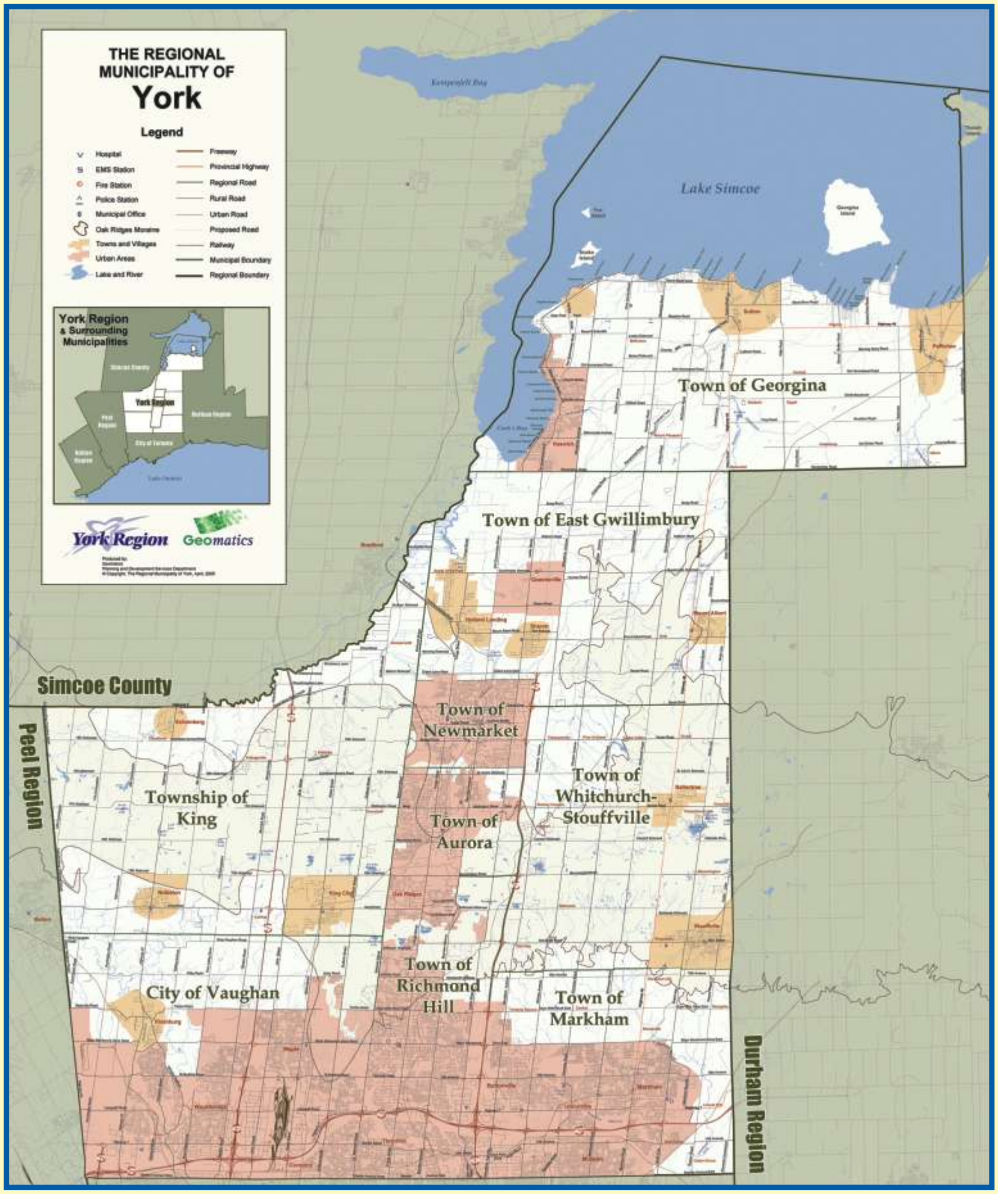
York Region

Pedestrian & Cycling Master Plan Study

Volume 2:
Planning & Design Guidelines



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Foreword

The Planning and Design Guidelines set out in this report were developed as part of the York Region Pedestrian and Cycling Master Plan. They are intended to guide the Region and its partners in improving pedestrian facilities and developing a regional-scale cycling network. These guidelines contain information and recommendations regarding typical planning and design solutions for pedestrian and cycling facility planning, design and implementation.

The guidelines were developed through an iterative process that involved an extensive review of guidelines and best practices from other municipalities and jurisdictions as well as input from Regional staff, York Region's Pedestrian and Cycling Advisory Committee and other stakeholders. Public input was used to identify guidelines for specific features of the master plan.

The Planning and Design Guidelines provide the Region of York with the tools necessary to design and implement a pedestrian and bicycle network that responds to what residents believe is needed to improve conditions for walking and cycling in York Region and is based on engineering and planning best practices.

The guidelines described in this report are intended to act as a general reference for pedestrian and cycling network planners, designers and the public. They are a carefully selected set of currently accepted design practices in North America and should be treated as a reference to be consulted during the development and construction of pedestrian and cycling facilities. Where appropriate, references are given to the most relevant detailed design standards and manuals, which include the details on currently accepted practices. These sources are identified in **Chapter 9.0**, and should be assumed by the Region as the primary reference for walking and cycling facility guidelines and standards in Ontario.

Disclaimer

The Planning and Design Guidelines are not intended to be used as a basis for establishing civil liability.

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CHAPTER 2.0 PLANNING CONSIDERATIONS

Chapter 1.0 Planning Considerations

The primary goal of the York Region Pedestrian and Cycling Master Plan (PCMP) is to create a well-connected, safe and functional pedestrian and cycling system that will encourage more people to become and remain interested in walking and cycling.

This can be accomplished by providing facility types that appeal to a wide range of users groups, skill and age levels, including a variety of on-road and off-road facilities such as bike lanes, sidewalks and multi-use trails.

1.1 User Categories

Since it would be impossible to plan and design a pedestrian and cycling network system for every individual users group, two primary users groups are assumed, one based on cyclists and one based on pedestrians. Most other users fall into one of these categories from a facility design perspective. However, there are some users that have special considerations which should be accounted for outside of the two primary design groups.

