact by reducing corner radii, limiting the use of dedicated turn lanes, and removing channelized right turn lanes when possible.

7.2 Intersection Components

This section outlines the key intersection components that impact off-street pathway crossings, including signage, pavement markings, intersection controls, and traffic calming elements.

7.2.1 Intersection Signage

Signage is critical at intersections to control right-of-way and to provide warnings and wayfinding as appropriate. At the same time, care must be taken to not place too many signs at intersections; otherwise, they begin to lose their impact. Intersection signage is important for pathway approaches to establish right of way. Additionally, shared pathway (RB-98) or a pathway organization (RB-94) signage should be installed on both sides of the intersection on the pathway approach. The specific application of signage at intersections is discussed throughout this chapter as design treatments are explained. A list and description of applicable signage can be found in Section 9.

7.2.2 Intersection Pavement Markings

Like signage, pavement markings are a key component of intersections that help to dictate right-of-way while also raising awareness of the BC Parkway crossings. There are two types of pavement markings that are most often used at intersections along the BC Parkway. Pedestrian crosswalks are typically marked with either parallel white painted lines aligned along the crossing direction or zebra pavement markings that are painted perpendicular to the crossing pedestrian crossing direction. Cross-ride pavement markings (also called elephants feet) are used to indicate that people will be cycling their bicycle perpendicular to the motor vehicle travel direction. Cross-ride pavement markings are white broken lines painted along the cycling crossing direction and can either be installed on the outside of a crosswalk or alone.

Enhanced pavement markings inside the crosswalk area may be considered. These markings can increase the visibility of the crossing, beautify the public realm, and add visual continuity along a pathway when used at multiple crossings. They can also be used as a type of facility branding as seen along the Spirit Trail located within the District of West Vancouver, District of North Vancouver, and the City of North Vancouver.

Pathway pavement markings at intersection approaches are also important to consider. It is recommended that a yellow centre is provided along the pathway at intersection approaches to organize pathway users by direction. The specific application of pavement markings at intersections is discussed throughout this chapter. A list and description of applicable pavement markings can be found in Section 9.

7.2.3 Intersection Controls

Intersection controls help pathway users safely and efficiently cross the roadway by clearly indicating right-of-way and by warning both motor vehicle drivers and pathway users of a potential conflict area. Determining who has right-of-way and selecting which type of control to use (if any) is dependent on the context, including the type of street, crossing location, line of sight, topography and alignment of the street and pathway, land use, and the volumes and speeds of both pathway users and motor vehicles. Both roadway-facing intersection controls (for motor vehicle drivers) and off-street pathway-facing intersection controls (for pathway users) can be provided.

Roadway Facing Controls

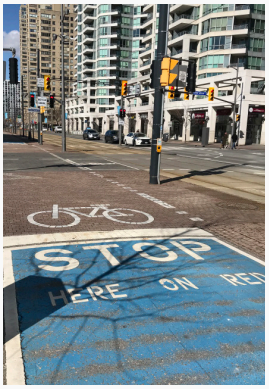
The 2018 *TAC Pedestrian Crossing Control Guide* provides guidance on when various types of crossings systems are warranted at intersections. If BC Parkway is crossing a roadway that is currently uncontrolled a warrant should be conducted to determine the appropriate intersection control required. Some of the municipalities along the BC Parkway also have their own guidance and warrant process to determine the crossing control that is warranted. Specific roadway facing controls are described in Section 7.4 and Section 7.5 for signalized and unsignalized crossings, respectively and are summarized in Table 10.

TABLE 10 - ADVANTAGES AND DISADVANTAGES OF INTERSECTION CONTROL DEVICES

Type of Control	Description	Advantages	Disadvantages
RFB 	Rapid Flashing Beacons (RFBs) have flashing amber lights that alternate back and forth to attract motorists' attention, increasing yielding behaviour. RFBs or other side mounted flashing beacons can be used to mitigate conflicts at challenging crossings such as slip lanes and roundabouts*.	• Less delay for major street (activated on demand only). • Can be implemented when conventional signal warrant is not met or where a conventional traffic signal is not desired. • Requires less infrastructure (side mounted) • Can be activated through inductive loop technology.	• Does not provide a 'red/stop' condition for drivers, and may lead to variation in motorist behavior. • Wide streets can make side of street signing more difficult for drivers to see. • No platooning of crossing users so unpredictable for motor vehicle traffic.
Special Crosswalk 	A Special Crosswalk, also referred to as Overhead Pedestrian Flashers, is not a traffic signal but a traffic device installed to enhance warning and awareness for motorists of a crosswalk at intersections and mid-block crosswalks. The system consists of an overhead Pedestrian Crossing sign (MUTCD RA-5) with pedestrian-activated flashing amber beacons**.	• Less delay for major street (activated on demand only). • Can be implemented when conventional signal warrant is not met or where a conventional traffic signal is not desired. • Requires less infrastructure than full signals.	• Does not provide a 'red/stop' condition for drivers and may lead to variation in motorist behavior. • No platooning of crossing users so unpredictable for motor vehicle traffic. • Less visibility than a traffic signal.

Type of Control	Description	Advantages	Disadvantages
Half Signal 	Half signals, also referred to as pedestrian signals, or pedestrian/ cyclist actuated signals, are traffic signals that facilitate pedestrian and cyclist movements while controlling motor vehicle movements on only one street, rather than two or more streets. They can be used at the intersection of major and minor streets, or at major mid-block crossings.	• People walking and cycling are given a clear signal when to cross, and drivers on the major street see a conventional signal indicating when to stop. • Suitable for streets with higher volumes and larger cross sections, where crossing opportunities are less frequent and side mounted systems are less effective. At intersections: • Side street motor vehicle traffic access the major street from stop condition, typically with all movements. However, this can create a conflict with bicyclists and pedestrians crossing the minor street.	• Higher cost as the system requires more infrastructure than RFB or other side mounted flashing beacons. • Increased delay for major streets compared to RFB system. • If located on bus routes, it could impact the predictability of transit schedules as bicycle activation will slow motor vehicle traffic if a coordination strategy is not developed. At intersections: • Some concerns of potential confusion for road users, including pedestrians, with side street being stop controlled and major street signal controlled.

* Several cities are reviewing the use of RFB devices at bicycle crossings. In many municipalities RFBs are only used at pedestrian crossings and on roadways with one motor vehicle lane in each direction.
** The City of Vancouver does not install special crosswalks.

Type of Control	Description	Advantages	Disadvantages
Full Signal 	Full signals are also known as traffic signals. They control all approaches and regulate which user can enter the intersection safely at a given time. Full traffic signals are used at intersections between a combination of streets that are major and minor in classification.	• A full signal assigns right of way for all users. • They are usually installed at higher volume intersections (for all road users alike). • Ability to coordinate/ delay/ time the actuations and calls, similarly to a half signal.	• Higher installation costs due to more • infrastructure required. • May impact traffic operations and result in delay.

Off-Street Pathway Facing Controls

Signage and pavement markings are the primary means of communicating to BC Parkway users when they must yield or stop before proceeding through an unsignalized and/or minor intersection or a crossing at a mid-block location. The off-street pathway controls required will depend on which user has the right-of-way: the motor vehicle driver on the roadway or the pathway user.

Typically, the best practice is to provide consistency along the off-street pathway facility and at unsignalized intersections. The preferred treatment is to give the right of way to pathway users by requiring individuals travelling on the roadway to stop. However, there may be some locations where yield or stop control may be used to control the movements of pathway users. These include locations where:

- Appropriate sightlines are not achieved between motorists and people riding bicycles, additional signage for bicyclists to yield or stop and watch for turning motorists should be installed. The presence of stop or yield signs on the pathway does not limit people walking from entering the crosswalk in an appropriate manner.
- At locations where a pathway intersects with a roadway that has a designated bicycle facility.

4.2.4 Traffic Calming

Geometric design can be used to calm traffic at intersections, creating a safer crossing environment for off-street pathway users. Curb extensions and median islands are two examples of treatments that can be used to narrow the roadway for motor vehicles which can help to slow motor vehicle speeds on the approach to intersections. Speed humps can also be used along local streets. These traffic calming devices have additional benefits, as they can also help to alert drivers of the upcoming crossing, create better sightlines, and reduce the crossing distance for pathway users. In addition to median islands and curb extensions, raised crossings, directional closures, or full closures may be considered. Each of these traffic calming features will slow or prohibit vehicles, making people walking and cycling safer and more visible. Considerations for curb extensions and median refuges at intersections and mid-block crossings can be found in throughout Section 4. Further design guidance on traffic calming features to be used along roadways and at intersections can be found in the 2018 *TAC Canadian Guide to Traffic Calming*.

7.3 Intersection Approaches

This section outlines the important design considerations for the intersection approaches, from both the perspective of a roadway and pathway user. This section provides guidance on features that can be used to reduce roadway and pathway user speeds upon approaching the intersection along with strategies to reduce motor vehicle access of the BC Parkway. Guidance on stopping sight distance and intersection sight distance can be found in Section 2.0.

7.3.1 Roadway Approach

Streets can be designed to ensure that as motorists are aware that they are approaching an intersection or mid-block crossing of the BC Parkway. Visual cues and geometric design elements can be used to alert road users of the multi-use pathway crossing and encourage reduced motor vehicle speeds. Design elements and visual cues at roadway approaches can include:

- Vertical elements such as trees and other landscaping can help to alert motorists of the crossing. However, vegetation must be managed so that sightlines are maintained.
- Signage and pavement markings also help to alert motor vehicle drivers of the pathway crossing. The Pedestrian and Bicycle Crossing Ahead warning sign (WC-46) with a Crossing (WC-7S) tab should be installed on the approach to the intersection to alert motorists of the BC Parkway crossing perpendicularly. The Bicycle Trail Crossing Side Street sign (WC-44) should be installed on the approach to the intersection of any roadway that travels parallel to the BC Parkway. Custom Turning Vehicles Yield to Bicycles signs should be installed at the intersection for all turning movements across the BC Parkway. Further signage and pavement marking design guidance is discussed throughout in Section 9.

- Geometric design elements such as curb extensions and median islands may be also used to slow motor vehicle traffic approaching intersections and crossings with the BC Parkway. These elements have the added benefit of reducing crossing distances for pathway users. Median islands also provide a refuge allowing pathway users to cross one direction of motor vehicle traffic at a time. Median islands are especially desirable on higher speed roads and/or roads with multiple travel lanes in each direction. They should include curb ramps or cut throughs with tactile warning strips. Median islands should be a minimum of 3 metres wide in order to provide adequate protection for all types of users (i.e. bicycles with trailers).

7.3.2 Pathway Approach

Geometric design and signage and pavement markings should also be used to inform pathway users that they are approaching a roadway crossing. Geometric design can be done to reduce user speed on the BC Parkway as users approach intersections and mid-block crossings. Design features can include:

- Narrowing the pathway width to the minimum standard.
- Adding horizontal and vertical curvature to the pathway, including an uphill grade in advance of the crossing.
- Arrange planters, benches, and other landscaping and amenities to create traffic calming.
- Warning of the intersection could be marked every 20 metres in advance to warn pathway users of the mixing zone ahead. Consider increasing the frequency of the markings upon approach to the transition. These markings can include:
  - » Parallel lines showing the travelled way
  - » Some kind of green paint application
  - » Solid lines and stencils
- The BC Parkway should either bend-in or bend-out upon approaching an intersection, as discussed in Section 7.4.2.
- Adding additional width and queuing space to ensure pathway users can all cross during one signal phase. This can be done at intersections where BC Parkway is heavily used.
- Adding a yellow centreline is installed 10 to 15 metres in advance of an intersection to help organize movement through the intersection.

Along the route of the BC Parkway there are a number of community plazas that have been maintained by community groups, private companies, and TransLink. Pathway approaches at intersections can be ideal locations for the installation of plazas and other trail amenities. Additional information about plaza's can be found in Section 5.

Accessibility

This section outlines treatments that should be used at intersections to ensure that BC Parkway is accessible for all users. It is recognized that each municipality has their own practices and design guidance for providing facilities that are accessible to all. This Section is intended to provide an overview of current best practices.

Detectable Warning Surfaces

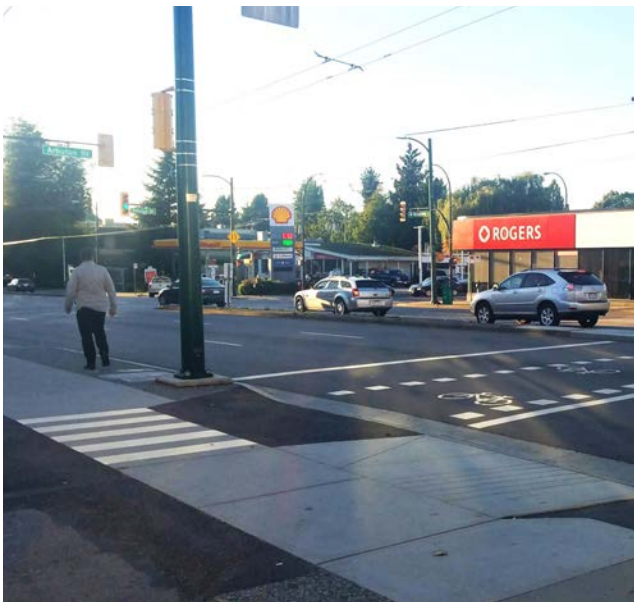
A detectable warning surface is a surface treatment or material that is detectable by sight, cane, and underfoot, helping to alert and/or guide people who have sight or vision loss. These surfaces should be slip-resistant, non-glare, and should be made of a contrasting colour or material so that they stand out from the surrounding pavement.

Tactile walking surface indicators, also referred to as tactile guides, are recommended as the standard detectable warning surface treatment. There are two sub-types of tactile walking surface indicators: tactile attention indicators and tactile direction indicators. Tactile attention indicators, also known as truncated domes, alert pedestrians to potential hazards or changes in elevation, such as at the base of a curb ramp or the edge of a transit platform. Tactile direction indicators, also known as directional tiles, indicate travel direction and are used as a wayfinding device to guide pedestrians to key destinations, such as a crosswalk or bus stop. Chapter B.3 of the 2019 *B.C. Active Transportation Design Guide* provides further guidance on the application of tactile walking surface indicators.

Curb Ramps

Curb ramps are smooth, graded transitions between the street and the BC Parkway. Curb ramps are critical for enabling people using mobility devices, pushing strollers, riding bicycles or other active devices, to comfortably navigate the BC Parkway. Curb ramps consist of an accessible ramp, flared sides, and clear approach and landing areas at the top and bottom of the ramp that provide manoeuvring space. Some curb ramp design considerations include:

- Both the crosswalk and curb ramp should be at least as wide as the connecting off-street pathway. For combined walking and cycling crossings, the minimum width of the curb ramp (exclusive of flared sides) is 3.0 metres. For separate walking and cycling crossings, the minimum width of the pedestrian curb ramp (exclusive of flared sides) is 1.8 metres. Bicycle curb ramps should be a 2.0 - 3.0 metres wide depending on if they are uni- or bi-directional. The ramps for bicycles should be the same width as the green paint application.
- Ramp surface shall be stable, firm, and slip resistant.
- Curb ramps should have a maximum running slope of 8.3%.
- The maximum counter slope at the bottom of the curb ramp should be 5%. Counter slopes are where the down slope of the curb ramp meets the upwards cross slope of the gutter or road. Steep counter slops can be difficult to navigate for wheelchair users.
- Avoid locating catch basins or drainage inlets in the ramp area to reduce the risk of water pooling. Ensure that the landing areas are well maintained and cleared of debris.
- Provide ramp flares with a maximum slope of 10% to avoid abrupt grade changes and tripping hazards.
- Curb ramps should be equipped with both score lines and tactile attention indicators, as described above, to make the users aware they are entering a hazard area and direct their travel.



- Double curb ramps aligned with the perpendicular crosswalks are preferred to combined curb ramps, as they align the user with the crosswalk and the receiving curb ramp. Where double pedestrian curb ramps are not possible, combined curb ramps may be used. Score lines are particularly important on combined curb ramps to guide people with vision loss in the correct direction.
- Separate walking and cycling curb ramps are preferred at crossings with separate crosswalks and cross-rides, with the bicycle crossing preferably located closer to the parallel motor vehicle travel lane. Contrasting surface materials may be used to differentiate the pedestrian and cycling curb ramps. Where separate walking and cycling ramps are used, score lines and tactile attention indicators should only be installed on the pedestrian curb ramps. This ensures that people who have vision loss are able to correctly identify the designated pedestrian crossing and stay aligned with the receiving pedestrian facility.

Chapter G.3 of the 2019 *B.C. Active Transportation Design Guide* provides further guidance on curb ramps. Additionally, sections 5.7.3 and 6.4.6 of the 2017 *TAC Geometric Design Guide for Canadian Roads* provide design guidance on pedestrian and bicycle curb ramps, respectively.

Score Lines

Score lines consist of a series of parallel grooves that are embedded or troweled into curb ramps, laneway crossings, and driveway ramps. They are detectable by cane and underfoot, providing directional wayfinding for people who have vision loss. The score lines should be aligned with the crosswalk and the receiving curb ramp, helping to guide pedestrians in the correct direction. Score lines may be used in conjunction with detectable warning surface treatments such as tactile attention indicators.

Visual Navigation Aids

Visual navigation aids such as signage, pavement markings, wayfinding, and contrasting materials help to ensure that people of all ages and abilities can safely and easily navigate an intersection. Visual aids are especially important for people who are deaf, have hearing loss, or have a decline in cognitive abilities. Providing adequate lighting also enhances accessibility at intersection. Additionally, pedestrian countdown timers at crosswalks can help people walking and cycling to determine whether it is safe to cross the intersection. Providing consistent and clear wayfinding signage throughout the region and along BC Parkway is important to ensure that all users have easy to follow visual cues to guide their way. TransLink has developed the *Wayfinding Guidelines for Utility Cycling* in Metro Vancouver. This document is available online.

Audible Navigation Aids

Audible pedestrian signals provide non-visual indications in the form of audible and vibro-tactile indications that confirm when it is legal and safe to make a street crossing. These signals can assist pathway users with sight or vision loss. Additionally, they are useful for many other users who may benefit from non-visual prompts, such as children, seniors, and people with a decline in cognitive abilities. By indicating when a crossing interval begins, audible signals allow people walking to begin the crossing before turning cars enter the intersection and to complete the crossing with less delay. These non-visual signals can also provide directional guidance that can assist in the crossing of non-perpendicular intersections and multi-lane crossings.

7.3.3 Access Restriction

Access control devices are features that are used at locations where multi-use pathways intersect streets to restrict access by unauthorized motor vehicles while accommodating periodic access (e.g. maintenance vehicles). There are a number of physical features and treatments that are used to both restrict motor vehicle access and visually indicate to bicyclists the need to slow down.

The Bicyclists' Injuries & the Cycling Environment (BICE) study conducted for the Cycling in Cities Program at the University of British Columbia found that 12% of all cycling injury collisions requiring emergency room treatment were a result of impact with infrastructure such as bollards, street furniture, curbs, fences, speed bumps, or stairs. Maze gates can also impact snow clearing as it creates a barrier, which may lead to lower operational standards for people cycling.

Currently, there are several locations along BC Parkway where rigid bollards have been used to restrict vehicle access on BC Parkway. BC Parkway access points should minimize the use of bollards to restrict motor vehicle access. Bollards create a confined operating space and increase the likelihood of conflicts and collisions between other pathway users and the bollards themselves. Existing bollards should be removed unless a history of vehicle access has been observed.

At locations without bollards where motor vehicle access continues to be observed, consider other treatments to minimize vehicle access. Alternative treatments include raised centre medians, flexible delineators, and signage to indicate that motor vehicles are prohibited. Design guidance on these measures are summarized below:

- Add signage at the pathway entry to indicate its intended use as a pathway and its restriction of motor vehicles.
- The physical design of the pathway point of entry should clearly indicate that it is not intended as a motor vehicle access. One method of restricting motor vehicle entry is by using a centre island that splits the point of entry into two pathways separated by low landscaping. The low landscaping allows maintenance and emergency vehicles to straddle the island to access the pathway when needed.

Current best practice is to avoid the use of rigid bollards or maze gates at pathway points of entry unless there is a demonstrated history of motor vehicle encroachment, and/or a collision history. The use of rigid bollards or maze gates (offset gates) for bicycle speed control is also not appropriate. The slowing effect it creates is offset by the safety hazard it creates for bicyclists. Bollards and other obstructions placed within the operating space of a bicycle facility have been shown to present a significant injury risk to bicycle users.

The pathway-side approach to the island should include solid lane markings leading to and around the island to guide pathway users around the centre island. The width of the pathway on either side of the island should be no more than 1.8 metres to emphasize the non-motorized use of the pathway. The pathway entry design also needs to consider winter maintenance and snow clearing equipment.

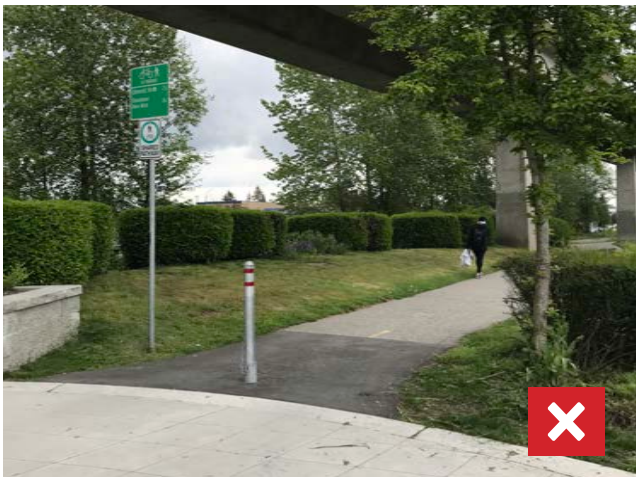
- If motor vehicle incursion occurs despite the use of the strategies described above, consider targeted surveillance and enforcement which may require policy changes. If motor vehicle incursion continues, evaluate the reasons why such incursion is taking place at this specific location, and determine whether changes to the pathway farther from the point of entry would effectively eliminate the incursion.
- Consider using flexible delineators or spring-mounted bollards in order to reduce potential injuries from crashes.