Guideline:

1.1 Planning and design of a regional pedestrian and cycling network should be primarily based on two design modes: cycle based and pedestrian based. Most other modes fall under these two categories.

1.1.1 Cycle Based

Cycle based users include most users that are on wheels. They can travel at higher rates of speed and require more space to manoeuvre than users who are on foot. Wheeled users are also typically willing or able to travel longer distances than those on foot, but are more susceptible to steep grades.

This group includes cyclists, those using scooters, in-line skaters and skateboarders.

1.1.2 Pedestrian Based

Pedestrian based users are primarily those who are travelling on foot. These users typically travel at lower speeds (with the exception of joggers) than cycle based users and generally require less manoeuvring space.

This group includes pedestrians, joggers, those requiring mobility aides to walk and people in wheelchairs. People in wheelchairs are included in this category because they tend to operate at speeds more comparable to pedestrians than to cyclists.

1.1.3 Skateboarders and In-line Skaters

These user categories require special consideration beyond the primary cycle based and pedestrian based categories. For example, skateboarders and in-line skaters are similar to cycle based users. However, they are more vulnerable to the effect of grades (both up and downhill), require more manoeuvring space and typically do not travel as fast. As a result, they may be able to use cyclist facilities but not in all cases or without adjustments to the design of a facility.

Guideline:

1.2 Skateboarders and in-line skaters have special design requirements which should be considered when designing a trail.

1.1.4 All Terrain Vehicle (ATV) Considerations

Since All Terrain Vehicles (ATV) are motorized vehicles and do not qualify as a sustainable mode of transportation, this document does not directly address their requirements in terms of trail planning and design. However, in rural areas of York Region, ATV's do and will likely continue to share some multi-use trails with users. As a result, there are a few general guidelines that should be given consideration when planning and designing mutli-use trails to ensure that all trail users are able to enjoy them in a safe manner:

- Signage should be installed, warning users of potential ATV traffic and vice-versa;
- Trails should be wide enough to allow ATVs to safely pass other trail users; and
- Trails should be patrolled and monitored to ensure that trail users are acting in a safe manner with respect to each other.

Guideline:

1.3 Although ATV's are not a sustainable mode of transportation, their requirements and interaction with users should be considered where ATV use is permitted.

1.2 Cycling Network Classification

The proposed network hierarchy for the cycling network portion of the PCMP consists of two systems:

- The primary "spine system"; and
- The secondary "community system".

The details of each system are discussed in the following subsection.

Guideline:

1.4 The cycling network portion of the York Region PCMP should consist of a primary "spine system", and a secondary "community system".

1.2.1 The Primary "Spine" System

The spine system will consist of cycling routes designed to provide direct links between major nodes and communities throughout York Region including commercial, employment, institutional, residential, tourist destinations and transit terminals and buses, serving as the "backbone" of the cycling network. Spine cycling routes are intended to serve utilitarian (commuter) cyclists, although recreational cyclists may and should be encouraged to use these routes as well.

The proposed spine system will consist primarily of on-road bike lanes, paved shoulder bikeways signed-only routes and some linear off-road multi-use trails. The cycling facilities encompassing the spine network would be located mainly on arterial roads to serve as a "higher-order" cycling network geared towards more experienced and confident cyclists. However, the spine network will also have segments of signed-only cycling routes (some with wide curb lanes) where space constraints will make retrofitting existing roads to accommodate dedicated bike lanes difficult and in most cases not economically feasible. **Chapter 3.0** of this document describes these bikeway facility types in more detail.

Guidelines:

1.5 The spine system should consist of routes designed to be direct and that support cycling for commuting purposes.

1.6 The spine network should be comprised mainly of on-road bike lanes, paved shoulder bikeways with some wide curb lanes and signed-only routes as well as linear off-road multi-use pathways, serving as a higher-order cycling network for experienced and confident cyclists.

1.2.2 The Secondary "Community" System

The purpose of the secondary community system is to provide connections between local destinations in a specific neighbourhood and "feed" them into the spine system. Community routes will typically be planned and implemented by Local Municipalities and Conservation Authorities and should be designed to serve both utilitarian and recreational cyclists. Routes along this system may be less direct than the spine system routes, and take advantage of quieter streets, providing links to local destinations such as schools, community centres, residential areas, local stores and commercial nodes, parks and recreational areas. The community system also provides an alternative to the spine system for longer-distance or primarily recreational cyclists who simply prefer a quieter cycling environment.

The proposed secondary community system may consist of bike lanes, signed-only routes on local residential streets, some with wide curb lanes, as well as off-road multi-use pathways. Bike lanes and paved shoulders should be provided where feasible, especially in new development areas.

Guideline:

1.7 The community system should consist of routes that lead into the spine system. Community system routes should connect local destinations such as schools, community centres, residential areas, local stores, commercial nodes, parks and recreational areas.

1.3 Pedestrian System Classification

The system hierarchy for the pedestrian-based portion of the PCMP will follow the same Primary (Spine) and Secondary (Community) hierarchy as the Cycling Network. The pedestrian system can be further broken down into three elements:

- The pedestrian zonal system;
- Connections between zones; and
- Key missing links within zones.

The details of each element are discussed in the following subsection.

Guideline:

1.8 The pedestrian-based portion of the York Region PCMP should consist of a pedestrian zonal system, which consists of connections between zones and key missing links within zones.

1.3.1 Pedestrian Zonal System

The pedestrian zonal system should consist of geographic zones of pedestrian facilities. A density of facilities and facility types are recommended for each zone in the PCMP, with zones further removed from the Regional Centres having a lower density of facilities. This reduction in facility density should be coincident with a reduction of population and employment density. This system of zones will allow infrastructure to be placed where it is most needed, without ignoring areas that require less infrastructure. Areas contained within pedestrian zones should receive first priority in terms of investment in pedestrian infrastructure, while general policies should oversee the development of pedestrian infrastructure outside of the zones.