If all other access restriction measures have failed and rigid bollards are installed, it is important to consider the following:

- ensure that the rigid bollards are shorter than the height of a typical handlebar.
- The minimum height of the bollard is 1.0 metres with a minimum diameter of 100 millimeters.
- The hardware that is used to hold a bollard should be flush with the pathway surface or recessed into the pathway in order to minimize additional hazards for bicycle tires.
- Removable bollards should be fully removable and a permanently affixed cap that is flush without collar should cover the open hole when the bollard is removed.
- Bollards should not restrict access to people with disabilities and should allow passage by all users who are legally permitted to use the pathway.
- A functional minimum of 1.2 metres of clearance between bollards must be maintained, though this minimum should be reviewed, and pathway widened for other legal users of the pathway if necessary.
- If bollards are used, a tactile painted diamond should be installed to delineate the safe shy zone from the bollard.

If additional speed-reduction is needed for pathway users, textural surface contrast, transverse pavement markings, and warning signage treatments can be applied to the intersection approach of the pathway.

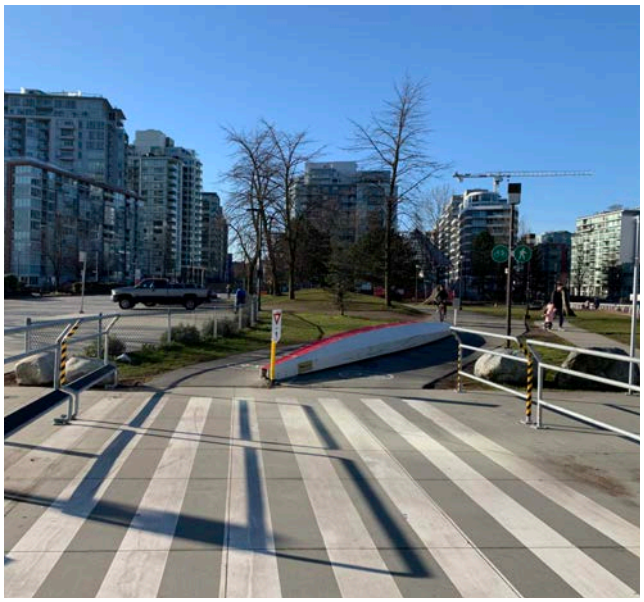
FIGURE 18 - EXAMPLES OF EXISTING ACCESS RESTRICTION TREATMENTS



7.3.4 Other Design Consideration Examples

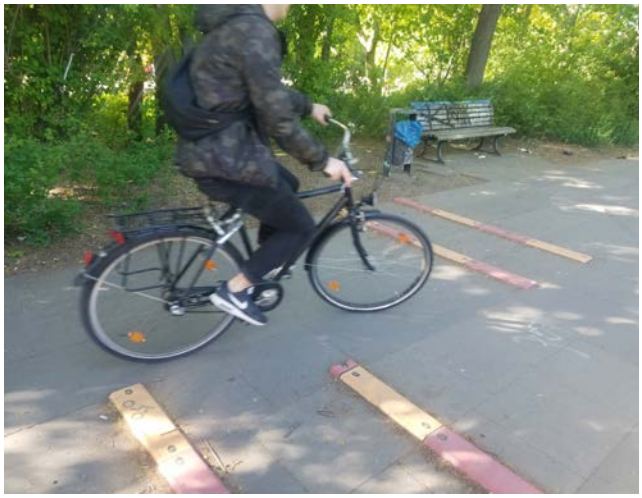
Curb Extensions and A Median Refuge

At signalized intersections with three or more motor vehicle travel lanes, enhanced treatments such as a median refuge island or curb extensions could be provided to reduce the crossing distance. Curb extensions can also help improve sightlines by restricting parking or other obstructions approach the crossing location. For design guidance for traffic calming treatments refer to the 2018 *TAC Canadian Guide to Traffic Calming* or existing municipal design guidelines. It is worth noting that the implementation of refuge areas is not considered best practice in the City of Vancouver.



Art, Creative Signage or Other Objects

There are opportunities to add other features such as art, creative signage, or other objects at the approach to an intersection crossing or plazas that can draw people's attention and allow them to understand and recognize that they are transitioning to a shared space.



Speed Reduction at Pathway Approach

Geometric design may be used to reduce user speed on bicycle pathways and multi-use pathways as they approach roadway crossings and where pathways transition into shared spaces or plazas. This can include reducing the pathway width to the recommended minimum, adding horizontal and vertical curvature to the pathway, or an uphill grade in advance of the crossing. Additional speed-reducing elements that can be applied to the pathway approach include textural surface contrast, transverse paint lines, yield markings, and warning signage along the pathway.

7.4 Signalized Intersections

Signalized intersections are defined as locations where the BC Parkway crosses a street that is controlled by a traffic signal. This can include locations where all movements are controlled by a full traffic signal or locations where a half signal is actuated by BC Parkway users. At signalized intersections design treatments such as dedicated phasing, pavement markings, and signage are required to provide safe and comfortable crossings for all pathway users. These treatments highlight the pathway user's presence and inform motorists that the crossing is not only for people walking, but for multiple types of users.

At signalized intersections with high volumes of turning motor vehicles or with complex intersection geometry, it is recommended that a separate signal phase is provided to allow pathway users to cross the intersection separate from turning motor vehicles (additional information on signal phasing can be found in Section 7.9).

At larger intersections where there are channelized turn lanes, where feasible, it is recommended that channelized slip lanes be removed from all major intersections and replaced with dedicated or shared right turn lanes. This section provides design guidance to create safe and comfortable crossings for BC Parkway users at signalized intersections.

7.4.1 Intersection Control

Signalized intersections require all users to follow traffic control devices to ensure safe operations and movement through the intersection act as both roadway and pathway facing controls. Two types of signalized traffic control device are considered for this design guide: full signals and half signals.

Full Signals

Full signals are conventional traffic signals for all approaches and regulate which user can enter the intersection safely at a given time. Full traffic signals are used at intersections between a combination of streets that are major and minor in importance. If full traffic signals are installed when not warranted, it may result in long delays to users of the intersection and non-compliance with the traffic signal. If full signalization is unwarranted, there are a number of other controls that may be used to enhance the off-street pathway crossing visibility and the yielding behaviour of motorists, such as half signals and unsignalized controls.

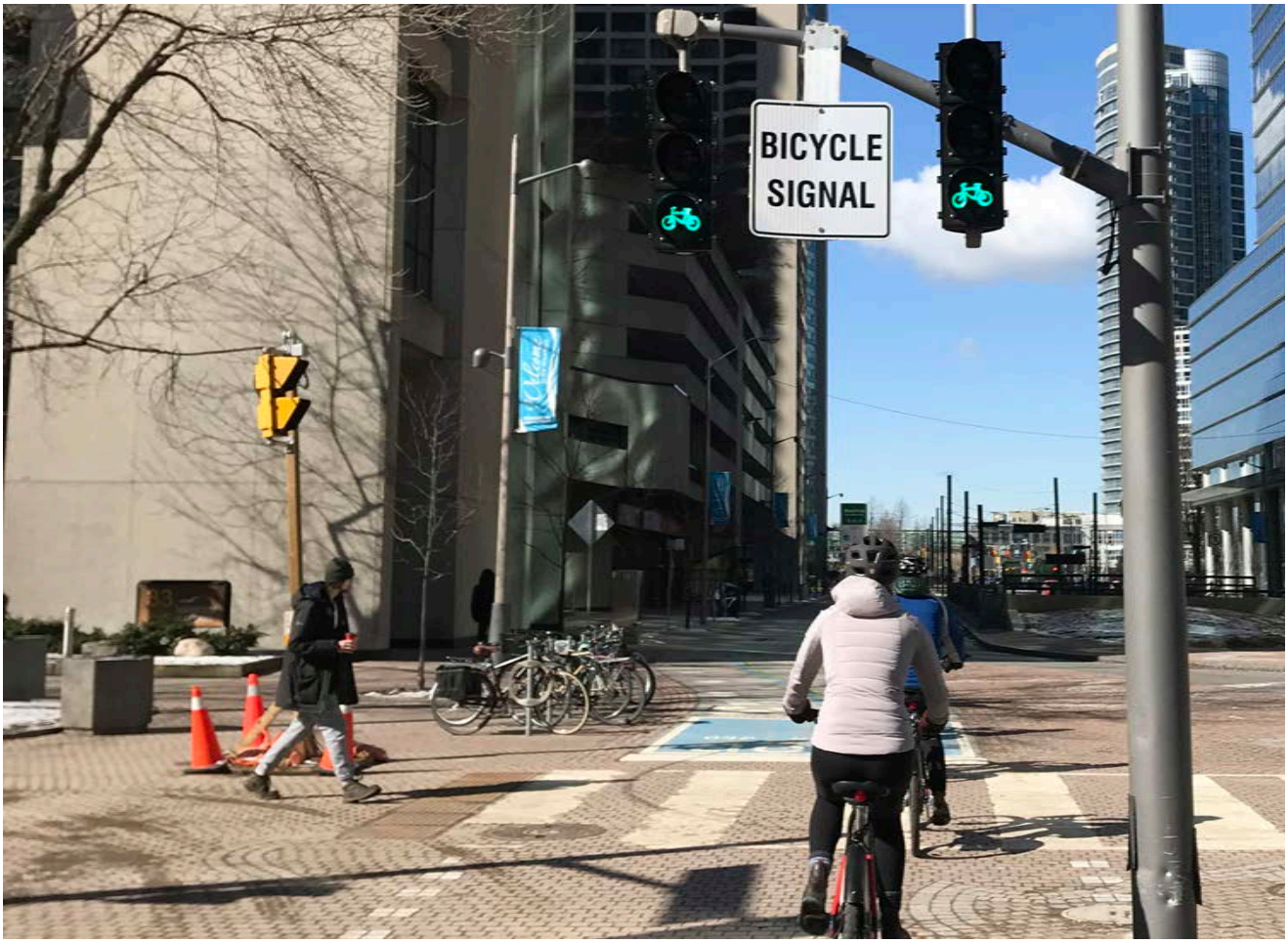
Half Signals

Half signals are traffic signals that control movements on only one street, rather than two or more streets. They can be used at the intersection of major and minor streets, or they can be used at mid-block crossings. Half signals give very clear directions to motorists facing the signals and at mid-block crossings; however, they can be misunderstood by motorists on the cross street. This is due to the requirement to control one traffic movement with traffic lights while other movements are controlled by signage (stop sign). This can create confusion between people walking or cycling across the street

and motorists proceeding from a stop- controlled condition, leading to the potential for conflicts.

Both half signals and full signals along off-street pathways, as described above, are typically activated by pedestrian and/or bicycle push buttons, but may also be triggered by motion detectors, in-pavement loop detectors, video, or other technologies. When pushbuttons are used, care should be taken to ensure they are located in a convenient and accessible location. For additional information on these intersection controls, refer to the 2018 *TAC Pedestrian Crossing Control Guide.*

Separate bicycle signals and protected signal phasing can be used to reduce conflicts between people cycling/walking and motorists. Protected signal phasing may be provided if warranted; alternatively, a leading signal phase may be provided for people walking and cycling. More information about traffic signals can be found in Section 7.9. It is important to note that the Motor Vehicle Act (MVA) currently does not recognized bicycle signals as a traffic control device and as such, they have no legal meaning under current legislation. Municipalities should only consider the installation of bicycle signals based on sound engineering and legislative review.



7.4.2 Signalized Intersections Without Channelization

This section provides guidance on the treatment of BC Parkway crossings at signalized intersections without channelized right turn lanes.

Design Guidance

When designing the off-street pathway approach, there are generally two options for designing the alignment of the pathway as it approaches a signalized intersection.

Bending the pathway towards the parallel roadway (bend-in).
Bending the pathway away from the parallel roadway (bend-out).

For both bend-in (Figure 19 and 20) and bend-out designs (Figure 21 and 22), reduce the ① corner radii to as small as possible for the design vehicle and circumstance. An effective turning radius is based on the typical travel path used by motorists to travel around a corner. By identifying the effective turning radius allows the designer to select a corner radius that best suits the design vehicle. The taper ratio of the pathway alignment shift should be between 3:1 to 10:1, with a 10 to 15 metre tangent ②. Both designs must ensure ③ good sightlines are provided for pathway users Sightline obstructions can include trees, guideway columns, signals, and utility poles.

For the bend-in design (Figures 19 and 20), intuitive sharing of existing traffic signals at signalized intersections can be achieved ④. For the bend-out design (Figures 21 and 22), the pathway crossing is set back a minimum of 6 metres to provide space for one vehicle to stop in advance of the crossing ④. This provides some additional reaction time to drivers turning across the path.

Bending the pathway away (bend-out design) from the parallel roadway is generally recommended as it yields more benefits; however, bending the pathway towards (bend-in) the roadway tends to require less space. Both bend-in and bend-out intersections can be configured with separated or combined crossings for pedestrians and cyclists. Separated crossings are preferred, when space permits, and should include separated ramps or contrasting pavement for cyclists and pedestrians. The following provides a summary of the benefits and disadvantages of both bend-in and bend-out alignments.

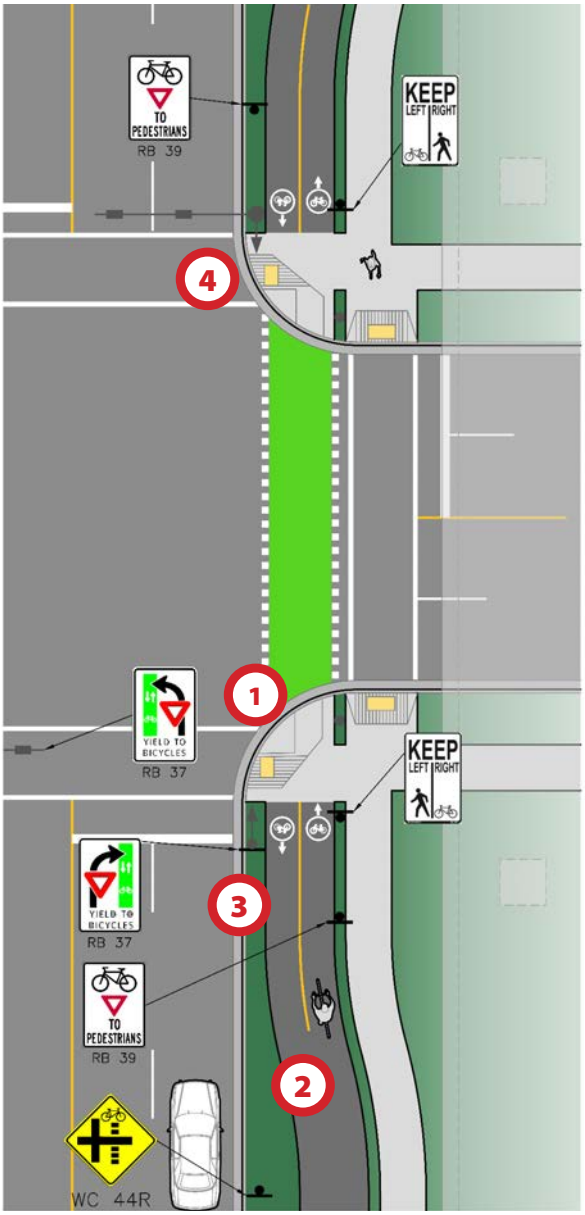


FIGURE 19 - BEND-IN SEPARATED CROSSINGS

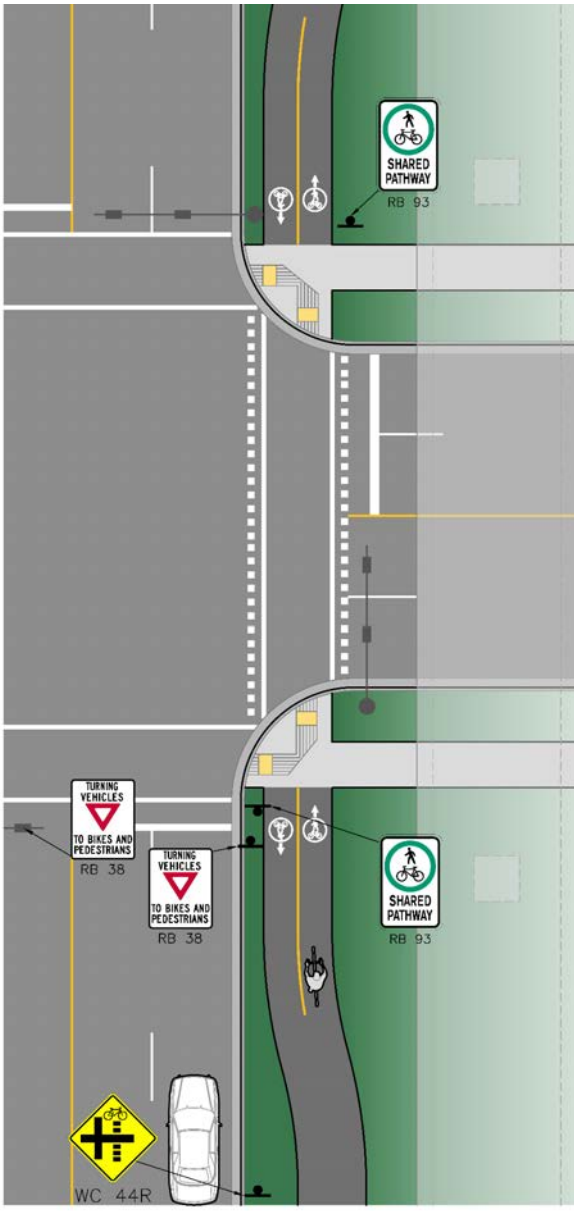


FIGURE 20 - BEND-IN MULTI-USE CROSSINGS

1. Reduce corner radii
2. 3:1 to 10:1 taper ratio alignment, with a 10 to 15 metre tangent
3. Provide good sightlines for motorists to see people using the pathway
4. Intuitive sharing of existing traffic signals at signalized intersections with optional bicycle activated signal

Bend-In Crossings (see Figures 19 and 20)
+ Improves sightlines for motorists to see people using the pathway;
+ Allows for intuitive sharing of existing traffic signals at signalized intersections;
+ Tends to require less space; and
- Less space for pedestrian queuing and turning vehicle stacking.

Bend-Out Crossings (See Figures 21 and 22)
+ Provides additional reaction time for motorists turning onto the crossing street. For vehicles turning right, this is dependent on having clear sightlines to the pathway on the approach;
+ Allows motorists from the parallel street to orient their motor vehicles perpendicular to the pathway before crossing it, facilitating better sightlines for both pathway users and motorists;
+ Provides stacking space for motorists turning from the parallel street, so that they are out of the through traffic path when waiting for people to cross the intersection;
+ Provides more room for bicycle box placement to facilitate bicyclists turning off the pathway;
+ Provides more space for people walking to queue between the pathway and curb when crossing the parallel roadway, and is thus preferred at intersections with high volumes of people crossing the roadway;
- There may be reduced sightlines for motorists approaching the intersection on the crossing street, as the stop bar is set back. It may also cause some motorists to queue onto the crosswalk as they advance towards the intersection for better sightlines; and
- Tends to require more space at intersections.

Signage and pavement markings are similar in each treatment. The Bicycle Trail Crossing Side Street Sign (WC-44), is used for the parallel street in advance of the intersection. A combined crosswalk and cross-ride are used to bring awareness to the multi-use pathway crossing and separated cross-ride and crosswalk markings are applicable for separated facilities. Turning Vehicle Yield to Bicycles signs (RB-37) or Turning Vehicles Yield to Bikes and Pedestrians signs (RB-38) should be placed in advance of where motorists could cross a cycling or multi-use pathway facility and are required to yield to the cyclists and pedestrians. A second, complementary sign can also be added on the receiving (far) side of the intersection. Shared pathway (RB-98) or a pathway organization (RB-94) signage should be installed on both sides of the intersection on the pathway approach. Curb ramps should be provided in all cases. At intersections where bicyclists are separated from other users two ramps should be provided. The ramp intended for pedestrians should include tactile walking surface indicators, more information about these treatments can be found in Section 7.3.2.

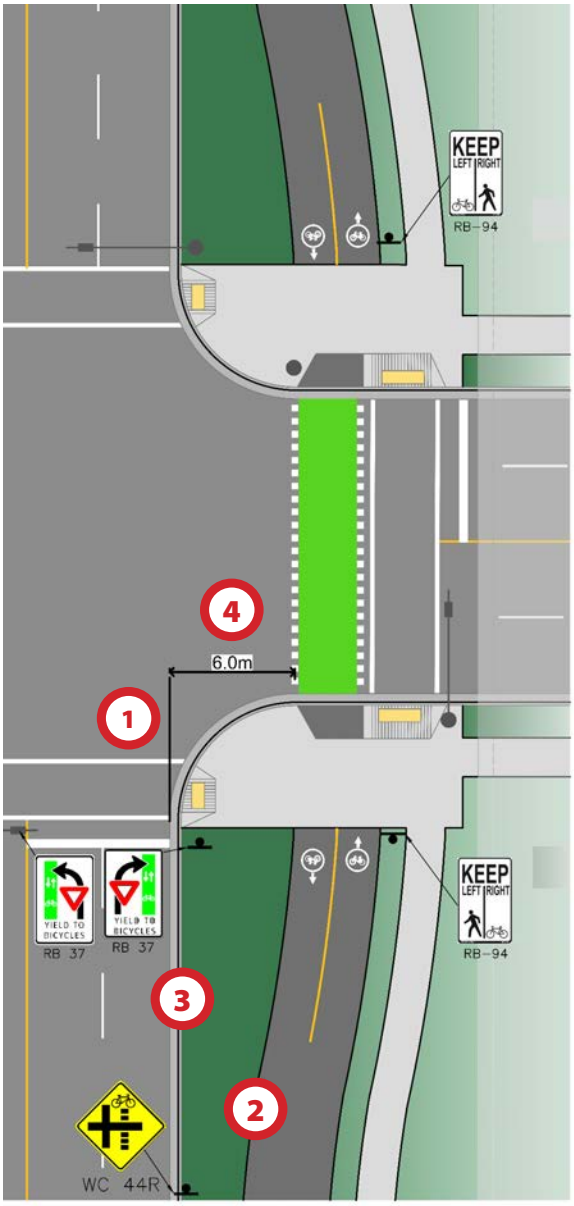


FIGURE 21 - BEND-OUT SEPARATED CROSSINGS

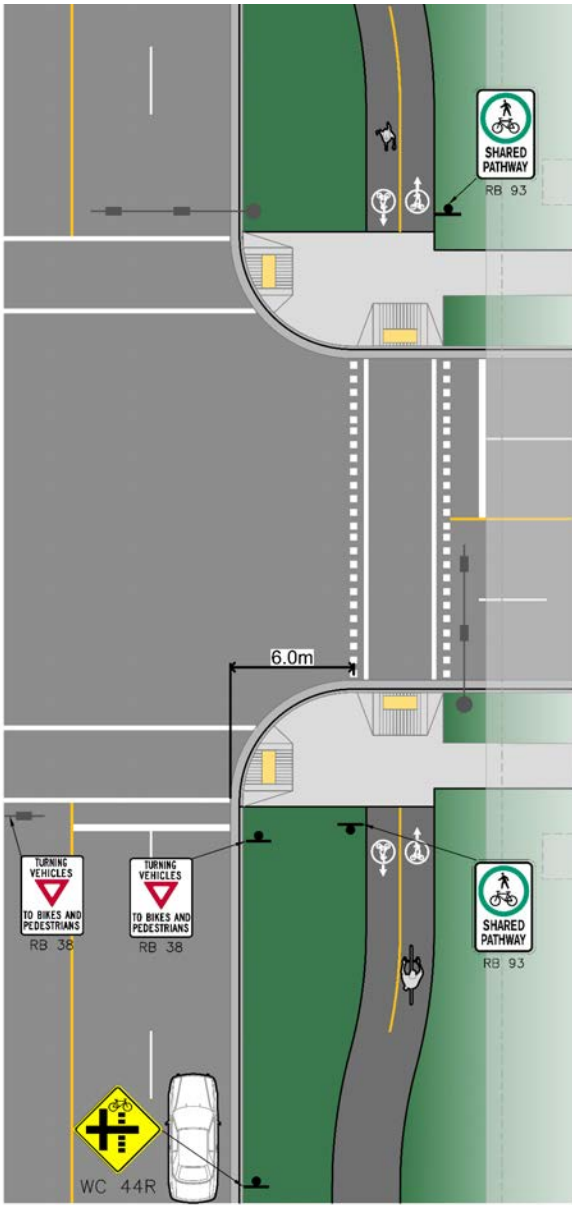


FIGURE 22 - BEND-OUT MULTI-USE CROSSINGS

1. Reduce corner radii
2. 3:1 to 10:1 taper ratio alignment, with a 10 to 15 metre tangent
3. Provide good sightlines for motorists to see people using the pathway
4. Setback crosswalk to provide space for one vehicle

7.4.3 Signalized Intersections with Channelization

Design guidance is included for both un-channelized and channelized signalized intersections, understanding that circumstances exist where removing channelized turn lanes is not possible or desirable due to increased crossing distances for the pathway users. Intersections where BC Parkway pathway users are required to cross a channelized right turn lane requires special attention, as motor vehicles may maintain a relatively high speed when turning. Higher speeds increase the safety risk and potential collision severity for pathway users crossing the intersection. Due to the additional safety concerns, channelized right turn lanes should be avoided where possible at BC Parkway crossing locations.