Guideline:

1.9 The pedestrian zonal system should consist of geographic zones of pedestrian facilities that see increased pedestrian infrastructure as one gets closer to schools, Regional Centres and transit nodes.

1.3.2 Connections Between Zones

Zones should be connected by supportive pedestrian links to encourage longer distance trips across zonal boundaries. This could include such measures as improving the pedestrian experience along arterial roads by widening or adding sidewalks, or by moving sidewalks back from the roadway to increase the distance between pedestrians and vehicular traffic. These links should be capable of handling relatively large volumes of pedestrian traffic.

Guideline:

1.10 Pedestrian zones should be connected to encourage longer and more frequent trips across zonal boundaries.

1.3.3 Key Missing Links Within Zones (Sidewalks)

While the pedestrian zonal system should dictate the density of links and facilities that are provided within the pedestrian system, it is important to identify missing links in the system that are of such importance that they deserve extra consideration. This could include an arterial road that services a school, but does not have any pedestrian facilities. Identifying key links that are missing can help to move them higher on the list of infrastructure priorities. The pedestrian component of the PCMP focuses primarily on missing sidewalk links on regional roads.

Guideline:

1.11 Key missing links within pedestrian zones should be identified so they may be scheduled as high infrastructure implementation priorities.

1.4 User Characteristics

A successful pedestrian and cycling network should provide a well-defined and comfortable environment for all its anticipated users. It is therefore important to identify the primary target groups for whom the facility is being designed. While there are a wide range of skill and age levels and considerable variation in typical trip length and purpose, from a planning perspective, users can generally be grouped according to age, skill level, trip purpose and whether they are in an urban, suburban or rural environment. In the Region of York, consideration should also be given to the needs of tourists who may choose to walk or cycle to enjoy the many attractions and natural amenities that the Region of York has to offer.

1.4.1 Age

A successful pedestrian and cycling network should account for the needs of all users, young and old. As people age, their needs shift between utilitarian and recreational, short-distance and long distance trips.

While cyclists can be of all ages, different age groups typically have different needs. Children may cycle to their school or to local recreational facilities, or for other short distance trips, but are unlikely to go on longer trips. Many children also cycle for recreational purposes.

Adults are more likely to cycle for longer trips, and some will use a bicycle as a commuting option. As adults age, they tend to move more toward cycling for fitness and recreation.

With respect to pedestrians, walking skill levels tend to vary between younger and older people. Children are less likely to travel alone on streets other than their local neighbourhood streets than are adults. Most parents will not allow children to walk along, or cross, busy roads without adult supervision. Thus if children are to be attracted to a pedestrian system, it is important for links to be created on residential side streets with clear sightlines and moderate traffic volumes and speeds. Children are also more prone to unpredictable behaviour, and therefore require a higher order of attention with regards to safety.

For the elderly, crossing wide streets can be difficult, especially if the pedestrian signals do not allow enough clearance time for seniors to make their crossing. By providing alternative links away from busy, wide arterial roads, or introducing refuge islands to permit two-stage crossings of wide roads, more seniors are likely to use the system.

1.4.2 Skill Level

Generally speaking, pedestrian and cycling facilities should consider the needs of users of all skill levels. However it should be recognized that a master plan which is aimed towards experienced users will likely intimidate inexperienced users, who then lose any benefit of the plan.

A plan that is aimed toward inexperienced users will attract few additional experienced users. Since the experienced users are likely already using the existing system and typically have preferred routes, they are unlikely to deviate from their usual patterns.

An effective plan should be for the most part designed for new and inexperienced users, but still provide good links for experienced users. With respect to cyclists, less skilled, casual riders tend to cycle for recreation more often than utility, typically stay within their local neighbourhood and will usually avoid busier roads until they gain sufficient confidence and skill. They typically favour easier cycling conditions, such as trails or routes that are relatively flat and have good surfacing. They are more easily discouraged from cycling by poor conditions than experienced riders.

Experienced riders tend to cycle more frequently than casual riders and will typically use the network for both utilitarian and recreational purposes. Experienced cyclists are not averse to using busy roads, but prefer to make use of wide shared curb lanes and on-street bike lanes in urban areas. When making use of off-road trails, they prefer a wide range of conditions that will offer a challenging experience.

1.4.3 Trip Purpose

Recreational users are more likely to use the system for fitness, leisure or touring, while utilitarian users are more likely to use the system to reach specific destinations such as places of employment.

There are several barriers that may deter recreational users from becoming utilitarian users. Weather is a major factor, as the general climate of York Region is not conducive to most users during winter and parts of the fall and spring. A lack of trip end facilities is another factor. Proper workplace showering, changing, and lock-up facilities are essential in encouraging increased utilitarian use of the system. Another factor is trip distance. Most users are only willing to travel a relatively small distance (this is more pronounced for pedestrians than for cyclists). To overcome this, network facilities should provide links to other transportation modes, most notably public transit. Trip end facilities and linking walking and cycling with public transit are discussed further in **Chapter 6** and should be a priority for the Region of York.

1.4.4 Urban – Suburban / Rural

The use of the network will differ between urban / suburban users and rural users. Since urban / suburban users typically live closer to their destinations than their rural counterparts, they are more likely to make short trips and utilitarian trips. Urban and suburban systems will generally have a higher order of infrastructure than rural systems due to a higher density of users. Urban and suburban systems should have more bike lanes, signed routes and sidewalks, while rural systems may have more roads with wide paved shoulders (which could be used by both cyclists and pedestrians) and off-road trails.

Chapter 2.0 Design Parameters

Careful consideration should be given to the physical, aesthetic and environmental requirements for each type of pedestrian system or cycling route. The appropriate balance of these requirements will ensure a network has a suitable level of comfort and safety in an appealing setting. Each of these elements is outlined in this section with appropriate guidelines for network design.

2.1 General Considerations

Different modes generally require different manoeuvring envelopes. Manoeuvring envelopes also vary based on the intended use of the facility.

Multi-use trails which are intended for users of various skill levels and modes will generally have a greater clearance than a trail that is intended to provide a challenging, natural hiking experience. **Figure 2.1** illustrates various measurements of clearance on multi-use trails.