Roads with channelized right turn lanes may be retrofitted to remove the channelization and reduce the corner radii, as seen in Figure 23. Removing channelized turning lanes is preferred at most intersections where the geometry allows for the required vehicle turning movements. Removal of channelization is desirable for many reasons including:

- Reducing the number of crossings and potential conflict locations for BC Parkway users;
- Reducing the speed of turning vehicles;
- Improving sightlines for turning motorists; and
- Reclaiming space to be used by people traveling on the BC Parkway.

The benefits of removing channelization all contribute to improving safety and comfort for pathway users. Where removal of the channelized right turn lane is not feasible, a second option is to redesign the channel as a 'high entry angle' or 'smart channel.' The difference between a conventional channelized right turn lane and a high entry angle right turn lane. High entry angle channels increase the entry angle to the cross road and decreases the turning speed to be more consistent with a yield condition. The high entry angle reduces the motorist viewing requirement and requires less neck rotation for motorists.

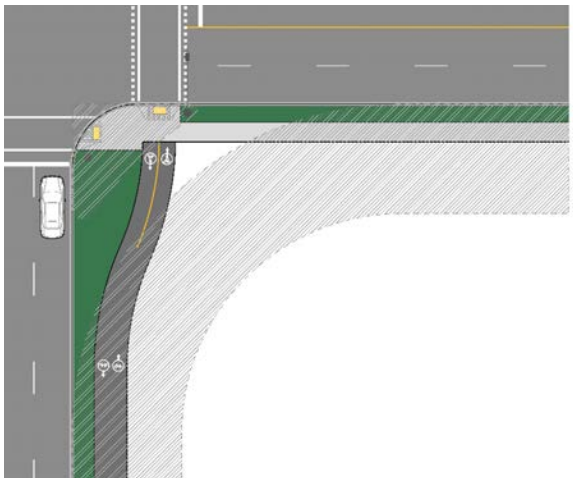


FIGURE 23 - RECONFIGURED CHANNELIZED INTERSECTION

High entry angle approaches also make pedestrians and bicycle users more visible at the crossing. Figure 24 illustrates the difference between conventional channelized right turn lanes compared to a 'smart channel' right turn lane.

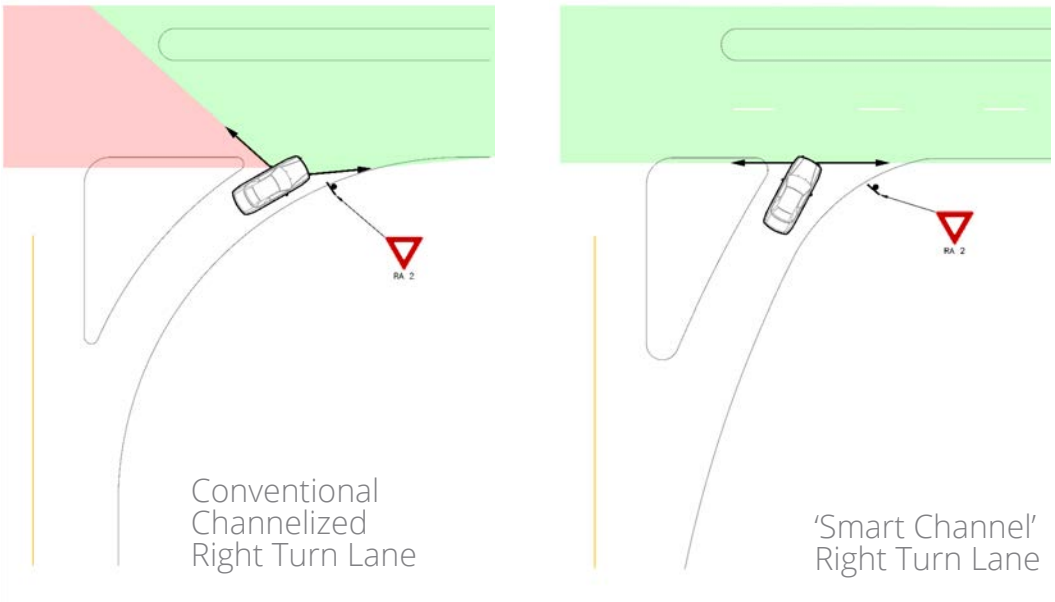


FIGURE 24 - CONVENTIONAL VERSUS SMART CHANNELIZED RIGHT TURN LANES

Design Guidance

Geometric design, signage, and pavement markings can help to reduce the speed of turning motor vehicles using channelized turn lanes and make BC Parkway users more visible. The design (Figure 26) should ensure adequate motor vehicle decision sight distance is achieved for the crossing. (1) Turning motor vehicle speeds can be reduced by providing a low-angle right turn 'smart channel' configuration (2). The curb radius can be compounded to accommodate larger vehicles such as trucks and buses (3), while a painted radius can mark off where smaller motor vehicles should turn (4). A minimum of 6 metres should be provided to allow for a motor vehicle to queue after the crossing without obstructing the pathway while waiting for a gap to turn right (5). The pathway should be oriented perpendicular to the roadway at the approach, which improves sightlines and gives pathway users the shortest possible crossing distance (6). A combined crosswalk and cross-ride should be painted across both the channelized right turn lane and across the main intersection. Curb ramps should be provided in all cases. The pathway centerline may be striped near the intersection. Pathway facing signage can be yield or stop control, this is required because the current MVA only prescribes right of way for pedestrians but not bicycles in a crosswalk. (7) Pathway facing signage should be installed to confirm right of way. An optional mountable curb apron can be installed to enable larger vehicles to the turn wide turn while visually creating a smaller space.

The Pedestrian and Bicycle Crossing Ahead Sign (WC-46) should be installed on the main roadway for both directions of the roadway in advance of the intersection, along with the Crossing supplementary tab sign (WC-7S). Multi-Use Crossing signs (CUSTOM) should be installed on each side of the slip lane prior to the combined crosswalk and cross-ride. A yield sign (RA-2) should be installed for motor vehicles exiting the right turn lane. A yield sign for pathway users (RA2 (BICYCLE)) should be installed to confirm right of way. Shared pathway (RB-98) or a pathway organization (RB-94) signage should be installed on both sides of the intersection on the pathway approach, depending on pathway configuration. Curb ramps should be provided in all cases.

At signalized intersections where separate pedestrian and bicycle pathways are provided, as seen in Figure 25, it is desirable to keep the walking and cycling pathways separated across the intersection when the channelization island is large enough to accommodate this. Separate curb let downs are preferred, although contrasting paving materials can alternatively be used in constrained locations.

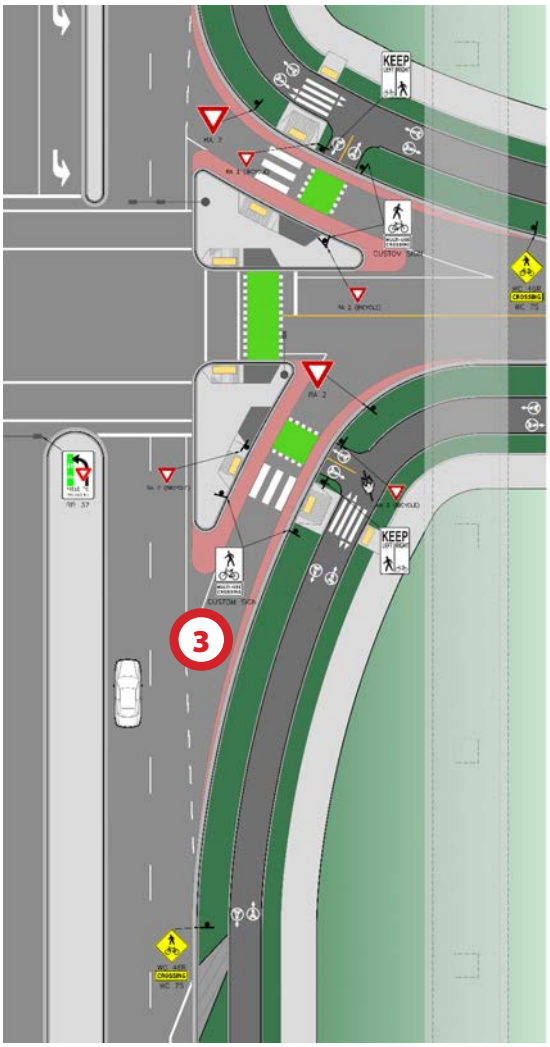


FIGURE 25 - CHANNELIZED INTERSECTION WITH SEPARATED CROSSINGS

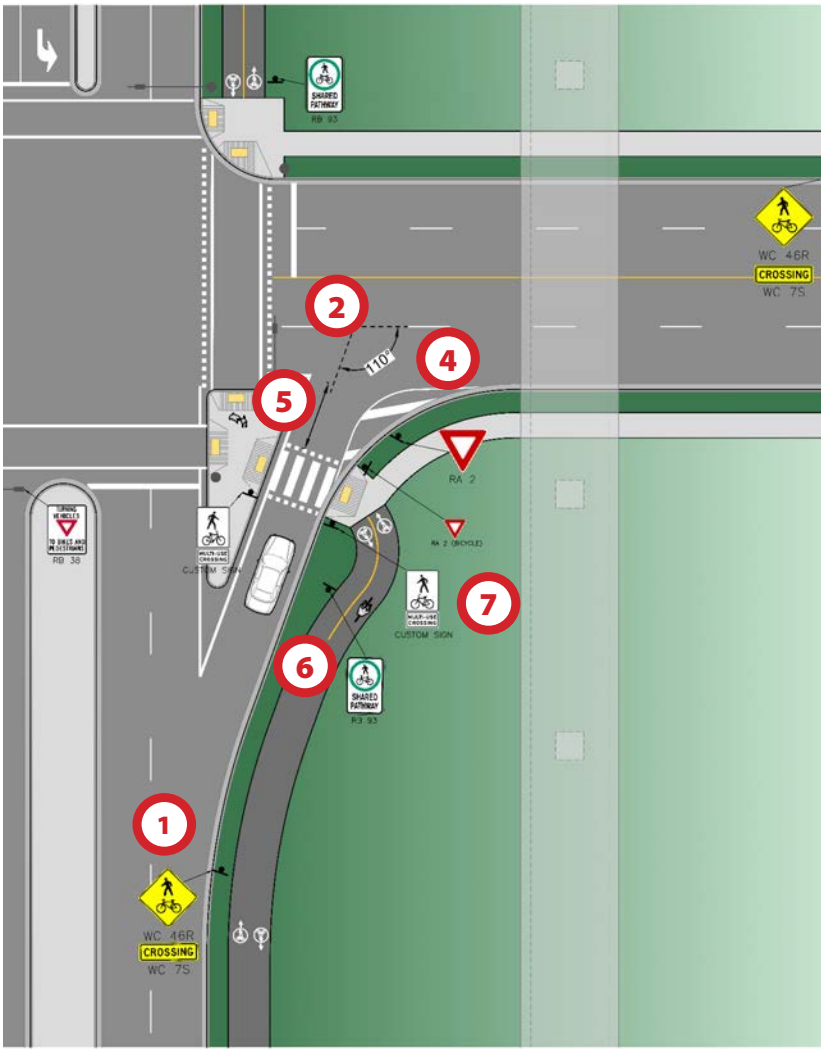


FIGURE 26 - CHANNELIZED INTERSECTION WITH A MULTI-USE CROSSING

1. Ensure adequate motor vehicle decision sight distance is achieved for the multi-use crossing
2. Consider a low-angle right turn 'smart channel' configuration to reduce turning speed
3. Compound curb radius to accommodate the largest design vehicle
4. Painted radius for passenger car turn
5. Minimum 6m to provide space for one vehicle
6. Orient trail perpendicular to the roadway at approach
7. Pathway facing signage

7.5 Minor Intersections and Driveways

Minor intersections are typically locations where the BC Parkway intersects local and minor collector roadways. Typically, these intersections are controlled by stop signs on at least two of the four legs, with a preference to stop control the roadway that crosses the pathway, which then assigns the right-of-way to the BC Parkway.

Driveways are locations where motor vehicles cross BC Parkway to access local access roadways or parking lots. In both of these locations, motorists might not be expecting pathway users, which highlights the importance of design features to highlight and/or control the conflict point. Additionally, considerations should be made at minor intersections and driveways to restrict certain movements to improve the safety and comfort of the pathway users.

4.51 Intersection Control

Minor intersections are typically low volume intersections where both motor vehicles and BC Parkway users' movements are controlled by a number of different control devices. Unsignalized intersections often rely on both motorists and pathway users to yield the right of way depending on the context of the intersection. At unsignalized intersections, pathway users may be given right-of-way through stop control for the side street. Where this is the case, no intersection controls are required for the pathway user, although signage, pavement markings, and geometric design may be used to alert BC Parkway users of the upcoming intersection. Other types of roadway facing controls that can be installed at minor intersections include: Rapid Flashing Beacons and Special Crosswalks which are summarized below. More detail about both can be found in Section 7.2.3.

There may be some locations where yield or stop control may be used to control the movements of pathway users:

- Where sightlines are not achieved between motorists and people riding bicycles, additional signage for bicyclists to yield or stop and watch for turning motorists should be installed. The presence of stop or yield signs on the pathway does not limit people walking from entering the crosswalk in an appropriate manner.
- At locations where a pathway intersects with a roadway that has a designated bicycle facility yield or stop control for pathway users can be installed.

Consistent use of traffic control for pathway users and motorists is essential to ensure pathway users' safety and compliance. Pathway user compliance at intersections with pathway stop control and should only be used when geometric or sightline issues increase the risk of a conflict.

Rapid Flashing Beacon

When activated by a pathway user that is waiting to cross, Rapid Flashing Beacons (RFBs) have flashing yellow lights that alternate back and forth to attract motorists' attention, increasing yielding behaviour. RFBs can be rectangular or circular and can be installed to 'gate' a crossing with one on either side of the street. A two-sided RFB can be included in the median island, if a median exists.

Special Crosswalks

Special Crosswalks, also known as Overhead Pedestrian Flashers, Pedestrian Corridors, and Pedestrian Crossovers, is a traffic control system installed to aid people in walking across the street. The system consists of an Overhead Pedestrian Crossing sign (RA-5) with flashing amber beacons that are activated by the pathway user. Advanced warning signs and flashers can be installed where sightlines are constrained. Pavement markings and ground mounted signs also supplement the overhead flashers. At intersections, the flashers are typically only installed on one side. When used in conjunction with a bicycle crossing, a custom combined Pedestrian and Bicyclist Crossing sign can be used.

7.5.2 Minor Intersections

Design Guidance

An example of BC Parkway crossing a minor, unsignalized street can be seen in Figure 27 and 28. The figures highlight the following design considerations:

- This treatment includes reduced corner radii (preferably 5 metres) that helps to slow motor vehicle turning speeds (1).
- The pathway bends out, away from the parallel roadway (2).
- A minimum of 6 metres of space should be provided between the face of the curb and the start of the combined crosswalk and cross-ride to provide stacking space for turning motor vehicles so that they are out of the through traffic path when waiting for people crossing (3).
- Unsignalized crossings at minor intersections should be stop controlled for motor vehicles crossing the BC Parkway (4). However, as outlined previously, where sightlines are not achieved between motorists and off-street pathway users, signage for pathway users to yield or stop and watch for turning motorists should be installed (for more information about sightlines, see Section 4.3). If pathway users are required to stop, stop signs should be installed on the pathway and oriented to indicate to pathway users riding bicycles that they must stop before proceeding across the crossing. The presence of stop signs on the pathway does not limit people walking from entering the crosswalk in an appropriate manner, nor does it relieve motorists of the responsibility to yield to people in the crosswalk. An additional measure to bring awareness of the crossing to motorists is to install enhanced crossing treatments such as Rapid Flashing Beacons or Special Crosswalks.
- Raised crossings or fully raised intersections are the preferred design treatments at unsignalized intersections and driveways to help define right-of-way, slow approaching vehicles, and create a comfortable level crossing for pathway users (5). Raised crossings increase crossing visibility and yielding behaviour with vertical deflection. Raised crosswalks are most appropriate in areas with high volumes of pathway users, such as near parks, schools, transit stations and other major destinations.

Raised intersections are full intersections that are constructed at a higher elevation than the adjacent approach streets. 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. A raised intersection should be raised by the same amount as any adjacent raised sidewalks (typically 80 millimetres). When raised crossings or intersections are not possible, pathway users are crossing at the same grade as the street. In this case, separate ramps for people walking and cycling are preferred but contrasting pavement can be used to define the space for constrained locations.

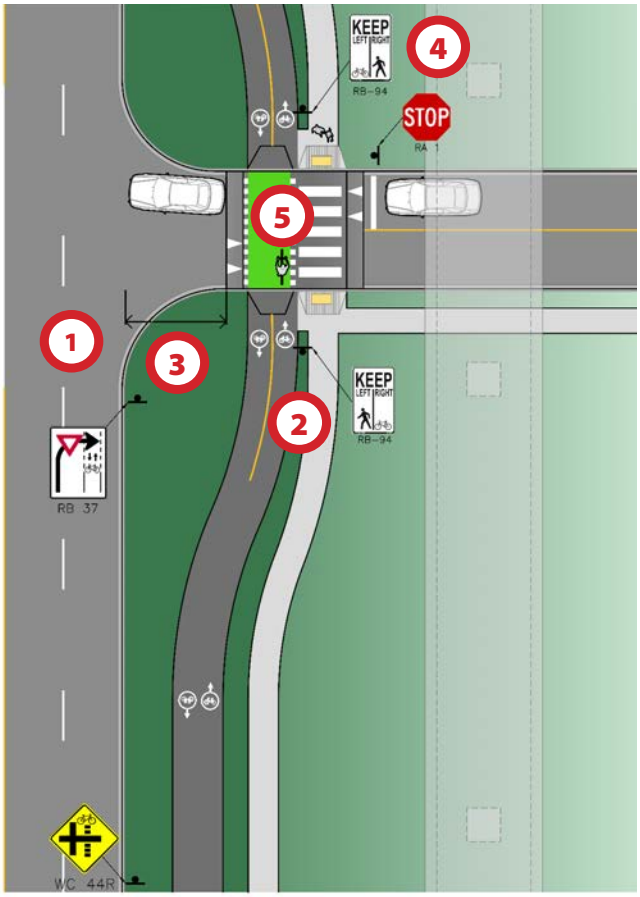


FIGURE 27 - MINOR SEPARATED CROSSING INTERSECTION

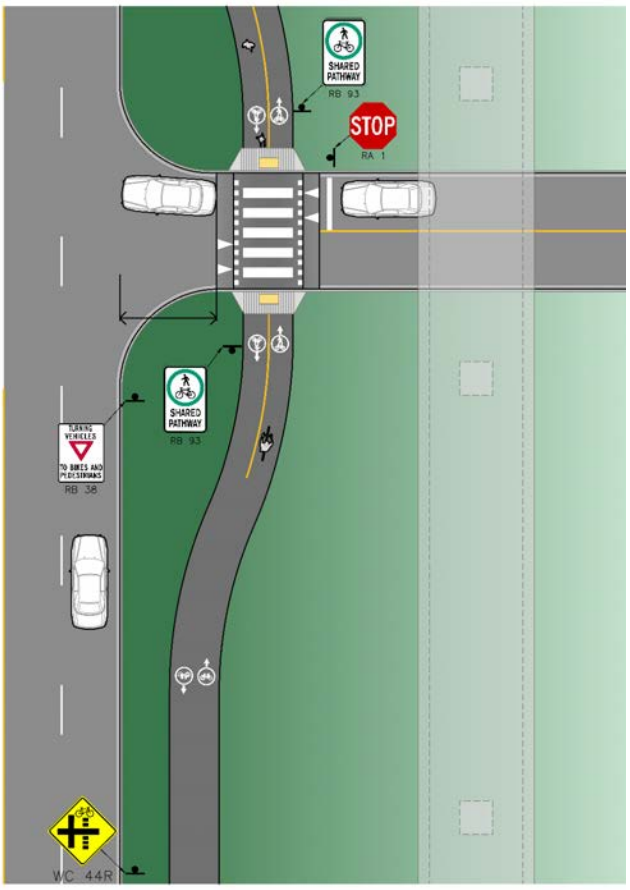


FIGURE 28 - MINOR MULTI-USE CROSSING INTERSECTION

1. Reduce corner radii
2. Bend-out deflection of pathway at intersection
3. Minimum 6 metres to provide space for one vehicle
4. Stop control at minor street crossings
5. Optional raised crossing

Signage and pavement markings are similar for both the multi-use and separated crosswalk scenarios. The Bicycle Trail Crossing Side Street Sign (WC-44) is used for the parallel street in advance of the intersection. Combined zebra and elephant's feet marking are used to bring awareness to the multi-use pathway crossing, and separated cross-ride and crosswalk markings are applicable for separated facilities. Turning Vehicle Yield to Bicycles signs (RB-37) should be placed in advance of where motorists could cross a cycling facility and are required to yield to the cyclist. A second, complementary sign can also be added on the receiving (far) side of the intersection. The Pedestrian and Bicycle Crossing Ahead sign (WC-46), along with the Crossing supplementary tab sign (WC-7S), may be installed on the cross street approach in advance of the crossing. Shared pathway (RB-98) or a pathway organization (RB-94) signage should be installed on both sides of the intersection on the pathway approach.