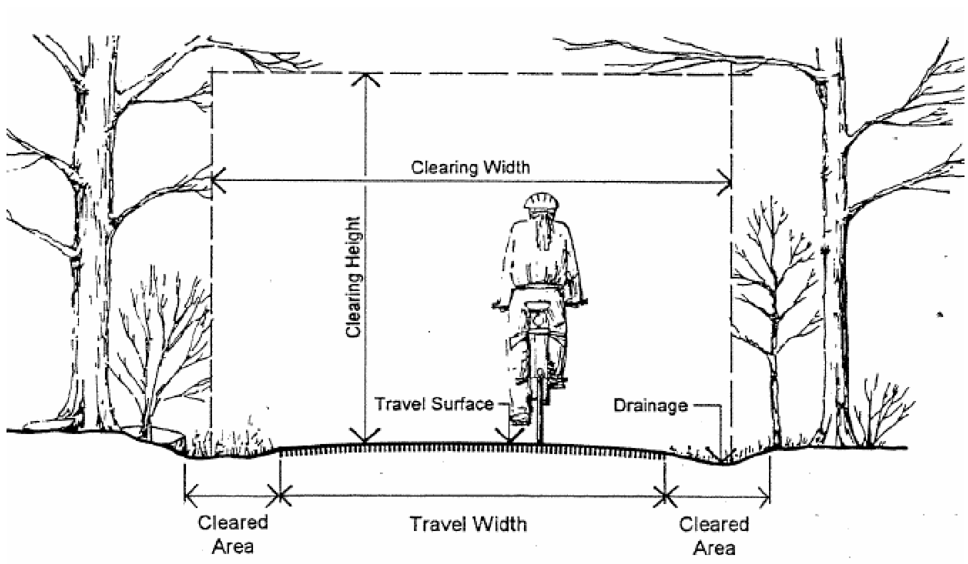

Figure 2.1 Cross-Section of a Typical Multi-Use Trail

With respect to pedestrians, the minimum recommended operating space allowance for a pedestrian or a wheelchair user is 1.2 m. The desirable minimum space allowance is 1.5 m.

Guideline:

2.1 The recommended minimum horizontal space for a pedestrian or a wheelchair user is 1.5 m

The minimum recommended operating space for an in-line skater is 2.3 m. This is based on the average pedestrian space requirement, plus an additional manoeuvring allowance of 0.4 m on either side. The manoeuvring space allows for a typical in-line skater to avoid hazards and provides room for the natural meandering of the activity. **Figure 2.2** illustrates the typical operating envelope for an in-line skater.

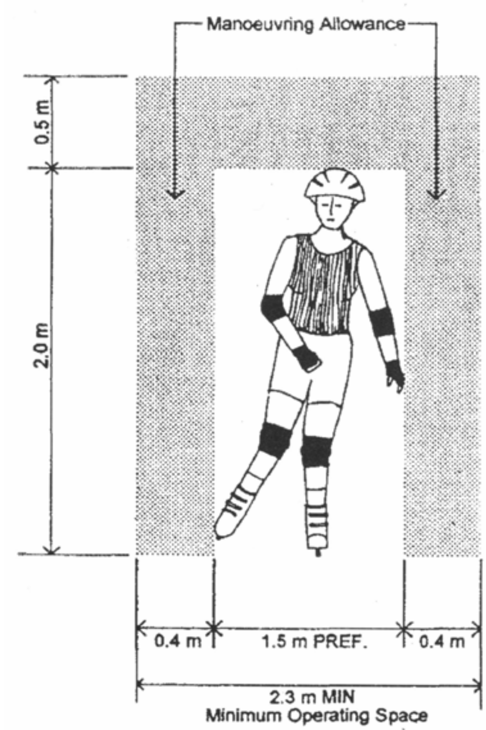

Figure 2.2 In-Line Skater Operating Spaces
Source: Design, Signage and Maintenance Guidelines, Waterfront Regeneration Trust, 1997

Guideline:

2.2 The recommended operating space that should be allocated for an in-line skater is 2.3 m of horizontal clearance, and 2.5 m of vertical clearance. Trails accommodating two-way travel should be a minimum of 3.0 m, or 4.0 m where frequent in-line skating is expected.

Bicycles are distinct from all other modes of transport and are the lightest and smallest vehicles on the road network. To assure safety and comfort, the design of cycling facilities should account for the amount of space required by a moving cyclist.

The Transportation Association of Canada's (TAC) Geometric Design Guide for Canadian Roads (1999) suggests that for design purposes, the following dimensions of a bicycle should be used:

- Length: 1.75 m
- Width at pedals: 400 mm
- Height to lowest pedal position: 100 mm
- Width at handlebars: 800 mm
- Height to handlebars: 1.25 m
- Height to top of seated rider: 2.0 m.

The operating envelope for a cyclist consists of the actual space occupied by a bicycle and cyclist (typically 0.7 m wide by 2.0 m high). It includes an operating space allowance to accommodate the natural side to side movement of a cyclist plus variations in bicycle tracking (0.4 m each side plus 0.5 m above the cyclist). This translates into a minimum recommended width for a uni-directional cycling lane of 1.5 m for roadways with low speed and moderate traffic volumes.

For off-road trails, a minimum width of 1.5 m per direction is recommended to accommodate a cyclist's movement. For bi-directional trails, a desirable minimum width of 3.0 m should be provided to accommodate two-way cycling traffic.

Because two cyclists passing each other in opposite directions benefit from a shared central 0.4 m manoeuvring allowance, the minimum recommended operating space allowance for two way traffic is 2.6 m. This is one of the many reasons why cycling on standard width sidewalks (1.5 m) should not be permitted or encouraged (with the exception of young children). **Figure 2.3** illustrates TAC's recommended design dimensions that define the operating space for cyclists for on and off-road trails.

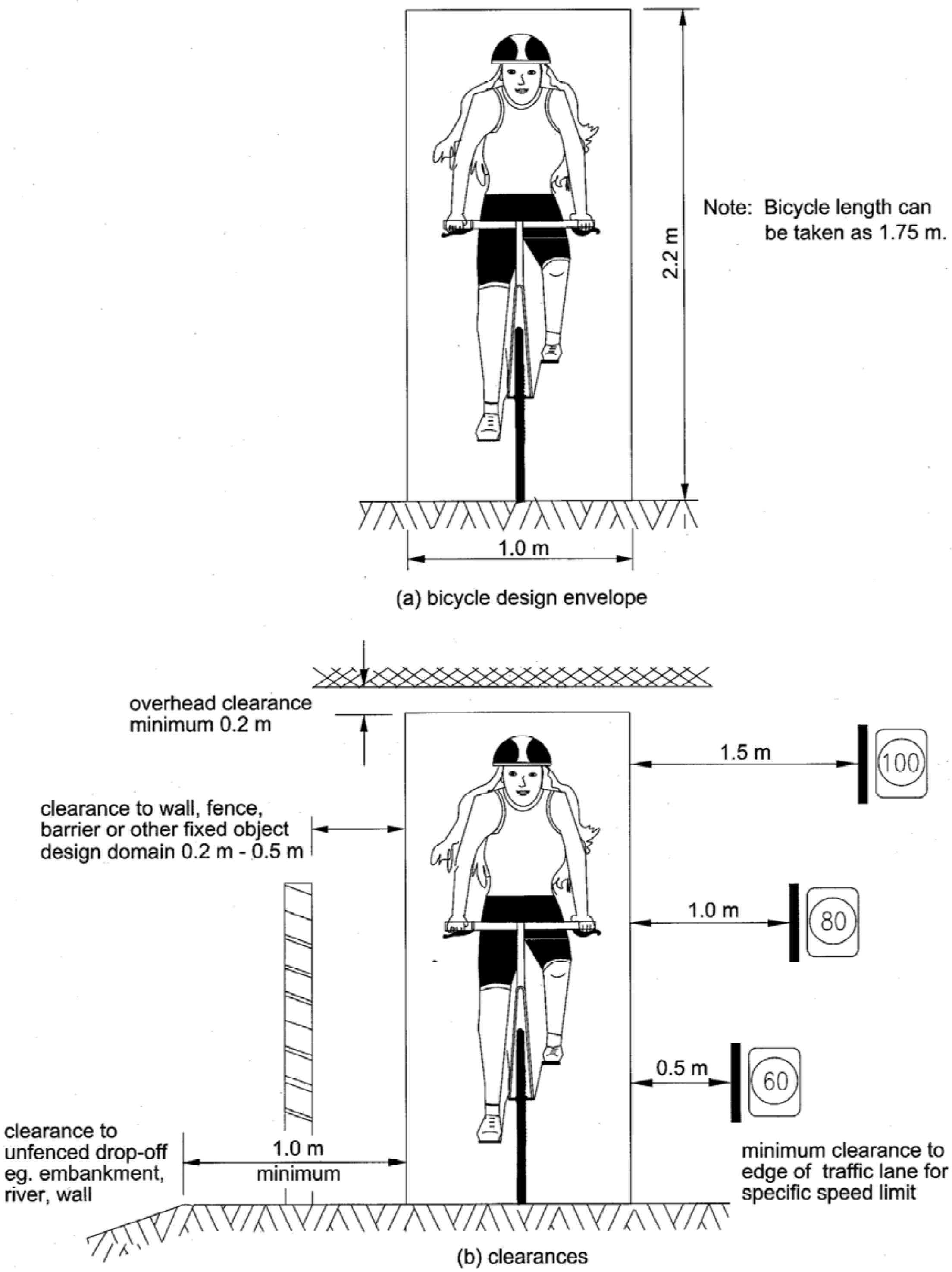

Figure 2.3 Operating Envelope for Cyclists
(TAC, 1999 – Figure 3.4.2.1)

In designing cycling facilities, it is important to understand that geometric design considerations for on-road bikeways are typically governed by roadway design criteria. In Ontario, the Ministry of Transportation of Ontario (MTO) Geometric Design Standards for Ontario Highways (GDSOH, ITH), and the Transportation Association of Canada's (TAC) Geometric Design Guide for Canadian Roads (1999) and Bikeway Traffic Control Guidelines for Canada (1998) are the primary references for roadway design, along with York Region's own design standards.

Although roadway design standards set out in these references typically exceed the requirements for on-road cycling facilities, the operational aspects of on-road cycling should be understood.

Off-road cycling facilities, particularly multi-use trails outside of a road right-of-way should be designed to accommodate cyclists of all skill levels and ages. Key criteria associated with the design of off-road cycling routes include bicycle operating speeds, horizontal and vertical curvature, width, clearances, gradients, sight distances, superelevation, crossfall and drainage.

Guideline:

2.3 The recommended minimum operating clearance width for a cyclist is 1.5 m for on and off-road one-way travel and 3 m to accommodate two-way travel on off-road trails.

2.1.1 Gradients

There are two major considerations when designing grades: the effort to ascend or climb, and conditions required for safe descent. Guidelines for gradients differ between on-road systems and off-road systems.

With respect to on-road systems, it is widely accepted that pedestrians can stop almost immediately while travelling on foot, regardless of the type of grade on which they are travelling. Therefore, when designing grades for the system, the factor that is thought to best define the maximum grades permitted for all users is based on those for a cyclist or in-line skater.

For cyclists without a gear-shifting system, it is almost impossible to climb a 50 m long 10% grade. Bicycles equipped with simple gear-shifting systems allow almost every cyclist to climb a 50 m 15% grade. However, grades greater than 5% should normally be avoided, while it is desirable for grades to be less than 3%, especially long uphill grades. Where possible, on long steep grades, it is desirable to introduce relatively flat rest areas approximately every 100 metres of horizontal distance.

Figure 2.4 illustrates the relationship between acceptable grade and grade length.