4.5.3 Driveways

While the BC Parkway provides protection for users from adjacent through traffic, there is the potential for conflicts at locations where there are driveway or alleyway crossings present. Design considerations need to be made to increase motorists' and pathway users' awareness of the crossings and potential conflicts to ensure safety.

Design Guidance

An example of BC Parkway crossing a driveway can be seen in Figures 29 and 30. Provide sufficient sight distance for motorists and pathway users to see each other ahead of the point of conflict. If there is on-street parking near the driveway, a sightline analysis should be completed to determine the extent of parking restrictions required on either side of the access/driveway.

- Where space permits, a 'bend out' alignment can be used from the driveway intersection with the roadway in order to provide additional stopping distance and a space for turning or exiting motor vehicles to wait for crossing people on bicycles. These bends can also serve to reduce bicycle speeds on higher speed sections of the BC Parkway (1).
- A minimum of 6 metres of space should be provided between the face of the curb and the start of the combined crosswalk and cross-ride to provide stacking space for turning motor vehicles so that they are out of the through traffic path when waiting for people crossing (2).
- Design alleyway and driveway crossings to support continuity of pathway material to highlight to motorists that they are crossing a bicycle and walking facility, and that the pathway users have right-of-way (3).
- It is also desirable to maintain a consistent pathway elevation rather than ramping people on the pathway up and down. This concept should be applied where adjacent grading permits construction. Motorists entering the roadway from driveways, alleys and accesses are legally required to stop prior to entering the roadway. However, additional traffic control signage can be installed to reinforce this in locations where motorists encroachment on the sidewalk and/or pathway is an issue (4).
- Signage can also be provided to alert motorists both entering and exiting the driveway or alleyway to the presence of people walking and on bicycles and the direction(s) they are approaching from.

The Bicycle Trail Crossing Side Street Sign (WC-44) is not required at all driveway locations, but can be used for the parallel street in advance of major driveway crossings. Combined zebra and elephant's feet marking are used to bring awareness to the multi-use pathway crossing, and separated cross-ride and crosswalk markings are applicable for separated facilities. Turning Vehicle Yield to Bicycles signs (RB-37) should be placed in advance of where motorists could cross a cycling facility and are required to yield to the cyclist. A second, complementary sign can also be added on the receiving (far) side of the intersection. Shared pathway (RB-98) or a pathway organization (RB-94) signage should be installed on both sides of the intersection on the pathway approach.

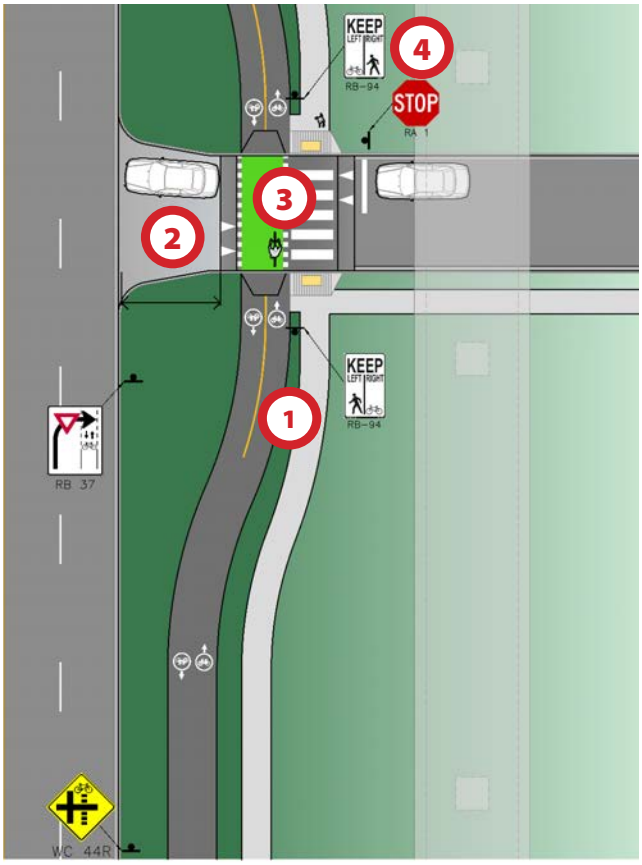


FIGURE 29 - DRIVEWAY SEPARATED CROSSING

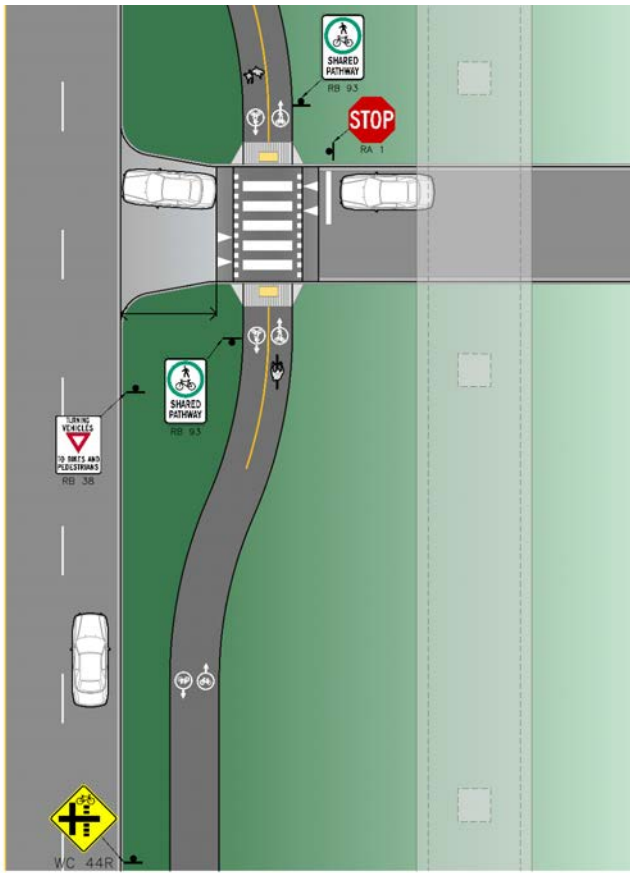


FIGURE 30 - DRIVEWAY MULTI-USE CROSSING

1. Bend-out deflection of pathway at intersection
2. Minimum 6 metres to provide space for one vehicle
3. Raised crossing / continuity of pathway materials and elevation
4. Stop control may be provided at commercial or high volume driveways

7.6 Mid-Block Crossing

This section provides guidance on the treatment of off-street pathways at mid-block crossings. Mid-block crossings, as the name indicates, are not located at intersections and need to be designed appropriately to consider that motorists are expected to yield to users at the crossing location. Typically, mid-block crossings are preferred when the nearest intersection is more than 75 metres from the crossing location. When an intersection is less than 75 metres from the crossing location consider rerouting the BC Parkway crossing to the nearest intersection.

In some circumstances, it may be appropriate to provide a midblock crossing with an additional signal if it follows the desire line of the parkway. There is an example of this at Joyce Station where a second pedestrian activated signalized crossing is located within less than 30 metres from another signalized intersection. This type of treatment may by suitable where pathway volumes are high and enhances the directness of the pathway.

Design Guidance

Pathway Alignment

At a mid-block crossing, the off-street pathway should be as close to perpendicular as possible to the road that is being crossed. The pathways on each end of the crossing should be aligned with one another. Therefore, pathway alignments may need to shift before crossing the road. Additionally, as noted earlier in this chapter, prior to the crossing the roadway, the pathway alignment should be adjusted geometrically to slow the pathway users' approach speeds to the crossing.

Adequate Sightlines (Of Bicyclists and Motorists)

Mid-block crossings should be installed only where adequate sight distance for both motor vehicle drivers and pathway users is available. Figure 31 and Table 11 show the calculation required for determining the appropriate sightlines required for mid-block crossings and resulting values for some roadway widths and speeds. These tables come from the 2017 *TAC Geometric Design Guide for Canadian Roads*. For any widths or speeds not shown in Table 2, the formula shown in the Figure 21 may be used to calculate the required sight distance.

Sightlines can be enhanced by 'daylighting' in advance of the mid-block crossing, which refers to improving sightlines of the crossing by removing obstructions and/or bringing pathways users further out into the motorists' line of vision. This can be accomplished by installing a curb extension to bring pathway users out into the view of motor vehicle drivers and to provide better sightlines for pathway users of motor vehicles on the road as they approach the crossing. On-street parking may also need to be removed in advance of the crossing on both sides of the road to enhance sightlines.

The extent of parking removal to ensure adequate stopping sight distance will be dependent on the design speed of the pathway and the roadway, and the location and width of the crossing. Curb extensions are also advantageous in that they shorten the crossing distance while creating a break in on-street parking that impedes motorists from driving down the parking lane.

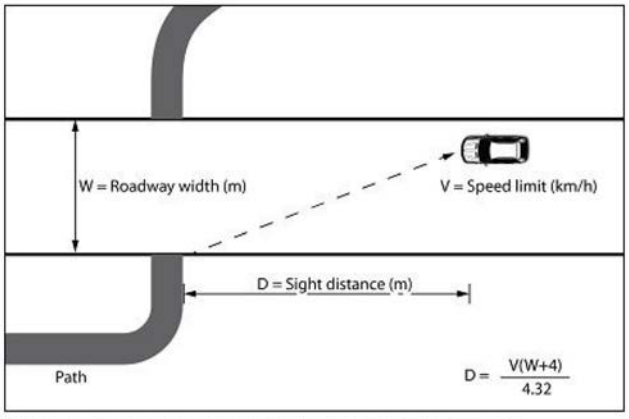


FIGURE 31 - MINIMUM SIGHT DISTANCE FOR MID-BLOCK CROSSING

TABLE 11 - MINIMUM SIGHT DISTANCE FOR MULTI-USE PATHWAY CROSSING

Roadway Design Speed (km/h)				
Width of Roadway - W (m)	**50**	**60**	**70**	**80**
7.0	130	150	180	200
10.5	170	200	230	270
14.0	210	250	290	330
17.5	250	300	350	400
21.0	290	350	410	460

Unsignalized Crossing

Figure 32 and Figure 33 show two options for designing a mid-block multi-use pathway crossing of an unsignalized street.

The following design components are highlighted in Figure 32:

- A median island has been added to provide refuge for crossing pathway users. The median island should have a desired width of 3.5 metres (minimum 2.5 metres) (1).
- A minimum travel lane width of 3.5 metres should be provided on either side of the island (2).
- For higher volume multi-use pathways or streets, the motor vehicle traffic may be stop controlled when the off-street pathway is crossing minor roads (3).
- RFBs can be implemented with midblock crossings dependent on site conditions. Stop lines should be set back 6 to 15 metres from the mid-block crossing for multi-lane cross sections to ensure that a person crossing the street is visible to the second driver when the first driver is stopped at the stop line. Stop lines should only be used when the crossing is signalized or stop sign controlled (4).
- Not shown in this figure but a separated bicycle and pedestrian crossing can also be installed.

In Figure 33, guidance is provided for designing a mid-block crossing at an unsignalized intersection. The following design components are highlighted in Figure 33:

- Where a curb extension has been installed to narrow the crossing to 6 to 7 metres (1).
- This example shows how the pathway is adjusted geometrically to slow the users approach speed prior to crossing (2).
- For higher volume multi-use pathways or streets, the motor vehicle traffic may be stop controlled when the off-street pathway is crossing minor roads (3).
- Stop lines should be set back 6 to 15 metres from the mid-block crossing either on the roadway when pathway users have right-of-way (4).
- A raised crossing can be considered as an optional treatment (5).

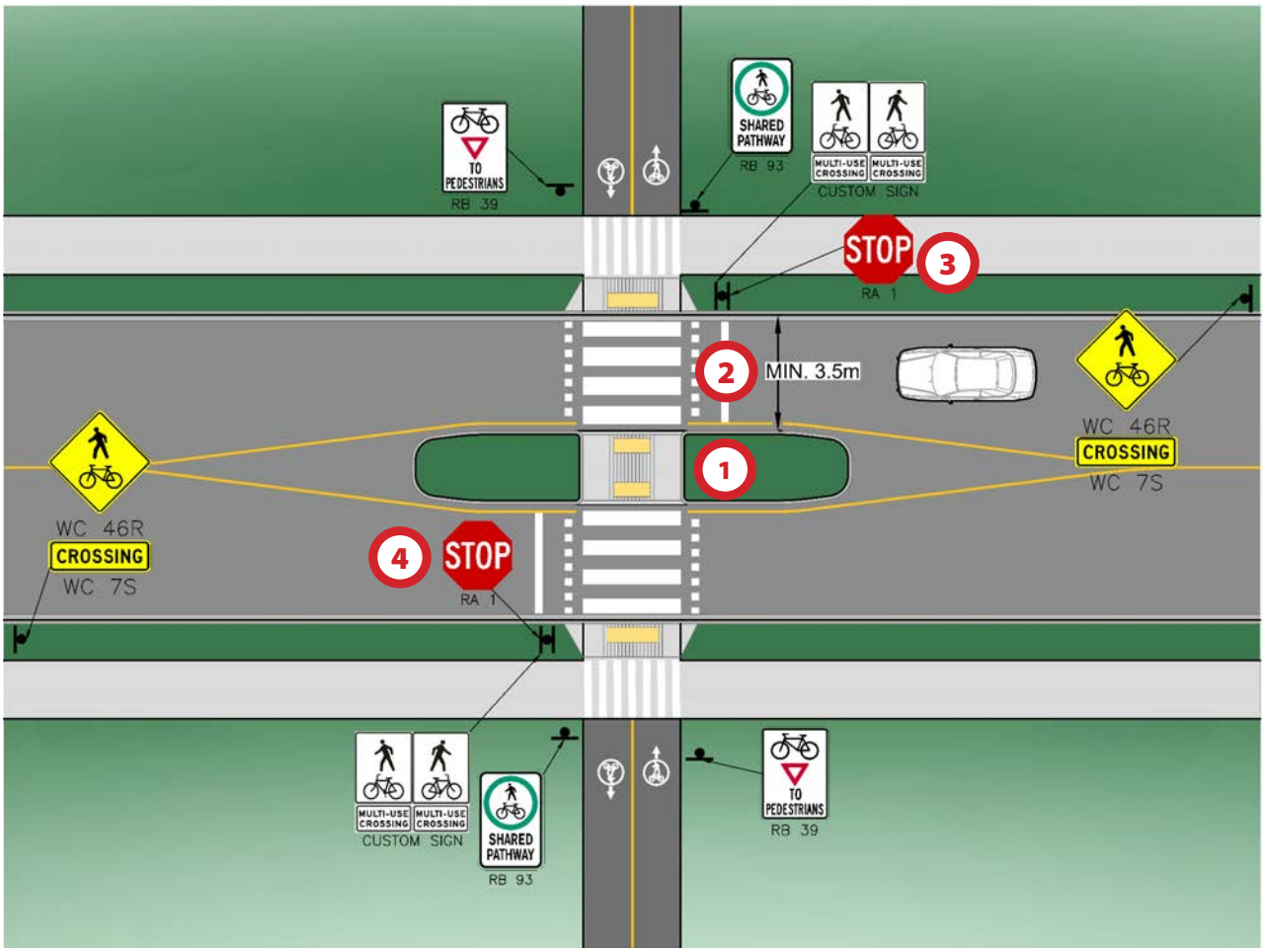


FIGURE 32 - MIDBLOCK UNSIGNALIZED CROSSING - MEDIAN ISLAND

1. Median island (minimum width 2.5 metres / desired 3.5 metres)
2. Minimum vehicle lane width 3.5 metres
3. Stop control for roadway users can be implemented at midblock crossings dependent on site conditions
4. Place the stop line back 6 to 15 metres for multi-lane cross sections

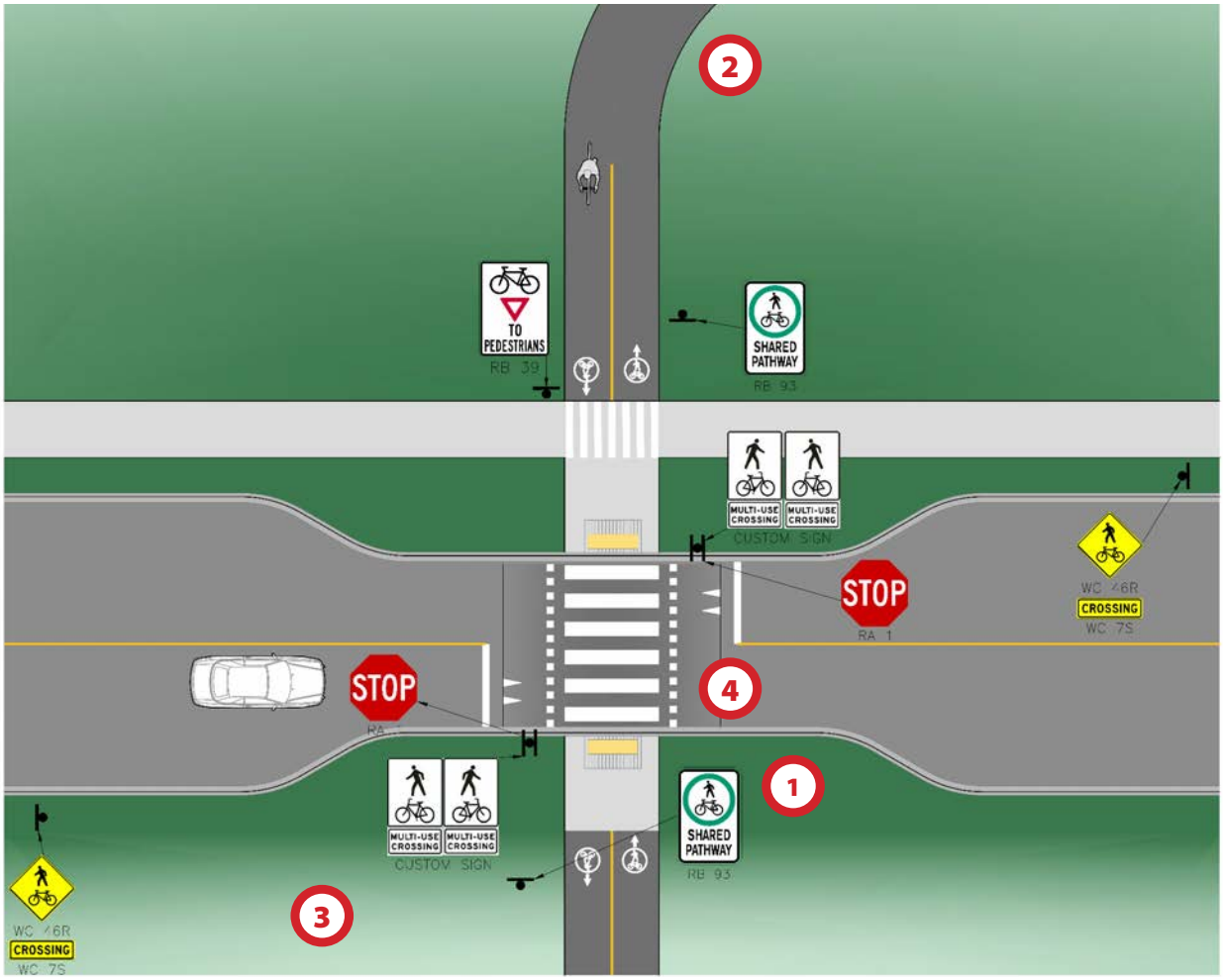


FIGURE 33 - MID-BLOCK UNSIGNALIZED MULTI-USE CROSSING - CURB EXTENSION

1. Curb extensions to reduce crossing distance
2. On approach to the mid-block crossing the pathway can be adjusted geometrically to slow the users approach speed prior to crossing
3. Stop control for roadway users can be implemented at midblock crossings dependent on site conditions
4. Optional Raised Crossing

Signage and pavement markings are similar in each treatment. The Pedestrian and Bicycle Crossing Ahead Sign (WC-46), along with the Crossing supplementary tab sign (WC-7S), is used for the approach on the cross street, while double-sided Pedestrian Crossing signs (RA-4R/L) should be installed on each side of the cross street. Combined zebra and elephant's feet marking and yield lines are used to bring awareness to the multi-use pathway crossing. Bicycle Yield to Pedestrian (RB-39) signs should be placed in advance of where a separated bicycle pathway crosses a pedestrian facility. Shared Pathway (RB-98) or a Pathway Organization (RB-94) sign should be installed on both sides of the intersection on the pathway approach. Curb ramps should be provided in all cases.

Along minor streets, another measure to bring awareness of to motorists is to install enhanced crossing treatments such as Rapid Flashing Beacons or Crosswalks. For additional awareness of crossing locations, reflective post inserts or sleeves for applicable signage can be added at all crossings.

There may be some locations where yield or stop control may be used to control the movements of pathway users, including locations where sightlines are not achieved and where BC Parkway intersects with a roadway that has a designated bicycle facility. Figure 34 is an example of a mid-block crossing that is stop controlled for pathway users. A stop or yield sign can be installed with optional RFBs (1). This example also shows a mid-block crossing with a separated bicycle and pedestrian crossing.