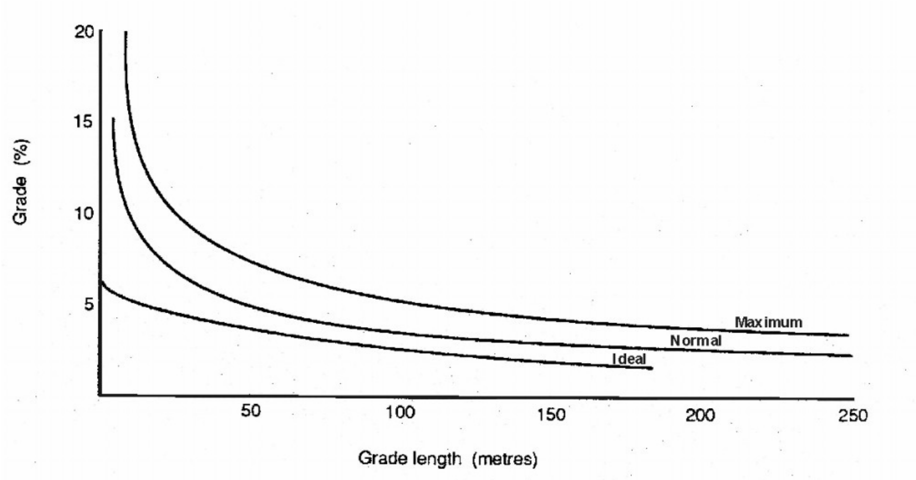

Figure 2.4 Acceptable Grades for Design Purposes
Source: Balshone, L. Bruce, Bicycle Transit: Its Planning and Design, Proeger, New York 1975

Where one-way bicycle operation is proposed and cyclists will be travelling in the downhill direction, steeper and/or longer grades are not as much of a concern. It should be recognized; however, that speeds and stopping distances increase when travelling downhill and that the available sight distances must be checked accordingly.

Most cyclists, especially utilitarian cyclists, prefer to ride on relatively flat routes to avoid climbing hills. When hills must be climbed, cyclists tend to require a wider operating area to accommodate the increased side-to-side movement or “wobble” that often occurs when exerting the additional effort necessary to power up a hill.

With respect to on-road cycling routes, many recreational cyclists often prefer moderate variations in topography (rolling hills) when cycling.

For on-road facilities proposed to have paved shoulders or bike lanes, this means that an additional clearance width of 0.5 m should be added to the 1.5 m to 1.8 m paved shoulder or bike lane on steep hills with grades exceeding 8%, where feasible. This should be undertaken in conjunction with road right-of-way standards.

In the Region of York, there may be segments of proposed cycling routes where it is difficult to accommodate even a minimum 1.2 m paved shoulder or bike lane. In these cases, wide curb lanes should be provided as an interim measure to mark as much additional shoulder or “lane” width as possible for cyclists and motor vehicles to use. On roads where sight lines are also an issue because of the horizontal or vertical curvature of the road, additional cautionary signs may be warranted to restrict passing manoeuvres.

Reducing the posted speed limit may be another alternative when a particular road segment experiences high motor vehicle volumes and/or commercial vehicle traffic.

Guidelines:

2.4 When conditions permit, an additional 0.5 m should be included in the width of the paved shoulder or bike lane for on-road facilities where the grade of the road approaches or exceeds 8%, where possible (1.5 m + 0.5 m = 2.0 m)

2.5 When grades exceed 8% and/or are in constrained situations, either wide curb lanes or signed-only routes (descent) and Share the Road signs (ascent) may be considered.

2.6 On steep road segments where motor vehicle volumes or the percent of commercial traffic exceed a desirable threshold for a cycling facility type, consideration may also be given to reducing the posted speed limit or selecting an alternative route for cyclists.

With respect to off-road systems, all off-road trails and pedestrian routes should be designed so that they are accessible for cyclists and pedestrians, including pedestrians using wheelchairs, scooters and other mobility devices where feasible. An exception may be for footpaths and hiking trails, which are typically not wheelchair or cyclist accessible. Grades in excess of 5% should be avoided for off-road cycling and pedestrian routes.

The grades on which an in-line skater can safely operate depends upon the level of expertise of the individual. A beginner can comfortably traverse slopes of no more than 3%, while an expert may be able to manage slopes in excess of 10% for short distances. Grades on routes for which in-line skating is permitted should generally be handled by skaters based on skating "ability". **Table 2.1** identifies appropriate grades for in-line skaters based on their skating ability.

Table 2.1
Appropriate Grades for In-Line Skating

Gradient	Maximum Distance	Ability of Skater
1% - 3%	100 m	Beginner / Novice
3% - 5%	100 m	Beginner - Intermediate
5% - 10%	100 m	Experienced
>10%	Evaluation Required	N / A

Source: In-Line Skating Review – Phase 2 – Final Report, TAC, 1997

It is expected that in-line skaters would share trails with other pedestrians and cyclists. Thus, the determining factor for a suitable maximum grade for an off-road trail should be based on the requirements for wheelchair users. Therefore, the maximum grade on an off-road trail should be based on requirements for wheelchair users. Therefore, the maximum grade on an off-road trail should not exceed 5% grade.

In locations where steep grades cannot be avoided, such as in environmentally sensitive areas where recommended grades cannot be implemented without extensive cut or fill procedures, steps and ramps should be provided nearby as alternate routes.

Guidelines:

2.7 All off-road pedestrian and cycling routes (with the exception of footpaths and hiking trails) should be designed in such a way that they are accessible to cyclists, pedestrians, and those using mobility devices.

2.8 Grades in excess of 5% should be avoided wherever possible on accessible trails or those intended for inexperienced users.

2.9 Steps and ramps should be provided along routes where steep grades cannot be avoided.

2.1.2 Design Speed

With respect to on-road systems, the standard operating speed for a pedestrian is 1.2 m/second(s). This ranges from 1.0 to 1.5 m/s depending on the age and mobility of the pedestrian.

Most recreational cyclists can maintain a speed of 20 to 25 km/hour, while utilitarian and fitness-oriented cyclists usually travel at higher speeds. In order to ensure that the trail system is safe for all users, a minimum design speed of 40 km/h should be provided. On descents with steeper grades (exceeding 4%), the design speed should be increased to 60 km/h, if possible.