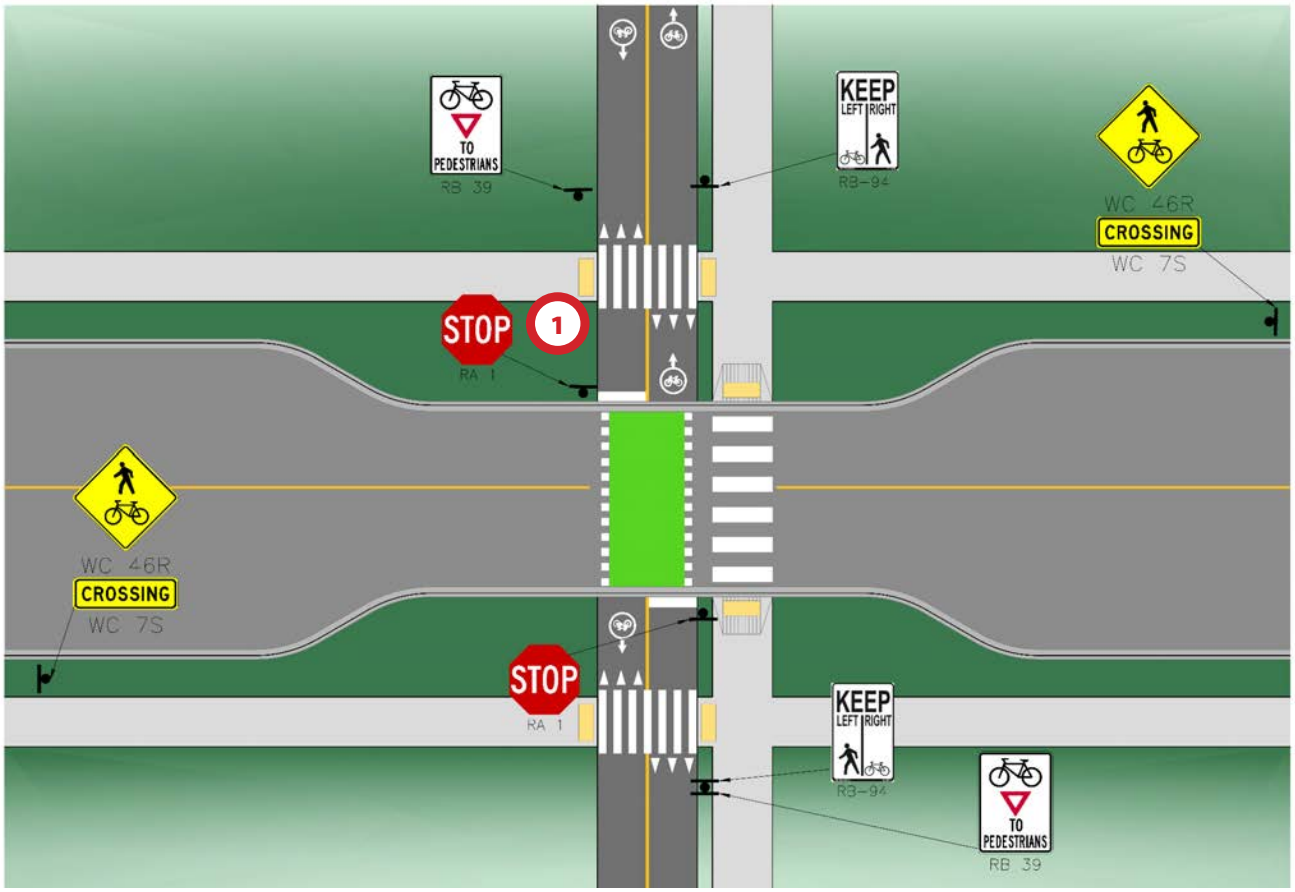


FIGURE 34 - MID-BLOCK UNSIGNALIZED SEPARATED

1 Stop control for pathway users can be implemented where required. RFBs can also be installed.

Mid-Block Signalized Crossing

Figure 35 shows a signalized mid-block crossing at a divided major roadway. In this example the following design components are shown:

- A traffic signal is installed for roadway users and a bicycle and/or a pedestrian signal is installed with automatic detection or a push button must be provided for activation ①
- A stop bar is provided along the bicycle path / multi-use pathway. If an intersecting sidewalk is provided, a 3.0 metres should be provided between the curb and the crossing ②.
- If a median island is present, it should be a minimum of 3.0 metres in width ③.

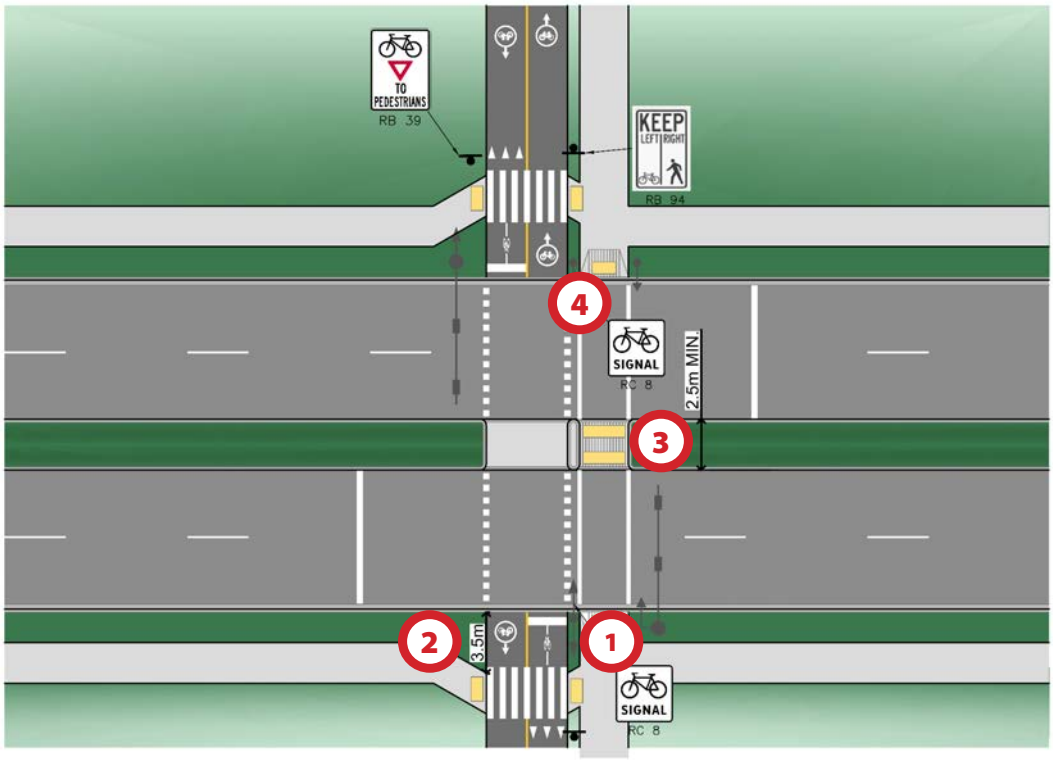


FIGURE 35 - SIGNALIZED MID-BLOCK CROSSING

① Bicycle signal with automatic detection for activation or bicycle push button

② Provide a minimum width 2.5 metres / desired 3.5 metres between pedestrian crossing and curb

③ Median island (minimum 3.0 metres)

④ Bicycle signal or stop control required for bicycle crossing

7.7 Transitions

The transition area is the space or zone where the BC Parkway changes from one facility type to another – for example, where a multi-use pathway transitions into a sidewalk and an on-road bicycle facility. This includes transitions such as off-street pathway to bicycle lane, bicycle ramps and channels, and making a left turn from an off-street pathway onto an on-road facility. This section provides general design guidance on how to enable this transitional movement and reviews common transitional areas. Transitions are very case specific, so the general design intent described below should be applied with a focus on moving transitions out of conflict areas.

Design Guidance

Off-street pathways generally have two-way operation for all pathway users. When pathway users are separated to allow people cycling and walking additional transitions occur. Typically, transitions are more relevant for cyclists since all pedestrian facilities allow two-way travel. Transitioning from a two-way pathway to a facility with one-way bicycle operation requires clear pavement markings and signage for the transition areas to ensure that contraflow bicyclists do not go the wrong-way down the one-way bicycle facility. Transitions between an off-street pathway and one-way bicycle facilities requires similar considerations for cyclists transitioning to the opposite side of the roadway with additional space designated for pedestrians.

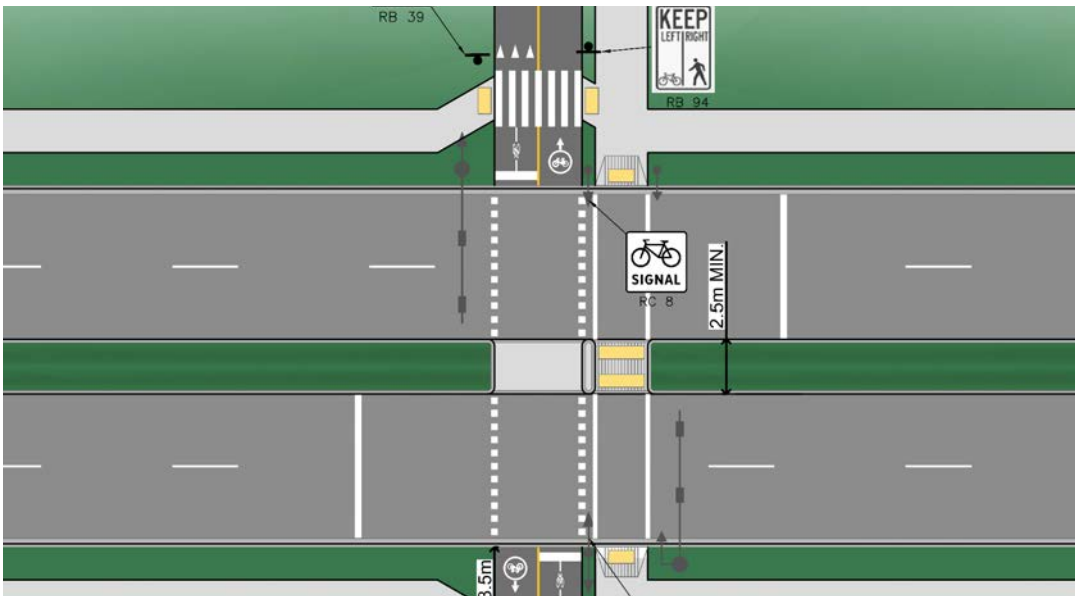


FIGURE 36 - BICYCLE LANE TO MULTI-USE PATHWAY TRANSITION

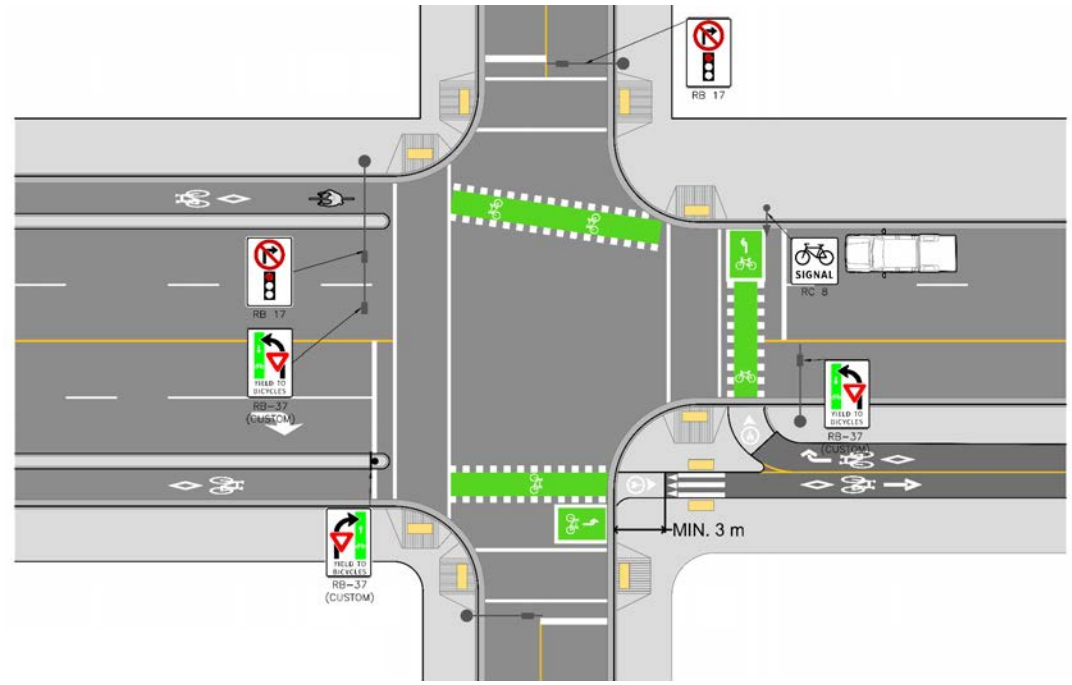


FIGURE 37 - TRANSITION SEPARATED PATHWAY TO ON-STREET (AND VICE VERSA) BI-DIRECTIONAL TO UNI-DIRECTIONAL - EXAMPLE 1

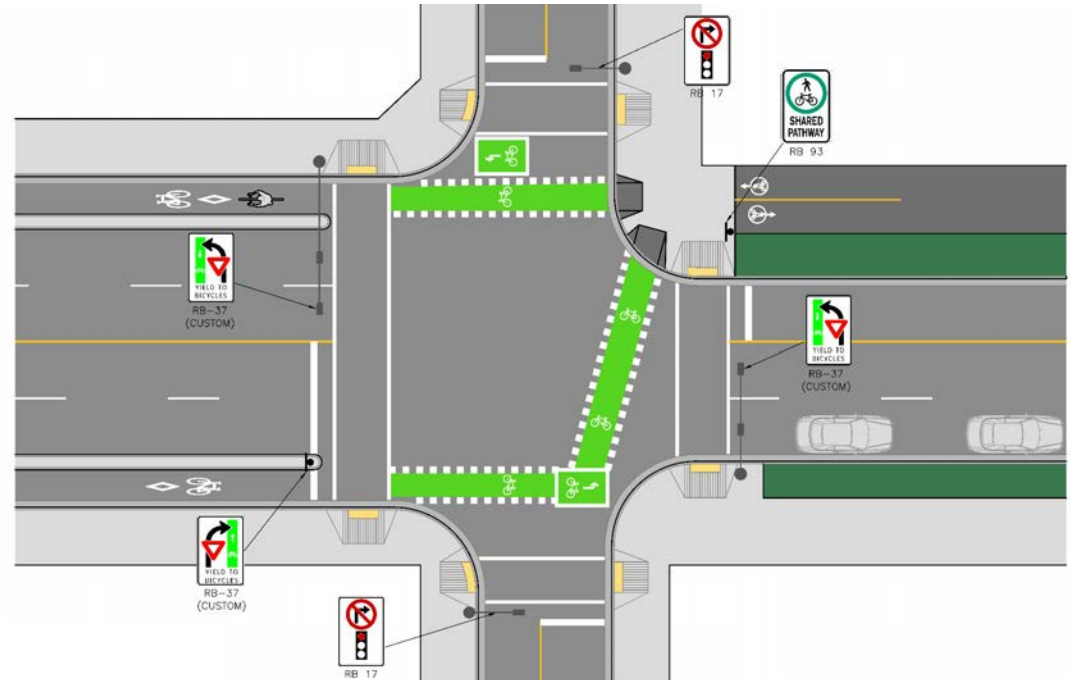


FIGURE 38 - TRANSITION MULTI-USE PATHWAY TO ON-STREET (AND VICE VERSA) BI-DIRECTIONAL TO UNI-DIRECTIONAL - EXAMPLE 2

Traffic control and signage

- Bicycle traffic signals should be provided, and signal timing should be coordinated with the cross street traffic to ensure that people cycling are protected. A No-Right Turn-On-Red phase shall be implemented when bicyclists have a green phase. Near side bicycle signals may be appropriate for some facilities.
- Bicycle route and/or directional signage should be installed at the intersection to indicate the shift in cycling facility.

Pavement markings

- Higher level conflict zone markings should be used to provide more visual guidance to other users at the intersection.
- Bicycle symbols with directional arrow provide visual guidance for bicyclists transitioning between the two facilities.
- Bicycle boxes or protected corners can be used to help transition between facilities.

Transitioning between an off-street pathway and an on-street neighbourhood greenway with an adjacent sidewalk requires special considerations to ensure the transition is safe and comfortable for all ages and abilities. Full traffic closure is the preferred treatment to create a safe and comfortable transition for all BC Parkway users by eliminating the need for people cycling to conflict with opposing motor vehicle traffic (See Figure 39). When a full closure is not possible or suitable consider directional closures for motor vehicle traffic to reduce volumes or moving the transition in advance of the intersection.

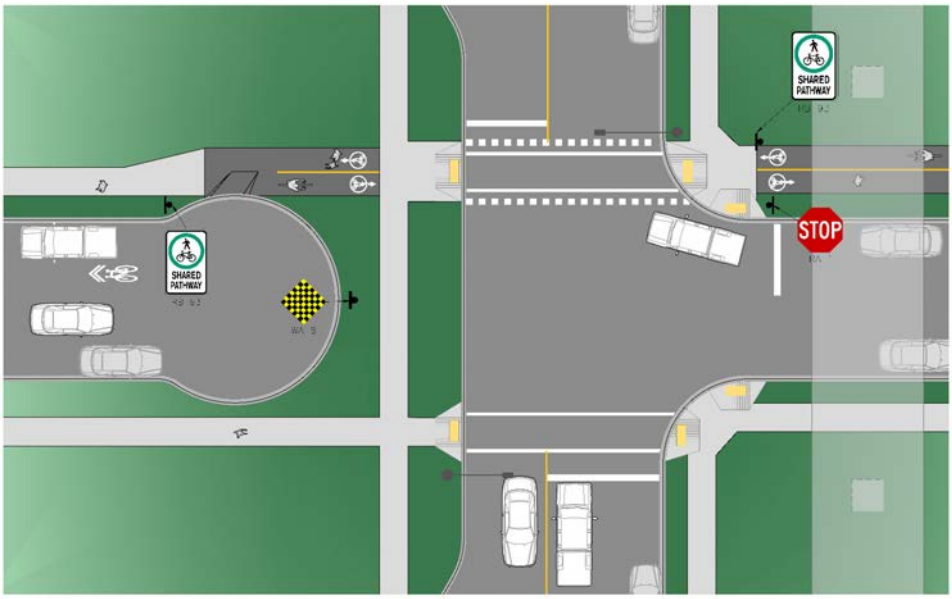


FIGURE 39 - NEIGHBOURHOOD GREENWAY TO MULTI-USE PATHWAY TRANSITION

Protected Intersections

There are also opportunities to provide protected intersections at crossings along BC Parkway. Protected intersections are intersections that use a number of enhanced design elements, to provide increased protection for people walking and cycling. Protected intersections provide a high level of safety and comfort for people cycling by clearly indicating right-of-way, promoting predictable movements, reducing the distance and time during which people on bicycles are exposed to conflicts, and adding protected design elements to the intersection. These design elements result in intuitive, low-stress movements in all directions. Conflicts between right turning vehicles and through bicycle users approaching an intersection are eliminated, while conflicts at the intersection itself are mitigated by adding physical protection for bicycle users and reorienting motor vehicles to increase visibility and encourage eye contact between users. Signal phasing may be used to completely eliminate all conflicting movements. There are several design guides that provide information about designing protected intersections including the B.C. *Active Transportation Design Guide*, the *MassDOT Separated Bike Lane Planning and Design Guide*, and the *NACTO* document titled *Don't Give Up at the Intersection*.

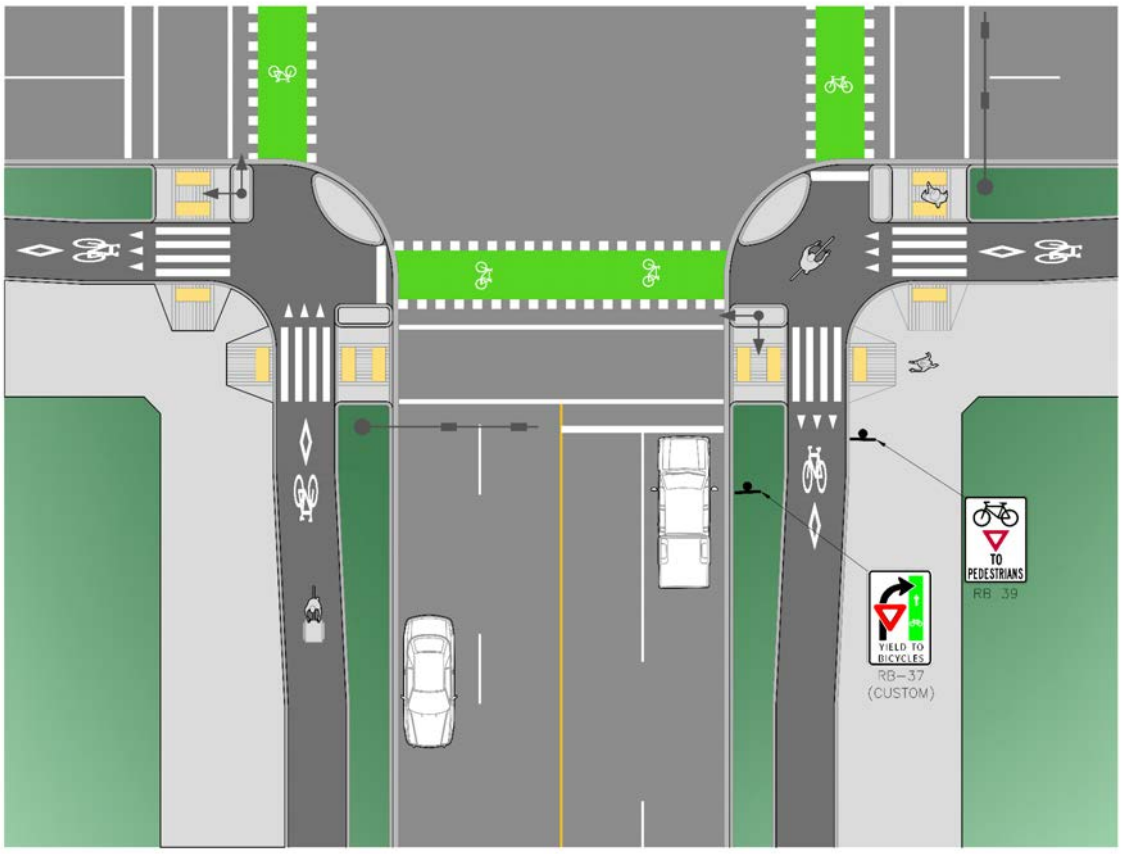


FIGURE 40 - PROTECTED INTERSECTION

7.8 Grade-Separated Crossings

Grade separation of the BC Parkway from motor vehicle traffic can allow for improved safety and uninterrupted flow of pathway users. This separation requires additional space, higher costs for construction and maintenance of the crossing facility, and may not provide as direct a route for the pathway users, which can be a deterrent to use. When grade-separated crossings are discussed in an urban context, considerations need to be made for other at-grade options as well as the implications of the key destinations and connections adjacent to the proposed grade-separated crossing. Additionally, safety can be a concern with both overpasses and underpasses. In both cases, pathway users may be temporarily out of sight from public view and may have poor visibility themselves.

The following should be considered when designing grade-separated crossings:

- Consider safety concerns and evaluate the risk at an at-grade crossing, considering potential exposure for the volume of pathway users expected, and the potential delay for pathway users at an at-grade crossing.
- Use in higher traffic volume locations where roadways with many travel lanes create an environment where at-grade crossings cannot be achieved safely and comfortably. Such locations include high speed on/off ramps, interchanges, highways, major arterials, and other geographic barriers.
- Use where rail crossings create a barrier to safe and comfortable pathway crossings.
- Use where high volumes of people walking and cycling exist or are planned. Grade separation may be considered where either it would not be safe to stop the through road or where significant operational issues would be created by an at-grade crossing.
- Overpasses are most applicable where the topography allows for a structure that has little grade change for people cycling and walking, such as when the roadway is lower than the pathway. Overpasses have a greater visual impact on the landscape but can be designed as an architectural feature.
- Underpasses are generally lower cost for construction than overpasses, except in areas with high groundwater, and are most applicable when the design allows for an open and accessible crossing that feels safe and secure. Underpasses provide better protection from weather, but because of their shelter effect, they can also lead to loitering. Other issues can arise with underpasses include drainage, snow clearance, lighting, and perceived safety.

Design guidance for providing grade-separated crossings includes:

- Ensure the crossings accommodates persons of all ages and abilities through the use of ramps. Ramps should be designed so that they are not too steep for wheelchair users or a deterrent for people on bicycles. See Section 6.5.2.1 of the 2017 *TAC Geometric Design Guide for Canadian Roads* for details about accessible ramps. If space is available, stairs can also be provided, but ramps must be provided.

- In situations where stairs are installed, bicycle channels should also be installed as part of the design.
- The minimum radius for the pathway needs to consider stopping sight distance, superelevation (increased cross-slopes through curves), bicycle speed, turning radii for larger bicycles (i.e. cargo, tandem, trailers), and coefficient of friction.
- At-grade access and connectivity to other facilities must be maintained.
- Minimize crossing distances to encourage use. If the at-grade crossing distance is significantly shorter, the grade-separated crossing may be poorly used.
- Entrances and exits should be clearly visible and accessible.
- The crossing width of a facility should remain consistent, except at entrances and exits where additional widths can better facilitate movements between different users.
- Minimum lateral clearance to obstacles should be provided; 0.2 metres to obstructions that are 100 millimetres to 750 millimetres high and 0.5 metres to obstructions that are greater than 750 millimetres high.
- Provide a flat landing area with less than 2% slope for turns, at prior to intersections, and following any steeper grades.

7.8.1 Overpasses and Bridges

- The minimum width for overpasses to accommodate two-way travel with lateral clearance is 5 metres.
- Protective railings should be a minimum of height of 1.4 metres.
- For facilities on bridges, structures (i.e. cantilever) may need to be added to the bridge if it cannot be retrofitted with the appropriate width of facility.

7.8.2 Underpasses and Tunnels

- Ensure design is well lit to increase the sense of security for users.
- Minimum width for underpasses that accommodate two-way travel with lateral clearance is 5 metres. Consider increasing width of facility if length of underpass is greater than 20 metres to allow for more opportunity to pass and improve sightlines for people using the pathway.
- Minimum vertical clearance is 2.7 metres, with a desirable clearance of 3.6 metres, which allows for a small service motor vehicle to use the underpass. The clearance is measured from the surface of the multi-use pathway to the underside of the structure.

7.9 Signals for Pathway Users

Traffic signals provide traffic control at street and pathway crossings. There are a variety of types of signalized crossing systems that can be used to provide various levels of control or warning to gain motor vehicle drivers attention. The needs of all street and pathway users need to be considered in the design of signals. This section summarizes considerations for off-street pathway users with the design of signalized crossing systems.

Each municipality within the study has implemented some of the enhancements indicated below. Because each municipality has their own standards for signalization, any new installation should follow the standards of the respective municipality and any deviation should be discussed and approved. Design professionals are reminded that any signal timing plans, particularly those involving bicycle signal phasing, shall be signed and sealed by a professional engineer experienced in traffic engineering.

Section 7.4 of this guide outlines the different types of signalized crossing systems, including full and half signals, overhead pedestrian flashers, and RRFBs. The purpose of this section is to specifically look at signalization considerations for pathway users including signal phasing, activation, and the use of countdown timers.

7.9.1 Bicycle Signals

A bicycle signal is a three-coloured traffic control device that can be used in conjunction with a full signal. The signal head can have a conventional circle with a supplementary Bicycle Signal tab sign or it can have a bicycle symbol for each head with an optional supplementary Bicycle Signal tab sign (Figure 41). Alternatively, bicycle traffic can also be controlled with pedestrian signal indications with a custom Bicycle Use Pedestrian Signal sign.

The Motor Vehicle Act (MVA) currently does not recognized bicycle signals as a traffic control device and as such, they have no legal meaning under current legislation. Municipalities should only consider the installation of bicycle signals based on sound engineering and legislative review.

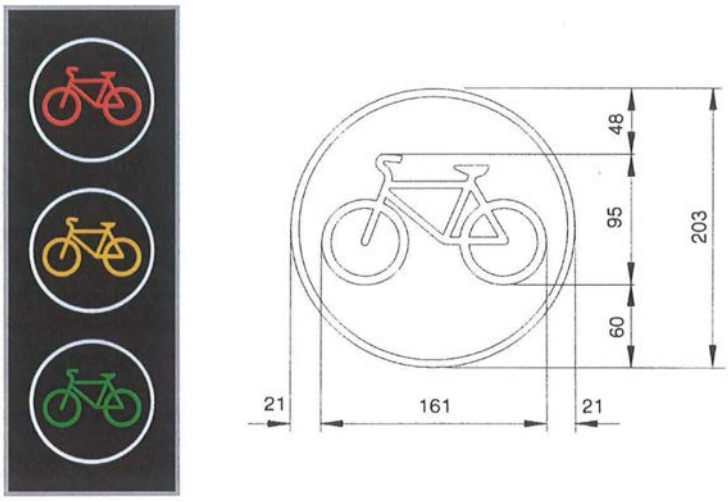


FIGURE 41 - BICYCLE TRAFFIC SIGNAL HEAD DISPLAY

Typical Application

There are various ways in which the movement of people on bicycles through an intersection can be controlled using traffic signals. A separate bicycle signal may be used to provide guidance to bicyclists at intersections where they may have different needs from the other street users. A separate bicycle signal head and phase may also be installed at locations to improve safety or operational concerns, such as where sightlines may not be achieved, where there is a high volume of conflicts with motor vehicles turning, or when there is a bi-directional bicycle facility, such as the BC Parkway. A review of existing motor vehicle volumes, traffic signal equipment, and traffic signal timing and phasing should be completed prior to the installation of bicycle signals to ensure that a separate signal phase can be accommodated. Guidance on separate signal phasing is provided in further detail below.

Placement

Where possible and in order to reduce the number of poles, dedicated bicycle signals should be placed on the existing signal and lighting infrastructure at intersections and other crossings required. The bicycle signal head should be visible to people cycling and the placement should not physically impede people walking.

Bicycle signals are typically side mounted on the far side of the intersection within 1.5 horizontal metres of the edge of the bicycle facility. The *TAC Traffic Signal Guidelines for Bicycles* indicates that if the far side is greater than 30 metres from the stop bar of the cycling facility, consideration may be given to the use of 300 millimetres bicycle signal lenses or the installation of a supplementary bicycle signal on the near side of the intersection or on the median of the intersecting street.

The *TAC Traffic Signal Guidelines for Bicycles* also suggest that a near side signal can include smaller (200 millimetres) bicycle signal lenses that are mounted in combination with a supplemental bicycle signal sign. In the United States, the MUTCD Interim Approval on bicycle signals allows a 100 millimetre bicycle signal head to be used as a supplementary nearside indication. This can be used to increase understanding that signals are only for people cycling. Overhead bicycle signals can be considered if practical and only when side mounted is not feasible.

Types of Signal Heads

Depending on the type of bicycle facility, the signal head that controls bicycle movements at signalized intersections can vary. For example, a bicyclist traveling in a shared lane is controlled by the vehicular signal head. Bicyclists traveling along an off-street pathway typically use a pedestrian signal. Where it is necessary or desirable to control a bicycle separately from motor vehicle traffic, bicycle users can be controlled by a traffic signal head designated for bicycle use, a bicycle signal face, or a pedestrian signal. Each of these three options are described below. Along a corridor, it is recommended that traffic signal indications for bicyclists are consistent and as uniform as possible.

Standard Traffic Signal Head Designated for Bicycle Use

While not standard practice in many municipalities, a vehicular traffic signal head may be designated for bicyclists by mounting a Bicycle Signal sign (CUSTOM) adjacent to the traffic signal. This may be beneficial at locations where:

- It is necessary to add a signal head where bicyclists cannot see existing vehicle signal faces;
- Bicyclists have a separate directional movement, phase, or interval; and
- It is desired to maximize the time a bicyclist may legally enter a crosswalk.

Traffic signal heads or bicycle signal heads must be visible to approaching bicyclists. At least one signal head should be visible for a minimum of 30 metres before the stop line based on stopping sight distance for a bicycle traveling at 25 km/h. Where bicyclist approach speeds are higher, the approach visibility should be lengthened to match the minimum stopping sight distance required for the higher bicycle approach speed. Where bicyclists do not have a continuous view of the signal for the minimum sight distance, a Signal Ahead (WB-4, BC W-012 Series) sign should be installed warning of the approaching signal. Where existing vehicle traffic signal heads are anticipated to be the sole source of guidance for bicyclists, design professionals should check that the signal heads are located within the cone of vision measured from the bicycle stop line as described in the *MUTCDC*. If the vehicle signal faces fall outside the cone of vision, supplementary vehicular or bicycle signal faces should be provided. The cone of vision from the bicycle facility is especially important to consider in locations where contraflow or two-way bicycle facilities are operating on one-way streets. It may be necessary to install new signal faces that are visible to approaching bicyclists.

Bicycle Signal Heads

A bicycle signal head can also include a signal head with bicycle symbols on the lenses. There is significant variation between the many sources on best practices of signal head/lens sizing and placement for far/near side applications:

- The *TAC Traffic Signal Guidelines for Bicycles* recommends 300 millimetres for far side or complex intersections, 200 millimetres for less complex intersections, and near side for complex intersections.
- The Alberta Bicycle Facilities Design Guide recommends 300 millimetres for far side intersections and 200 millimetres for near side, with near side placement only required if the lateral distance between stop bar and signal is greater than 30 metres.
- The *MassDot Separated Bike Planning and Design Guide* recommends the use of 200 millimetres and 100 millimetres lenses for far and near side applications, respectively.

In the Metro Vancouver context, the most common application is the use of 200 millimetres and 300 millimetres signal lenses, with the most common being the use of 300 millimetres signal lenses. The recommendation is to provide 300 millimetre signal lenses on the far side of intersections and 100 millimetre signal lenses on the near side of intersections.

Traffic signal mounting heights are based on the type and location of poles, and the size of traffic signal faces chosen. Bicycle signal heads should ideally be mounted in line with the bicycle facility. However, there are cases where the conspicuity of the bicycle signal is better mounted adjacent to the bicycle facility. Bicycle signal heads must be mounted so that they are do not result in obstructions in the right-of-way for people cycling or walking.

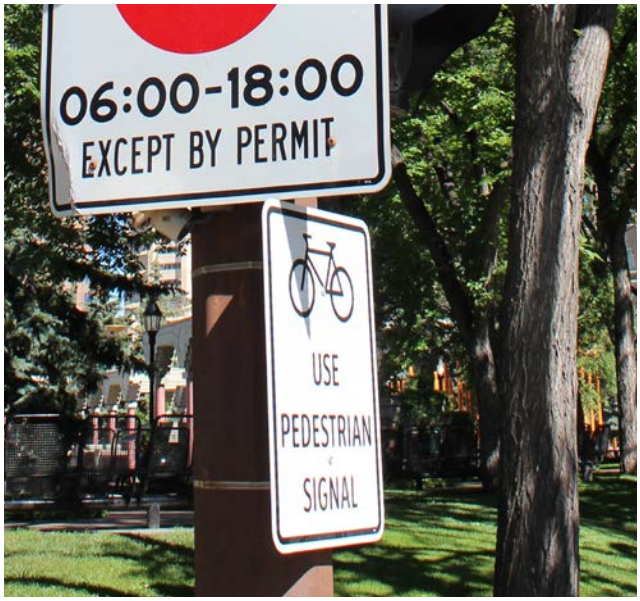
If a 100 millimetre bicycle signal lens is used as a near side supplemental signal, the bottom of the signal housing should be between 1.2 metres and 2.5 metres above the ground. The bicycle signal head should be oriented to maximize visibility to approaching bicycle traffic.

Pedestrian Signal Heads

The use of pedestrian signal heads can be an acceptable alternative for controlling bicycle traffic depending on the local laws associated with bicycle travel. If a pedestrian signal head is being used, then it should be supplemented with a Bicycles Use Pedestrian Signal sign. However, the inherent conflict in the rights and responsibilities of pedestrians and bicyclists in crosswalks may lead some design professionals to choose to install bicycle signal faces instead and separate bicycles and pedestrians at the intersection. Bicyclists who operate on multi-use pathways with pedestrians and other active users may be allowed to operate on sidewalks. It should be noted that the B.C. MVA indicates that cyclists may not ride on a sidewalk unless authorized by a bylaw made under B.C. MVA Section 124 or unless otherwise directed by a sign.

In these scenarios, bicyclists must follow the indications of pedestrian signal heads where they are crossing in crosswalks unless a traffic signal face or bicycle signal face is located for bicyclists.

Where bicyclists are directed to follow a pedestrian signal, they are only legally allowed to ride in the crosswalk if authorized to do so by municipal bylaw. In such cases, they may enter the crosswalk during the walk indication, as the BC MVA restricts users from entering an intersection during a flashing 'Don't Walk' interval. Caution should be exercised when using pedestrian signals to provide guidance to bicyclists at locations with long crossings or unique signal timing phases.



7.9.2 Signal Phasing

Traffic signal phasing represents the method by which a traffic signal divides the overall signal cycle to accommodate the turning movements of various users at an intersection. The signal phasing establishes the movements and users that are allowed to operate together at intersections. A phase consists of the necessary intervals of green, yellow, and red assigned to a particular traffic movement or combination of movements (i.e. pedestrian crossing, left turn movement, combined left turn and through movements). Evaluating signal phasing options requires an assessment of the benefits of a separate phase and the resulting tradeoffs that a protected phase has on efficiency. There are also the other factors that must be considered, including:

- Volumes of all movements by all modes
- Number of opposing lanes (through or adjacent/turning);
- Cycle length and resulting delay;
- Speed of opposing traffic;
- Sight distance;
- Collision history or potential for future collisions;
- Conflicts (turning paths) between all road users including, motorists and bicyclists, motorists and pedestrians, and bicyclists and pedestrians; and
- Continuity of bicycle system and proximity to schools, parks for all users and abilities.

Thresholds for Separate Phases

The decision to provide a separate phase should be based on a need to eliminate conflicts and improve safety at an intersection. Table 12 and 13 provides recommended traffic thresholds in terms of motor vehicles per hour turning across a protected bicycle lane to determine when a time-separated bicycle movement should be considered based on the posted motor vehicle speed. This example refers to protected bicycle lanes but this threshold could be applied to other active transportation facilities, including multi-use pathways as well. At locations where bicycle volume varies and may not meet the minimum required levels whereby bicyclists may not be present each cycle, detection should be used to skip a bicycle phase if not already designed to do so as part of fully signal timing plans for fully actuated signals. It should be noted that the volume thresholds for permissive conflicts are lower if a vehicle is crossing a two-way protected bicycle lane compared to a one-way protected bicycle lane. As BC Parkway allows for bi-directional bicycle movements, the bi-directional numbers should be used unless directions are separated in future designs.

For left turns on two-way streets, the thresholds vary depending on the number of opposing through lanes. Research shows that as the workload increases for motorists to look for gaps in approaching traffic, they are less likely to be looking towards the crosswalk or left side of the roadway for approaching bicyclists or pedestrians[1].

Managing Turning Conflicts

Where vehicle movements need to be managed and separate phases are not provided for turning movements, various geometric treatments can be considered to reduce motor vehicle speeds and increase sight distance. Turn conflicts can also be mitigated by time of day restrictions for movements. At locations where conflicts are high and the provision of a separate phase is not feasible or desirable, the following should be considered:

- Install regulatory signs, such as the turning vehicles yield to (or stop for) bicyclists (or pedestrians) (RB-37 OR RB-38);
- Install crossing islands, medians, or hardened centerlines to slow vehicle left turn speeds;
- Offset the bicycle crossing to create space for yielding (such as bend out elements or protected intersections); and
- Prohibit turns by time of day or when gaps are unavailable (through signal detection).

A separate signal phase at a signalized intersection for pathway users can help to reduce conflicts at intersections. Comparison of the operational and safety impacts of signal phasing changes are necessary in relation with necessary geometric modifications. Separated movements often require longer signal cycle lengths which may result in reduced user

[1] Canadian Council of Motor Transport Administrators (2013). Countermeasures to Improve Pedestrian Safety in Canada. http://ccmta.ca/images/publications/pdf/CCMTA_Pedestrian_Report_Eng_FINAL.pdf

compliance with signal indications. The following summarizes some of the different types of signal phasing. The following section outlines some of the various phasing schemes that can be used. For more details about these schemes and for diagrams refer to the *B.C. Active Transportation Design Guide* (Chapter G.2).

For left turns on two-way streets, the thresholds vary depending on the number of opposing through lanes. Research shows that as the workload increases for motorists to look for gaps in approaching traffic, they are less likely to be looking towards the crosswalk or left side of the roadway for approaching bicyclists or pedestrians[2].

Protected-Only Right Turn Phase

This phasing scheme represents a time-separated bicycle and pedestrian movement. All vehicle movements, including conflicting vehicle turns across the off-street facility, are restricted during an exclusive phase (similar to split phasing). Exclusive turn lanes for the conflicting motor vehicle turns are not required since all motor vehicle movements are stopped. Bicyclists may be directed to follow pedestrian signals during a shared active transportation phase. In this case a Bicycle Use Pedestrian Signal (CUSTOM) should be used.

TABLE 12 - CONSIDERATIONS FOR TIME-SEPARATED BICYCLE MOVEMENTS - LOW SPEED STREETS (50KM/HR AND BELOW)

Protected Bicycle Lane Operation	Motor Vehicles Per Hour Turning Across Protected Bicycle Lane			
	Two-Way Motor Vehicle Road			One-Way Motor Vehicle Road
	Right Turn	Left Turn Across One Lane	Left Turn Across Two Lanes	Right of Left Turn
Uni-Directional	250	150	50	250
Bi-Directional	150	0	0	150

TABLE 13 - CONSIDERATIONS FOR TIME-SEPARATED BICYCLE MOVEMENTS – HIGH SPEED STREETS (>50 KM/HR)

Protected Bicycle Lane Operation	Motor Vehicles Per Hour Turning Across Protected Bicycle Lane			
	Two-Way Motor Vehicle Road			One-Way Motor Vehicle Road
	Right Turn	Left Turn Across One Lane	Left Turn Across Two Lanes	Right of Left Turn
Uni-Directional	100	100	0	100
Bi-Directional	50	0	0	0

[2] Canadian Council of Motor Transport Administrators (2013). Countermeasures to Improve Pedestrian Safety in Canada. http://ccmta.ca/images/publications/pdf/CCMTA_Pedestrian_Report_Eng_FINAL.pdf

Right turn on red must be prohibited during the protected right turn phase. The use of a blanket No Turn on Red (NTOR) sign (*MUTCDC* RB-17R) should be considered. Depending on the turning volumes, this phasing scheme is more likely to have an impact on motor vehicle operations. To accommodate queues or an increase in signal cycle, an agency may consider the extension of turn lane storage lengths.

Concurrent Protected Active Transportation Phase

This phasing scheme also represents a protected movement for people walking and cycling. The active transportation phase runs concurrently with parallel through vehicle phases, but conflicting vehicle turns across the pathway facility is restricted. Turn movements across the pathway facility operate under a protected only phase. The provision of exclusive turn lanes for the conflicting motor vehicle turns are desirable for the adjacent through movement while the turning movements are held. In this phasing scheme, pathway users need to be controlled by a signal that is separate from the motor vehicle signal. Right (or left) turns on red should be prohibited during the protected active transportation phase. At locations where additional motor vehicle capacity is desired, the use of a blanket No Turn on Red sign (*MUTCDC* RB-17R) should be considered. The reduction of split times for other phases may require an increase in the signal cycle length. This phasing scheme can be effective for bicycle facilities along roadways with high through movement volumes and low turning volumes.

Leading Active Transportation Interval

At locations where active transportation user volumes and/or motorist turning volumes are lower than the threshold to provide a protected phase, or at locations where provision of a protected phase is not feasible, leading bicycle and pedestrian intervals may be considered. This scheme represents a partially separated walking and cycling movement. Leading intervals are typically between 3 and 8 seconds long and occur in advance of the green indication for turning motor vehicles. A leading bicycle and/or pedestrian interval allows a cyclists and pedestrians to enter the conflict area prior to a turning motorist, improving visibility. In some cases, a leading bicycle interval may allow bicyclists to clear the conflict point before motor vehicles enter. In this phasing scheme, a bicycle needs to be controlled by either the pedestrian 'walk' indication or via a separate signal face from the vehicle signal. Each of the three options outlined previously could be used. Right (or Left) Turn on Red must be prohibited during the leading bicycle active transportation phase.