It should be noted that on-street cycling facilities utilize existing roadways, which are generally constructed to a design speed of 70 km/h to 100 km/h for motorized vehicles (20 km/h over the posted speed limit). For these roads, sight distances and curvatures should, in most cases, exceed the minimum cycling route design parameters. In addition, in the majority of cases, a cyclist's or skater's line of sight will be above that of the driver in a typical automobile. Therefore, the cyclist or skater will actually be able to observe hazards at a greater distance than a motorist.

Although the design speed for a cyclist is not a significant factor for roadway construction, consideration may need to be given to some roads in the Region that are sub-standard and have significant horizontal and/or vertical curves that may pose potential hazards for cyclists. Modifications to the roadway geometry should be made as required before being designated as part of the cycling network.

Guidelines:

2.10 When designing off-road cycling facilities, the minimum design speed considered should be 40 km/h to ensure that the network is safe for all users. On descents with steeper grades (exceeding 4%), the design speed should be increased to 60km/h, if possible.

2.11 Roadway design characteristics such as sight-distances and curvatures exceed cycling route design parameters. However, special design considerations should be given to any existing or proposed roads that do not meet the minimum design parameters for a cyclist or may pose a potential hazard to on-road users.

2.12 Although new or improved Regional roads will typically be designed to the Region's roadway standards and thus exceed the minimum design parameters related to speed for pedestrian and cycling facilities, some existing roads may not. In these cases, additional signing should be considered when implementing on-road facilities.

For off-road multi-use recreational and boulevard trails, to ensure that off-road routes are safe for all users, a minimum design speed of 30 km/h should be provided. On descents with steeper grades (exceeding 4%), the design speed should be increased to 50 km/h.

This design speed is expected to be adequate for all anticipated off-road network users, such as cyclists, pedestrians, in-line skaters and those using mobility devices such as wheelchairs and strollers.

Guideline:

2.13 When designing off-road cycling facilities, the minimum design speed considered should be 40 km/h to ensure that the network is safe for all users. On descents with steeper grades (exceeding 4%), the design speed should be increased to 60 km/h.

2.1.3 Site Distance

The design of both on-road and off-road system facilities should take into consideration minimum stopping sight distance for pedestrians, motor vehicles and bicycles.

On-road facilities would not typically be required for pedestrians since they would be accommodated on the sidewalk. However, proper crossing treatments must be provided to ensure that pedestrians can safely cross roads at intersections or at mid-block crossings. **Sections 4.7 and 4.8** identify recommended crossing treatments for pedestrians at intersections and mid-block crossings, respectively.

On-road cycling facilities should typically be located on roads that provide for adequate sight lines to accommodate the minimum stopping distance required for motor vehicles. Minimum stopping sight distance is the least visible distance required by a driver to bring the vehicle to a stop before reaching an object in the vehicle's path. In another words, motorists approaching a pedestrian or cyclist on or crossing a road must be able to see a pedestrian or cyclist at a sufficient distance. This is necessary so that a motorist can effectively make the decision on when to pass a cyclist or when to stop in the event the cyclist has fallen or is blocking part or all of a travel lane, or when a pedestrian is crossing the street.

MTO's Geometric Design Standards for Ontario Highways (GDSOH, 1994) provides minimum stopping sight distances for a range of design speeds that are based on a driver's perception time of 1.5 seconds, reaction time of 1.0 second and longitudinal friction values for wet pavements. **Table 2.2** sets out MTO's minimum motor vehicle stopping sight distances based on speed.

Table 2.2
Minimum Motor Vehicle Stopping Sight Distance on Wet Pavement

Speed (v)		Perception and Brake Reaction		Coefficient of friction on wet pavement	Braking distance on level ground	Minimum Stopping Sight Distance (S)	
Design	Assumed Conditions	Time	Distance			calculated	rounded
Km/h	Km/h	s	m	f	m	m	m
40	40	2.5	28	0.380	17	45	45
50	50	2.5	35	0.358	27	62	65
60	60	2.5	42	0.337	42	84	85
70	70	2.5	49	0.323	60	109	110
80	79	2.5	55	0.312	79	134	135
90	87	2.5	60	0.304	98	158	160
100	95	2.5	66	0.296	120	186	185
110	102	2.5	71	0.290	141	212	215

Source: Geometric Design Guide for Canadian Roads, TAC, 1999.
(TAC - Table 1.2.5.3)

Although all new roads should be designed in conformance with these minimum standards, it is recognized that some existing roads in the Region of York may not. For road designs in which there are a number of severe physical constraints due to topography, environmental or right-of-way constraints, roadway designers may need to compromise on one or more of the standards. If stopping sight distance is sub-standard, the driver may not see an object in time to come to a safe stop. However, the driver may be able to steer around the object or sufficiently reduce speed to minimize damage or injury. Additional signing to caution both motorists and cyclists should be considered. **While sub-standard design is to be avoided and is not advocated, if it is dictated by other constraints, the consequences should be clearly understood and based on good engineering judgement.**

Stopping sight distances for off-road trails should be governed by the distance required for cyclists since pedestrians can typically stop immediately while walking or jogging, regardless of the trail configuration. Although wheelchair users cannot typically stop as immediately as pedestrians, the distance required for persons in wheelchairs or other mobility devices is less than that required for a cyclist since persons using these mobility devices do not travel as fast as cyclists. Therefore, basing stopping distance on the distance required for a cyclist would in essence accommodate all other expected network users. The minimum stopping sight distance for cyclists, both on-road and off, is the distance required to bring a bicycle to a full controlled stop upon spotting an obstacle. It is a function of the cyclists' perception and reaction time prior to braking, the initial speed of the bicycle, the coefficient of friction between the tires and the trail surface, and the braking capacity of the bicycle.

The stopping sight distance is given by the formula:

$$S = 0.694V + V^2 / 255 (f + G/100)$$

Where: S = stopping sight distance, m

V = speed (km/h)
f = coefficient of friction
G = grade, % (upgrade +, downgrade –)

Table 2.3 illustrates minimum stopping sight distances for a range of speeds and grades for bicycles. It is based on 2.5 seconds of perception-reaction time and a coefficient of friction (f) of 0.25 that accounts for paved surfaces during wet weather plus typical braking characteristics of bicycles. The coefficient of friction for unpaved surfaces should be reduced to 50% of those for paved surfaces.