Concurrent Phase with Permissive Vehicle Turning Movements

This phasing scheme represents a common scenario at most intersections where bicyclists and pedestrians are not provided any exclusive time in the intersection. In this case, bicyclists and pedestrians are crossing the intersection concurrently with parallel through vehicles, and motorists can make permissive turns. This phasing scheme has the least impact on motor vehicle operations, but does not address conflicts between turning motorists and through moving bicyclists and pedestrians. Geometric and signing treatments should be considered with this phasing scheme to improve safety.

7.9.3 Countdown Timers

Pedestrian Countdown-to-Red timers

Pedestrian countdown timers provide information for pedestrians to cross within the allotted green time. With pedestrian countdown timers, people crossing are aware of how much time they have to cross the street. Research has shown that fewer people are in the crosswalk once the countdown timer expires. Before and after case studies on the effects have been inconsistent among studies, with some studies claiming that timers increase pedestrian compliance[3][4][5] and others reporting increased pedestrian erratic behavior in the presence of countdown timers[6] and a decrease in pedestrian compliance[7].

[3] Arhin, S. A., & Noel, E. C. (2007). Impact of countdown pedestrian signals on pedestrian behavior and perception of intersection safety in the District of Columbia. Intelligent Transportation Systems Conference, 337-342.
[4] Eccles, K. A., Tao, R., & Mangum, B. C. (2003). Evaluation of Pedestrian Countdown Signals in Montgomery County, Maryland. Transportation Research Board.
[5] Schattler, K., Wakim, J., Datta, T., & McAvoy, D. (2007). Evaluation of pedestrian and driver behaviors at countdown pedestrian signals in Peoria, Illinois. Transportation Research Record, 2002(98), 106.
[6] Huang, H., & Zegeer, C. (2000). The effects of pedestrian countdown signals in Lake Buena Vista. Florida Department of Transportation.
[7] Botha, J., Zabyshny, A., Day, J., Northouse, R., Rodriguez, J., & Nix, T. (2002, May). Pedestrian Countdown Signals: An Experimental Evaluation. San Jose State University & City of San Jose Department of Transportation Final Report to the California Traffic Control Devices Committee.

In addition, drivers may behave differently when pedestrian countdown timers are installed compared to when pedestrian countdown timers are not installed.

Bicycle Countdown-to-Green Timers

Traffic Signal Countdown Timers (TSCTs) are technologies to assist users in decision-making at signalized intersections with real-time signal duration information. A study[8] in a simulated environment revealed that driver responses in the presence of a Red Signal Countdown Timer (RSCT) increased efficiency by reducing the mean headway between motor vehicles by 0.82 seconds. This result is suggestive of a reduction in start-up lost time at signalized intersections, or an improvement in signalized intersection efficiency when an RSCT is present.

7.9.4 Signal Activation

Traffic signals should passively detect bicycles or allow bicyclists to manually call a phase with a push button. Cyclists should not have to dismount to use a push button. One of the primary purposes of detectors is to call the signal phase. If detection is used on an intersection approach where bicyclists are expected, it should be designed to sense bicycles whether they are mixed with vehicle traffic or in their own lane.

[8] Mohammad R.Islama, David S.Hurwitza , Kristen L.Macugab, "Improved driver responses at intersections with red signal countdown timers", Transportation Research Part C: Emerging Technologies,Volume 63, February 2016, Pages 207-221.

Various technologies are available for passively detecting bicycles, including inductive loops, microwave, video, and magnetometers. To provide a backup to passive detection devices, a bicycle push button may be used.

The detection layout and design should be based on intersection geometry and the intended use and operation of the detectors. The design must reliably and accurately detect bicycle traffic and should provide guidance on how to actuate detection. Each type of detection should be monitored to evaluate effectiveness and field calibrated as needed to ensure the detection systems are working as intended.

Pushbuttons

- This type of activation should be used at signalized crossings of a major street and where dedicated bicycle detector loops cannot be installed.
- Dedicated pushbuttons should be installed such that the cyclist does not need to dismount or make a significant jog in their travel path in order to operate the device.
- Pushbutton could be either discrete (bicycles only) or joint use with pedestrians.
- The Integrated sign at the pushbutton will define the intended user group.
- Pushbuttons should be oriented the same direction as the direction users are travelling.
- Pushbuttons may also include a detection confirmation light to provide positive feedback to the user and potentially improve compliance with the traffic signal.

Detection Loops

- Loops can have either a discrete or joint use with vehicle loops. Discrete bike loops are more sensitive to bikes and this level of sensitivity must be carefully considered. Additionally, some loops may have difficulty vehicles with limited metal in them (e.g. carbon fibre bicycle frames).
- Bike loops are generally located at a dedicated bicycle facility.
- It is good practice to install bike symbol pavement markings to show bike operators the best detection location.
-

Other Types of Detection

Infrared, microwave (radar), LED, ultrasonic, video and/or motion detectors can also be used for detection at signalized bicycle crossings of major streets. These forms of detection can offer more flexible arrangements than inductive loops. There are situations, particularly during periods of poor weather conditions, where their use may present accuracy problems. In other cases, these types of detectors can be susceptible to false detections, so while they can be used, there should be a plan to ensure that accuracy is assured where loops or push button detection is undesirable or not available.

- *Video*: Video detection for bicyclists is usually part of the vehicle video detection.
- *Radar and MicroRadar*: Radar is generally used to detect bicycles or pedestrians in advance of a crossing and activate a signal to indicate motorist.
- *Infrared*: Thermal cameras are being used for the detection of vehicles, bicycles and pedestrians at intersections based on their thermal signature. This detection technology does not require street lighting to operate.
- *Indicator Light:* Indicator lights can be considered with the bicycle signal head. Indicator lights indicate that bicyclist has been detected by the sensor. These lights are relatively small and are mounted at or near the traffic signal face controlling the approach. The purpose of the confirmation light is to reduce users' concerns that they have not been detected. This can be particularly helpful at locations with long signal cycle lengths where bicyclists may be required to wait 60 seconds or more for a green signal. Compliance may increase for people riding bicycles when they know that they have been detected.

8.0 Lighting

Lighting is an important element to consider on off-street pathway facilities and is critically important. Lighting is important for active transportation users because it increases comfort and safety, and helps with wayfinding, navigation, and observation. Lighting also helps to enhance the visibility of street and pathway surfaces, other street and pathway users, and makes pathway users more visible to motor vehicle drivers.

Potential conflict areas such as intersections, driveways, and alleyway entrances are especially important to illuminate, as all users, especially those at higher operating speeds, need sufficient time to see, assess, and take appropriate action prior to entering the intersection. Caution should be exercised with street light pole placements adjacent to driveway and alleyway entrances. Maintaining a 1.0 metre clearance between the edge of the driveway and pole placement is recommended.

When designing and installing lighting, it is important to consider the location and whose jurisdiction the BC Parkway is under. For example, at intersections lighting is typically under the jurisdiction of the municipality. Along the corridor and under the guideway jurisdiction would likely be TransLink's. In many cases where the BC Parkway is adjacent to street the street lighting may be bright enough to illuminate the pathway. However, is open spaces or where there is no adjacent street lighting the corridor may be more challenging.

8.1 Design Principles and Considerations

Several key principles should be considered when designing lighting along the BC Parkway and where it crosses a roadway. These considerations include the positioning of luminaires, local context, safety and security, location, life-cycle considerations, and ensuring the lighting is appropriate for all users. Many municipalities require the use of LED technology for luminaire selection.

Positioning and Spacing of Luminaries

Proper positioning of lighting components will illuminate key features of off-street pathway facilities. Continuous sections of off-street pathway facilities may require lighting, as do the key features. Key features include wayfinding signage, conflict and decision points, and intersections. The position, placement, and angle of luminaries can maximize positive contrast and minimize glare. Consideration should be made to ensure that lighting components are positioned sufficiently away from existing lighting systems to avoid over lighting. Lighting posts and lighting fixtures should also be placed in such a way to minimize barriers to users of pedestrian and cycling facilities.

The spacing between light poles is important because it directly affects the uniformity of the lighting perceived by the user of a pedestrian and/or cycling facility. Uniformity is generally desired as it requires less effort for the user's eyes to readjust to differing lighting levels. Consistent illumination also helps minimize dark patches and shadows along the facility, which is particularly important for helping make pedestrian and cycling facilities more accessible for people with vision loss.

Local Context

Lighting design should always consider the aesthetic, environmental, safety, security, and social contexts in which a pedestrian or cycling facility is located. The design should simultaneously provide the minimum required lighting to meet desired lighting requirements and address all relevant safety and security considerations, while respecting the local context, minimizing over lighting and trespass, and complementing the built environment. This tends to be more applicable when discussing off-street pathway corridor lighting rather than lighting at intersection and crossing locations.

Safety and Security

Lighting is used to illuminate locations where off-street pathways cross a roadway as it improves the visibility of the intersection, surrounding environment, and other users. Lighting should provide users with enough sight distance to observe, navigate around, and avoid slower facility users so as to reduce the potential for collisions and traffic-related conflicts.

Users

Lighting design should always consider all users of a facility, as the users determine the type of lighting used, the lighting illumination levels, and the placement and positioning of lighting infrastructure. Lighting design for pedestrians should seek to provide gradual lighting transitions, provide an appropriate colour temperature, and minimize cast shadows. Specific lighting considerations for people with vision loss should be considered in high traffic areas and frequent points of interest such as arterial roadways and transit facilities.

Lighting design requirements, generally, are categorized into lighting for pedestrians and lighting for bicyclists. The users of BC Parkway can be comprised of children, adults, and seniors who walk or cycle as their main mode of transportation. They can also include users with wheelchairs, scooters, roller blades, skateboards, and reclining bicycles. Users of BC Parkway typically operate at different speeds, therefore requiring different lighting needs. At intersections, the needs of roadway users also need to be considered to ensure that they can clearly see BC Parkway crossing locations, obstructions, and other users.

It is recommended that if BC Parkway is located adjacent to existing street lighting, pedestrian scale lighting can be retrofitted onto an existing street lamp. If a separated bicycle and pedestrian pathway is provided, sufficient lighting should be provided for both pathways, this may require additional pedestrian scale lighting.

8.2 Types of Lighting

Many active transportation facilities require different types of lighting than typical street lighting because of the smaller surface area requiring illumination and the human scale of the users.

Street Lamps

The most common lighting used along BC Parkway and at intersection locations are street lamps. Street lamps are typically used to illuminate the crossing and surrounding roadway infrastructure. Street lamps may be equipped with secondary, shorter luminaires to enhance lighting in dense tree canopies along tree-lined boulevards, where pruning is not possible.

Pedestrian-Scale Lamps

Pedestrian-scale lamps are small-scale street lamps typically placed on off-street facilities such as off-street pathways and separated bicycle and pedestrian pathways. Pedestrian scale lights are typically mounted at a lower mounting height and have a lower lumen output compared to roadway lighting. While pedestrian lamps are more aesthetically pleasing for off-street facilities, their size makes them more conducive to vandalism. They also may not provide a level of illumination appropriate for an intersection crossing. Illuminated bollards can also be considered pedestrian-scale lighting providing an alternative to street lamps. This type of lighting would be more appropriate along the pathway rather than at an intersection.

Miscellaneous Lighting

Other types of lighting for pedestrian and cycling facilities can include, illuminated bollards, in-ground lighting, and other types of emerging technologies. These types of lighting are mainly used for wayfinding and decorative purposes as they may not provide sufficient illumination for safety and navigation. These types of lighting do not allow users to make out upper bodies and/or faces. They may also require higher maintenance because of vandalism concerns associated with their ease of access to pedestrian and cycling facilities. They do not adequately illuminate a BC Parkway intersection crossing.

Also included under miscellaneous lighting are structure mounted lights, which can be integrated into the guideway structure as a temporary or long-term measure. TransLink may also want to consider the installation of solar powered lighting. Both solar powered and lighting mounted onto the guideway.

8.3 Design Guidance

Design requirements for lighting are largely dependent on the facility requiring illumination and the intended users of the facility. There are some additional resources available that provide specific design guidance for lighting on transportation facilities, including:

- American National Standards Institute Illuminating Engineering Society RP-8-14 Standard Practice for Roadway Lighting (2018)
- TAC Guide for the Design of Roadway Lighting (2006)
- American Association of State Highway and Transportation Officials Roadway Lighting Design Guide (2005)

Corridor and Intersection Approaches

As BC Parkway is an off-street pathway, off-street pedestrian and cycling facilities are defined by TAC as those areas that are located 5 metres or more away from an adjacent roadway. Regardless of the presence of lighting along the pathway corridor, lighting is required on off-street facilities a minimum of 25 metres in advance of an intersection[9].

9 OTM Book 18 Cycling Facilities. (2013). Section 5.9.3 pg. 116 - https://ontario-traffic-council.s3.amazonaws.com/uploads/2018/05/OTM-Book-18.pdf-Dec.-2013.pdf

If the pathway is further than 5 metres from an adjacent street, it is recommended that it have its own independent lighting system that follows the TAC Guide for the Design of Roadway Lighting, Chapter 16 (Off-Street Facilities) and Table 3. This applies to both lit and unlit streets. If the street is unlit, transitional lighting should be provided leading up to the intersection so that drivers' vision can adjust to the illuminated intersection.

The municipalities BC Parkway is located within have their own standards for lighting within their jurisdiction. All lighting design will be designed at a minimum according to these municipal standards.

Design guidance considerations for pathway lighting includes:

- Light poles must be located outside of lateral clearance areas, and consistently on one side of the pathway (or in between the separated bicycle and pedestrian pathways) only.
- Luminaires should be mounted so that their finished height is no lower than 4.5 metres above the pathway surface.
- Light posts will usually be spaced at approximately 25 metres apart.
- The design of luminaires should provide appropriate illumination levels, with minimal spill of light off the trail surface.
- Lamps should be energy efficient, long-lasting and provide good colour rendering. LED lamps should be considered for new lighting.
- Although the BC Parkway should be lit from dusk to dawn, motion detection- based lighting is encouraged where possible to reduce the carbon footprint and disturbance of the natural context.
- Consider the use of solar powered or guideway mounted lighting to avoid having to connect to the municipalities electrical grid.
- Best practices with respect to dark skies preservation, energy conservation, and the prevention of light trespass to adjacent properties should be rigorously applied.
- If a separated bicycle and pedestrian pathway is provided, sufficient lighting should be provided for both pathways.

Signalized Intersections

At minimum, lighting requirements for BC Parkway at the approach to a signalized intersection should be illuminated to the same levels as that of the intersection. If vertical illuminance is required, the vertical levels should be equal to or better than required horizontal illuminance levels. When the configuration of an intersection changes, or the classification of a street is modified, the pedestrian conflict level of the intersection (as identified in Table 14 and Table 15) should be revised.

When this occurs a lighting evaluation of the entire intersection is recommended to ensure compliance with current standards. RP-8-14 also provides recommended levels for pedestrian areas and bikeways . The RP-8-14 requirements are based on pedestrian signal activity levels, and includes requirements for vertical illumination for increased uniformity.

Illuminance is defined as the total luminous flux incident on a unit area of a surface. Horizontal illuminance is the amount of light on a horizontal surface. Vertical illuminance is the amount of light on a vertical surface.

TABLE 14 - RECOMMENDED ILLUMINANCE LEVELS FOR WALKWAYS AND BIKEWAYS SOURCE: (TAC GUIDE FOR THE DESIGN OF ROADWAY LIGHTING – VOLUME 2 – CHAPTER 16 – TABLE 16.1) RECOMMENDED ILLUMINANCE LEVELS FOR PEDESTRIANS

Area	Minimum Average Horizontal Illuminance (LUX)	Max. Horizontal Uniformity (Ave. to Min. illuminance)
Walkways and Bikeways	5.0	10.0:1
Pedestrian Stairs	5.0	10.0:1
Pedestrian and Cyclist Tunnels	43.0	10.0:1

The principle purpose of lighting is to allow accurate and comfortable visibility at night of possible hazards in sufficient time to allow appropriate action. Night is defined by TAC as the hours between the end of evening civil twilight and the beginning of morning civil twilight. Civil twilight ends in the evening when the centre of the sun's disk is 6° below the horizon and begins in the morning when the centre of the sun's disk is 6° below the horizon (TAC Guide for the Design of Roadway Lighting).

Unsignalized Intersections

Signalized intersections require horizontal and vertical illuminance whereas unsignalized intersections require only horizontal illuminance. Chapter 12 of the *TAC Guide for the Design of Roadway Lighting* recommends that all pedestrian crosswalks with nighttime traffic be illuminated. It is worth noting that RP-8-14 does not distinguish between signalized and unsignalized intersections. Distinctions are made based on roadway classification and pedestrian conflict classification.

This chapter provides an overview of the different signage and pavement markings that direct all road users at intersections along the BC Parkway. Signage and pavement markings play an important role in creating awareness to both motorists and pathway users. The information provided in this section is based on the 5th edition of the *Manual of Uniform Traffic Control Device of Canada (MUTCDC)* and the 2012 *TAC Bikeway Traffic Control Guidelines for Canada*.
Generally, existing roadway lighting is sufficient for facilities located within the roadway allowance, provided the roadway lighting has properly accounted for the level of pedestrian and vehicle activity. On-street facilities with high levels of pedestrian activity or high potential for pedestrian and vehicle conflict will require additional or supplementary illumination through the use of additional lamp posts, secondary luminaires, or pedestrian-scale lighting.

The levels of illuminance for on-street facilities are shown in the tables below (Table 14 and Table 15). Generally, where the volume of existing or anticipated active transportation users is high, the level of illuminance should be greater.

The levels of pedestrian activity are defined as:

- **High**: Areas where a significant number of pedestrians are expected to be on the sidewalks or crossing the streets after dark (over 100 pedestrians per hour). Examples of high activity areas are, downtown retail areas, near theaters, concert halls, stadiums, and transit terminals.

- **Medium**: Areas where lesser numbers of pedestrians utilize the streets at night (10 to 100 pedestrians per hour. Typically this includes downtown office areas, blocks with libraries, apartments, neighborhood shopping, industrial, parks, and streets with transit routes.
- **Low**: Areas with very low volumes of night pedestrian usage (10 or fewer pedestrians per hour). These areas can be on any type of roadway but are likely to be along local and residential streets with single family dwellings, very low density residential developments, and rural or semi-rural areas.

For more information on levels of lighting required based on pedestrian activity and area, refer to *TAC Guide for the Design of Roadway Lighting* – Volume 2 – Chapter 9 – Table 9.3. RP-8-14 also provides guidance on luminance levels that differs from TAC.

TABLE 15 - RECOMMENDED ILLUMINANCE LEVELS FOR PEDESTRIANS SOURCE: (TAC GUIDE FOR THE DESIGN OF ROADWAY LIGHTING – VOLUME 2 – CHAPTER 9 – TABLE 9.3)

Pedestrian Activity	Minimum Average Horizontal Illuminance (LUX)	Minimum vertical illuminance at 1.5m above pavement (LUX)	Max. Horizontal Uniformity (Ave. to Min. illuminance)
High	20.0	10.0:1	4.0:1
Medium	5.0	2.0:1	4.0:1
Low	3.0	0.8:1	6.0:1

As seen in Table 16, there are two areas that are identified as high conflict areas: 'Mixed Vehicle and Pedestrian' areas, where no physical separation exists between vehicles and pedestrians, and 'Pedestrian Only' areas. For all other areas, the classification is for pedestrian only areas (no mixed vehicle/pedestrian). Areas with a greater level of conflict should have a higher level of illuminance.

TABLE 16 - RECOMMENDED ILLUMINANCE LEVELS FOR PEDESTRIANS (SOURCE: (RP-8 (2014) - TABLES 4, 5 AND 6)

Area	Pedestrian Conflict Area	Minimum Average Horizontal Illuminance (LUX)	Minimum vertical illuminance at 1.5m above pavement (LUX)	Max. Horizontal Uniformity (Ave. to Min. illuminance)
Mixed Vehicle and Pedestrian	High	20.0	10.0	4.0:1
Pedestrian only	High	10.0	5.0	4.0:1
Pedestrian	Medium	5.0	2.0	4.0:1
Pedestrian	Medium Density Residential	4.0	1.0	4.0:1
Pedestrian	Low Density Residential	3.0	0.8	6.0:1
Pedestrian	Rural/Semi Rural	2.0	0.6	10.0:1

Mid-Block Crossings

Lighting at pedestrian and cycling facilities at mid-block crossings is important to ensure that motor vehicle drivers can anticipate and predict pathway users crossing the street. To achieve positive contrast, light poles should be strategically placed in advance of the crosswalk. The placement of poles along with the luminaire selection, light distribution, and house side shielding can help to minimize light pollution. Mid-block crossings are typically designed with lighting poles that are similar in height to adjacent poles or poles that are specified by the authority having jurisdiction. For more information on lighting at mid-block crossings refer to TAC Guide for the Design of Roadway Lighting - Volume 2 – Chapter 12 – Section 12.5.2.

Other Locations

Tunnels and Underpasses: Tunnels and underpasses should be well lit for the security and comfort of pedestrians and cyclists. Ideally, users should be able to clearly see what is happening throughout the entire tunnel or underpass, though this is dependent on the geometry of the tunnel.

Bridges and Overpasses: Overpasses should be lit to ensure that users can see any hazards or obstructions as well as other users. There are opportunities to use bridge and overpass lighting to enhance and showcase the structure.

Warrants: There are cases where communities and jurisdictions have identified locations and scenarios where lighting is warranted along pedestrian and cycling facilities. These vary by community but often take into consideration the volume of users, likelihood of conflict, and presence of hazards. A warrant may be required for a street or pathway corridor. However, it is always recommended that lighting is provided at an intersection crossing.

Photo Source: Mike Zipf


2015
STOP
Rest your foot here
Rest your foot here

9.0 Signage and Pavement Markings

It is important to note that TransLink has developed their own BC Parkway Regulatory Signage and Pavement Marking Guidelines along with Wayfinding guidelines. These are more applicable to the signage and pavement markings along the BC Parkway corridor as opposed to the intersections but still can be used as a resource.

This chapter provides an overview of the different signage and pavement markings that direct all road users at intersections along the BC Parkway. Signage and pavement markings play an important role in creating awareness to both motorists and pathway users. The information provided in this section is based on the 5th edition of the *Manual of Uniform Traffic Control Device of Canada* (MUTCDC) and the 2012 *TAC Bikeway Traffic Control Guidelines for Canada*.

9.1 Signage

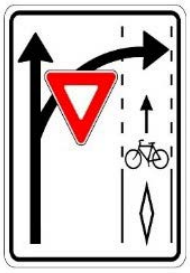
The Ministry of Transportation and Infrastructure (MOTI) oversees the B.C. Provincial Sign Program and maintains the Catalogue of Standard Traffic Signs and Supplemental Traffic Signs, which apply on all roadways under provincial jurisdiction. Meanwhile, the *MUTCDC* provides national guidance for the use of traffic control devices, including signage and pavement markings. *MUTCDC* signage is typically used on roadways that are under local and regional government jurisdiction. Other sources of signage and pavement markings include the *TAC Bikeway Traffic Control Guidelines for Canada* and the *TAC Pedestrian Crossing Control Guide*.

The TAC guidance and the B.C. Provincial Sign Program use different sign codes. For example, the sign code for a Stop sign is *MUTCDC* RA-1, using TAC guidance, or B.C. R-001 Series, using the B.C. Provincial Sign Program. There is overlap between the two systems, but there are also signs that are unique to each system. There are also some signs that have similar meanings but different designs – some with minor differences and some more noticeable. Where two different codes exist for the same sign, each code has been referenced in the Design Guide. If the sign appears in only one guide, that code has been referenced.

Design professionals are encouraged to review each signage system and consider the jurisdiction and the most appropriate sign for each application.

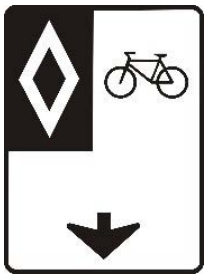
Please note that the information provided in this section is based on the TAC guidelines and the B.C. Provincial Sign Program, as indicated above. All pavement markings and signage should reflect the most current edition of each of the reference documents. Design professionals are reminded that the traffic control devices included in this section are not an exhaustive list of traffic control devices. A more exhaustive list of available traffic control devices that includes signage, pavement marking, and signals can be found in the documents referenced above.

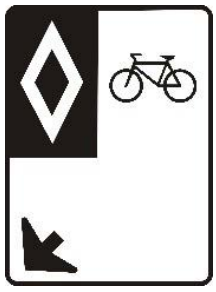
Regulatory Signs		
MUTCDC Sign Code	**BC Sign Code**	**Description**
RA-1	**R-001 Series**	**Stop Sign** The Stop sign indicates to cyclists that they must stop before entering the intersection and must not proceed until it is safe to do so.
RA-2	**R-002 Series**	**Yield Sign** The Yield sign indicates to drivers and bicyclists that they must yield the right-of-way before entering the intersection or roundabout, and must not proceed until it is safe to do so.
RA-4R, RA-4L	**PS-003 Series**	**Pedestrian Crosswalk Sign** The Pedestrian Crosswalk sign is used to indicate the location of a crosswalk. The right or left version of the sign is placed on either side of the crosswalk so that the pedestrian symbols are walking toward the centre of the road.
RA-5		**Special Crosswalk Overhead Sign** The Special Crosswalk Overhead sign indicates the location of a special crosswalk. This sign must be installed over the road.

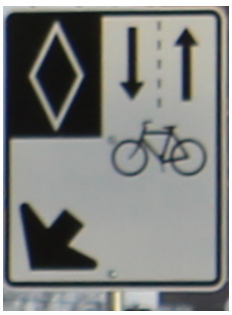
Regulatory Signs			
MUTCDC Sign Code	**BC Sign Code**	**Custom Signs**	**Description**
RA-4R, RA-4L 	**R-009 Tabs** 		**Except Bicycles Tab Sign** The Except Bicycles Tab Sign is used with Turn Control signs, Entry Prohibited signs and other regulatory signs, where bicycles are exempt from the specific regulation.
RB-37 		**Custom: City of Vancouver** 	**Turning Vehicles Yield to Bicycles Sign** The Turning Vehicles Yield to Bicycles sign may be used at conflict zones where motorists are required to cross a cyclist facility and are required to yield to the cyclist. The sign should incorporate the type of cycling facility present in the conflict zone (e.g. dashed bicycle lane lines, green paint, direction of travel etc.) Customized versions of the RB-37 sign with a supplemental 'Yield to Bicycles' tab have been developed by other municipalities (e.g., City of Vancouver) for improved visibility and readability.

Regulatory Signs			
MUTCDC Sign Code	**BC Sign Code**	**Custom Signs**	**Description**
RB-38 		**Custom (MassDOT)**  R10-15 alt.	**Turning Vehicles Yield to Bicycles and Pedestrians Sign** The Turning Vehicles Yield to Bicycles and Pedestrians sign may be used where motorists are required to cross or share a facility used by cyclists and/ or pedestrians and are required to yield to the cyclists or pedestrians. Customized versions of the RB-38 sign have been illustrated in other guidelines, such as the R10-15 alt. sign shown in the MassDOT guide.
RB-39 			**Yield to Pedestrians Sign** The Yield to Pedestrians sign may be used where cyclists are required to cross or share a facility used by pedestrians and are required to yield to pedestrians.

Regulatory Signs			
MUTCDC Sign Code	**BC Sign Code**	**Custom Signs**	**Description**
RB-90, RB-91			**Reserved Bicycle Lane Sign** The Reserved Bicycle Lane sign indicates that a lane is reserved for the exclusive use of bicycles. Reserved Bicycle Lane signs should be mounted either directly above (RB-90) or adjacent to (RB-91) the reserved lane. Reserved Bicycle Lane signs should be installed at a minimum of one sign between each intersection, with the first sign installed a maximum of 15 metres past the end of the curb radius. Signs should be installed at 200 metre intervals after the first signs. The City of Vancouver uses a CUSTOM regulatory sign with the skateboard decal at Protected Bike Lanes. The City of Vancouver Streets and Traffic By-Law No. 2849 was updated to include: *"Protected Bicycle Lane" means that a part of a roadway or path which is separated from motor vehicle traffic by a bicycle lane buffer and is designated by the City Engineer for use by persons on bicycles, non-motorized skates, skateboards, or push scooters.*

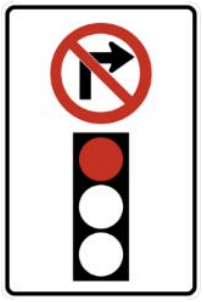




Regulatory Signs			
MUTCDC Sign Code	**BC Sign Code**	**Custom Signs**	**Description**
RB-92 			**Reserved Bicycle Lane Ends Sign** The reserved Bicycle Lane Ends sign must be installed at the end of the reserved lane denoting the end of the bicycle lane.
			**Reserved Bicycle Lane Begins Sign** The reserved Bicycle Lane Begins sign must be installed at the beginning of the reserved lane denoting the start of the bicycle lane.
			**Custom Reserved Bi-directional Bicycle Lane Sign** Custom signage for bi-directional protected bicycle lanes, such as the custom Reserved Bi-directional Bicycle Lane sign used by the City of Edmonton, may be used to further clarify the facility for cyclists and motorists.
RB-93 			**Shared Pathway Sign** The Shared Pathway sign indicates that both cyclists and pedestrians are permitted to use the path. This sign is often paired this sign with 'Bicyclists Yield to Pedestrians' (RB 39).

Regulatory Signs			
MUTCDC Sign Code	**BC Sign Code**	**Custom Signs**	**Description**
RB-94L  **RB-94R**  	**B-G-003-1 Series**  **B-G-003-1R Series**  **B-G-003-1L Series**  **B-G-003-2L**  **B-G-003-2 R Series**  	  	**Pathway Organization Sign** The Pathway Organization sign indicates to cyclists and pedestrians how to share a path on which there is a designated area provided for each.

Regulatory Signs			
MUTCDC Sign Code	**BC Sign Code**	**Custom Signs**	**Description**
			**Multi-Use Crossing Sign** The custom Multi-Use Crossing sign is used to indicate the location of a multi-use crosswalk.
			**Bicycle Signal Sign** The custom Bicycle Signal sign is used to inform people on bicycles and motorists of a bicycle signal.
			**Bicycles Use Pedestrian Signal Sign** The custom Bicycles Use Pedestrian Signal sign is used to inform people on bicycles and motorists that people cycling are to follow the pedestrian signals instead of the motor vehicle signals.

Regulatory Signs			
MUTCDC Sign Code	**BC Sign Code**	**Custom Signs**	**Description**
RB-17R 	**R-117-R** 		**Right Turn on Traffic Signal Prohibited Sign** The Right Turn on Traffic Signal Prohibited sign indicates to drivers that during the red traffic signal indication, they are not permitted to turn right.
RB-17L 	**R-117-L Series** 		**Left Turn on Traffic Signal Prohibited Sign** The Left Turn on Traffic Signal Prohibited sign indicates to drivers that during the red traffic signal indication, they are not permitted to turn left.

Warning Signs			
MUTCDC Sign Code	**BC Sign Code**	**Custom Signs**	**Description**
WC-20  **WC-20S**  			**Shared-Use Lane Single File Sign** Used to warn motorists and cyclists that cyclists are allowed full use of the lane ahead and to warn motorists that the lane is too narrow for side-by-side operation. Shared-use lane markings should be used to mark the location where cyclists should position themselves within the lane. **Single File Supplementary Tab Sign** The Single File supplementary tab sign (WC-20S) must be used to convey the meaning of this sign.
WC-19  **WC-19S**  	**W-132-1 Series**  **W-132-1 Tab**  		**Share the Road Sign** Used to warn drivers that they are to provide adequate driving space for cyclists and other vehicles on the road. **Share the Road Supplementary Tab Sign** The Share the Road supplementary tab sign (WC-19S) must be used to convey the meaning of this sign.

Warning Signs			
MUTCDC Sign Code	**BC Sign Code**	**Custom Signs**	**Description**
WC-44 			**Bicycle Trail Crossing Side Street Sign** The Bicycle Trail Crossing Side Street sign indicates to drivers that a bicycle path, which runs parallel and in close proximity to the through road, intersects a crossroad such that insufficient distance is available on the crossroad between the bicycle trail crossing and the through road for proper siting of the WC-7 sign.
WC-44T 			**Trail Crossing Tab Sign** The temporary Trail Crossing Tab sign is used for educational purposes after the WC-44 sign is installed.
WA-36L 	**W-054-L Series**		**Object Marker (Left)** The Object Marker (Left) is used to mark obstructions on the left side of the road or bikeway.

Warning Signs			
MUTCDC Sign Code	**BC Sign Code**	**Custom Signs**	**Description**
WA-36R	**W-054-R Series**		**Object Marker (Right)** The Object Marker (Right) is used to mark obstructions on the right side of the road or bikeway.
WA-36	**W-054-D Series**		**Object Marker** The Object Marker is used to mark obstructions adjacent to or within the road or bikeway, such as bridge piers and traffic islands.
WA-8	**W-014 Series**		**Checkerboard Sign** The Checkerboard sign indicates the termination of a road.

Warning Signs			
MUTCDC Sign Code	**BC Sign Code**	**Custom Signs**	**Description**
WC-43 			**Contraflow Bicycle Lane Crossing Sign** The Contraflow Bicycle Lane Crossing sign indicates to drivers that they are approaching a road with one-way vehicular traffic and two-way bicycle traffic. This sign is also installed on a laneway with compromised sight lines on the approach to a bi-directional separated bike facility.
WC-46 	**W-129-2 Series** 		**Pedestrian and Bicycle Crossing Ahead Sign** The Pedestrian and Bicycle Crossing Ahead sign indicates to drivers that they are approaching a location where a multi-use path crosses the road. The WC-7S Crossing Supplementary tab sign must be used to convey the meaning of the Bicycle Crossing Ahead sign.

Warning Signs			
MUTCDC Sign Code	**BC Sign Code**	**Custom Signs**	**Description**
WC-7R 	**W-129-1 Series** 		**Bicycle Crossing Ahead Sign** The Bicycle Crossing Ahead sign indicates to drivers that they are approaching a location where a bicycle path crosses the road.
WC-7S 	**W-129 Tab** 		**Crossing Supplementary Tab** The Crossing Supplementary tab sign must be used to convey the meaning of the Bicycle Crossing Ahead sign.

9.2 Pavement Markings

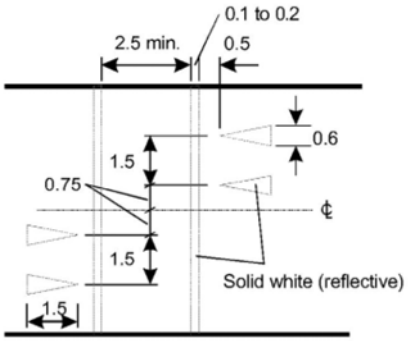
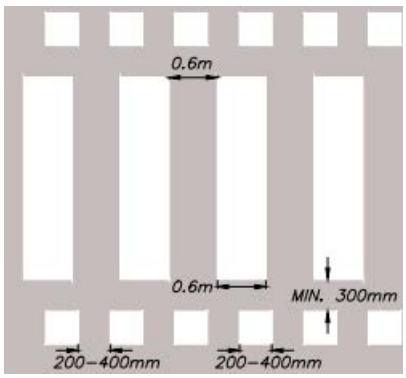
Pavement markings are an important element of the traffic control system for all road users. As stated in the *MUTCDC*, they serve a variety of functions, including defining lanes, separating opposing traffic flows, passing controls, lane usage and designation, pedestrian crosswalks, stop lines, parking areas, and symbol and word messages. Under favourable conditions, pavement markings convey information to the motorist, people walking, and people cycling without diverting their attention from the road or bikeway. However, they have limitations: they may be entirely covered by snow; they may not be clearly visible when wet; and they may have limited durability.

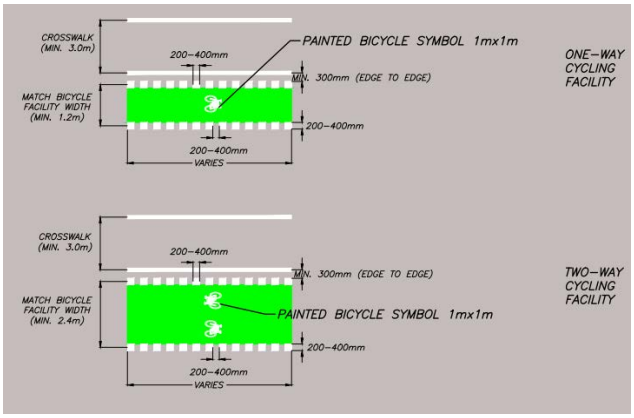
Pavement markings for bicycle and pedestrian facilities fall into three categories: longitudinal, transverse, and symbol markings. The principles for the design of pavement markings are outlined in Division C1 of the *MUTCDC*. Pavement markings must be uniform in design position and application. Pavement markings should be designed in accordance with the design standards in Division C1 of the *MUTCDC* as well as the *MOTI Manual of Standard Traffic Signs and Pavement Markings*. Design professionals are reminded that the pavement markings included here are not an exhaustive list.

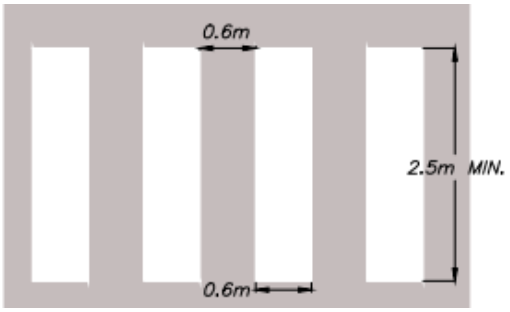
TransLink has also developed the BC Parkway Regulatory Signage and Pavement Marking Guidelines, which provides some guidance on the placement of wayfinding and etiquette signage.

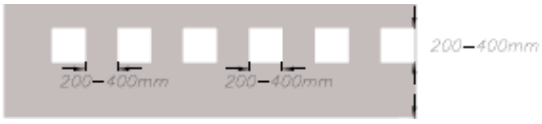
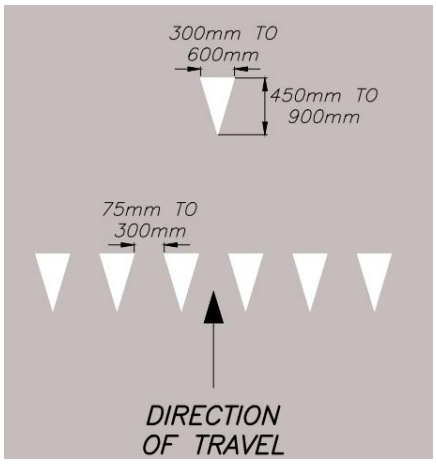
It is recommended that thermoplastic pavement markings are recommended and preferred over paint as they typically last longer.

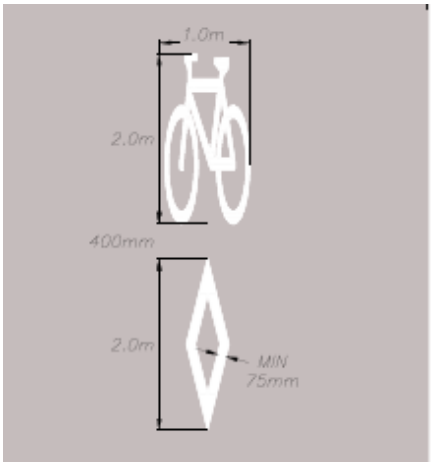
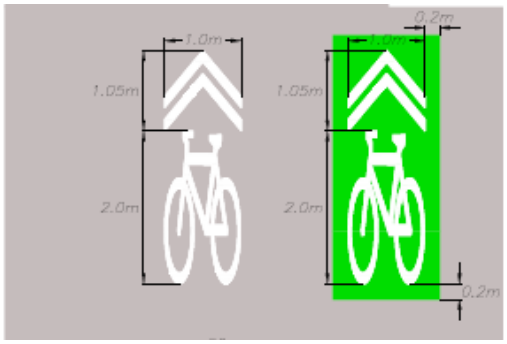
Name	Dimensions	Description
Longitudinal		
The longitudinal pavement marking widths shown in the figures indicate the desired widths. Acceptable ranges are noted in the table below.		
Bicycle Lane (Solid)		Delineates the edge of a travel lane dedicated for bicycle use where travel is permitted in the same direction on both sides of the line.
Bicycle Lane (Dashed)		Permits motor vehicles to cross the bicycle lane to perform a turning movement
Pathway Centre Line		Used to define a combined crossing area for people cycling and walking at multi-use pathways and on a separate bi-directional bicycle path. These markings are not sufficient by themselves and should always be used in conjunction with crosswalk signs or signals.

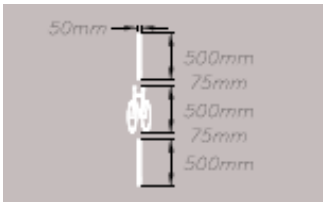
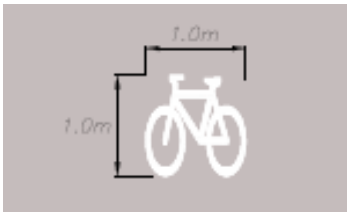
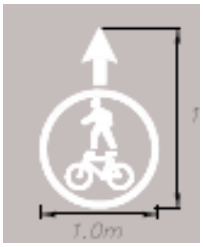
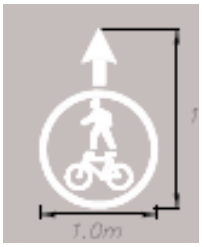
Name	Dimensions	Description
Transverse		
Triangular Pavement Markings (transitions to raised treatment)	 Pavement Markings (two-way street)	Pavement markings are used to identify the location of the transition to a raised intersection, crosswalk, or speed hump. These markings appear similar to the Advance Yield markings above but have a different size, spacing and triangle orientation.
Combined Cross-ride / Elephant's Feet at Zebra Multi-Use Crossing		Used to define a combined crossing area for people cycling and walking at multi-use pathways that cross where a zebra crosswalk would be installed. **Note:** The use of enhanced green pavement markings should not be used at multi-use crossings (combined cross-rides and crosswalks). The use of green should only be used for dedicated cycling facilities (see below).

Name	Dimensions	Description
	Transverse	
Cross-ride / Elephant's Feet and Crosswalk at Protected Bicycle Lane or Multi-Use Pathway Crossing		Used to define a street crossing area for people walking and cycling at a protected bicycle lane or separated multi-use pathway.
Twin Parallel Line Crosswalk		Used to define a crossing area for people walking at intersections with traffic control, such as traffic signals or stop control. Twin parallel line crosswalks can be combined with elephant's feet markings to indicate a shared-use crossing.

Name	Dimensions	Description
Transverse		
Zebra Crosswalk		Used to define a crossing area for people walking at uncontrolled intersections where heightened visibility is desired and at all mid-block crossings. Zebra crosswalk markings offer greater conspicuity than twin parallel line crosswalk markings and shall be used at all school crosswalk locations. Zebra crosswalk markings may be considered at locations with large numbers or percentages of older pedestrians or locations with high activity of pedestrians with mobility or visual impairments.
Stop Bar		Used to define the location for people on bicycles to stop.

Name	Dimensions	Description
	Transverse	
Cross-ride / Elephant's Feet at Twin Parallel line Multi-Use Crossing		Used to define a crossing area for people cycling at multi-use pathways. These markings are not sufficient by themselves and should always be used in conjunction with crosswalk signs or signals.
Advance Yield (Shark's Teeth)		Used in advance of marked or signed crossing to discourage the approaching vehicle from stopping too close to the crossing. Advance Yield markings also can be used to increase awareness that the approaching vehicle must yield to those in the crossing. Advance Yield pavement markings can be directed at either motor vehicle traffic or in bicycle facilities directed at people cycling.

Name	Dimensions	Description
Symbols		
Bicycle Symbol Reserved Use Lane		Pavement marking to indicate exclusive use of non-motorized vehicles. Symbols should be centered in the bicycle lane spaced at 75 m or as conditions dictate and approximately 10 m downstream from an intersection or crosswalk. Directional arrow markings may also be used to identify the correct direction of cyclist movement in a bicycle lane.
Bicycle Shared Use Lane Symbol (Sharrow)		Pavement marking to indicate shared use of the roadway with people on bicycles and motorized vehicles. Symbols should be spaced at a minimum 75 m and approximately 10 m downstream from all intersections. Green backed sharrows should be used where protected bicycle lanes merge into a shared-use lane and locations without physical protection where enhanced visibility is desired.

Name	Dimensions	Description
	Symbols	
Bicycle Detection Symbol		Pavement marking to indicate location of bicycle actuation loop. Symbol should be placed at the most sensitive area of detection.
Non-elongated Bicycle Symbol		Pavement marking used at conflict markings, bicycle pathway crossings, bicycle boxes or in two-stage turn boxes applications.
Custom Wayfinding Symbol		Wayfinding pavement marking to direct people on bicycles along bicycle routes.
Custom Multi-Use Wayfinding Symbol		Wayfinding pavement marking to direct people on bicycles and walking along multi-use pathways.

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