Table 2.3
Minimum Sight Stopping Distances

Grade %	Design Speed (km/h)								
	10	15	20	25	30	35	40	45	50
Minimum Stopping Sight Distance (m)									
+12	8	13	18	-	-	-	-	-	-
+10	8	13	18	24	-	-	-	-	-
+8	8	13	19	25	32	-	-	-	-
+6	8	13	19	25	32	40	-	-	-
+4	8	13	19	26	33	41	49	-	-
+2	8	14	20	26	34	42	51	61	-
0	9	14	20	27	35	44	53	63	74
-2	9	14	21	28	36	45	55	66	77
-4	9	15	21	29	38	47	58	69	81
-6	9	15	22	30	39	50	61	73	86
-8	9	16	23	32	42	53	65	68	92
-10	10	16	24	34	44	56	70	84	100
-12	10	17	26	36	48	61	76	92	110

Source: Geometric Design Guide for Canadian Roads, TAC, 1999.
(TAC Table 3.4.5.1)

Guideline:

2.14 The design of off-road cycling and pedestrian systems should take into consideration stopping sight distances for bicycles and wheelchairs.

2.2 Alignment Elements

The alignment elements discussed in this section are based on the requirements for cyclists since bicycle operations typically define the alignment elements of an on-road or off-road route. In general, route alignments for cyclists would also be sufficient for pedestrians and in-line skaters. Routes intended primarily for pedestrian use can have lower minimum standards, especially with regard to horizontal curves.

2.2.1 Horizontal Alignment

With respect to horizontal alignments, the design of on-road cycling facilities is typically governed by the controls and design considerations for accommodating motor vehicles.

The horizontal alignment of a roadway is the configuration of tangents plus circular and spiral curves.

Controls such as design speed, classification, topography, climate, traffic volumes and soils will influence the horizontal alignment of the roadway. Design considerations such as safety, driver expectation, cost, aesthetics and environmental factors are also taken into account.

Roadway design standards set out in the Geometric Design Standards for Ontario Highways (GDSOH) and the TAC Geometric Design Guide for Canadian Roads (GDGCR) with respect to horizontal curves, exceed the minimum requirements for cyclists.

Although a number of existing roadways in the Region of York proposed for bicycle facilities may not have been designed to current standards, it is expected that the existing horizontal alignment should be adequate to accommodate cyclists. Where this condition does not occur, appropriate signing should be considered.

The minimum radius of a curve on an off-road route depends on the bicycle speed, super-elevation and coefficient of friction between the bicycle tires and the bikeway surface. The following formula should be used to determine the minimum radius of horizontal curves:

$$R=V^2 / (127 \times (e + f))$$

Where: R = radius, m
V = speed, km/h
e = super-elevation, m/m
f = coefficient of lateral friction.

For most applications and conditions, the coefficient of lateral friction varies from 0.3 at 25 km/h to 0.22 at 50 km/h, and for unpaved surfaces is reduced to 50% of those of paved surfaces. **Table 2.4** provides the coefficient of lateral friction and minimum radius for a range of design speeds and super-elevation rates. Horizontal curves must be of sufficiently large radius to ensure that cyclists can safely negotiate the curve at the design speed. When horizontal curves are of very small radius, bikeway widening should be considered to compensate for the tendency of cyclists to track toward the inside of the curve.

Table 2.4
Minimum Radii for Paved Trails

Design speed, km/h	Coefficient of lateral friction	Minimum radius, m	
		e=0.02 m/m	e=0.05 m/m
25	*0.30*	*15*	*14*
30	*0.28*	*24*	*21*
35	*0.27*	*33*	*30*
40	*0.25*	*47*	*42*
45	*0.23*	*64*	*57*
50	*0.22*	*82*	*73*

Source: Geometric Design guide for Canadian Roads, TAC, 1999.
(TAC Table 3.4.5.2)

Widenings are not necessary for curves over a 32 m radius, and will therefore not usually be a consideration for on-street routes. **Table 2.5** shows the recommended widening of the riding surface on curves.

Table 2.5
Widening of the Riding Surfaces on Curves

Curvature (m)	Extra width required (grade = 0 to 3%)
24 to 32	*250 mm*
16 to 24	*500 mm*
8 to 16	*750 mm*
0 to 8	*1,000 mm*

Source: Technical Handbook of Bikeway Design, Velo Quebec, 1992.
(Table 4.5, pg. 52 of Source)

Horizontal curves must also be checked to ensure that there are no obstructions located on the inside of the curve, which could block the cyclists' line of sight and reduce available stopping sight distance. Vegetation should be cut back such that it does not obscure the line of sight around a curve.

Guidelines:

2.15 Horizontal curves of roads proposed for on-road bikeway facilities should conform to roadway design standards set out in the Geometric Design Standards for Ontario Highways (GDSOH) and/or the TAC Geometric Design Guide for Canadian Roads. When this condition cannot be met, additional cautionary signing should be introduced.

2.16 Consideration should be given to providing additional width on off-road bikeway segments at curves that have less than a 32 m radius.

2.2.2 Vertical Alignment

With respect to on-road facilities, the vertical alignment or profile of a roadway defines the vertical dimension of the facility. In roadway design, standards regarding gradients, cross-slope, location of passing and climbing lanes, vertical curves and clearances are defined by both MTO and TAC (Geometric Design Standards for Ontario Highways (GDSOH).

Generally, all vertical alignment standards with respect to roadway design are based on accommodating motor vehicles, and exceed the requirements for bicycles. However, due to its natural geography, there may be a number of existing roadways in the Region of York that do not meet current standards. However, it is still expected that the vertical alignment of sub-standard roads will still be adequate to accommodate cyclists.

With respect to off-road facilities, the minimum length of crest vertical curves for off-road bicycle routes depends on the minimum stopping sight distance for the design speed of the facility. This is calculated to satisfy the safety requirements of bringing a bicycle from full speed to a full stop when an obstacle is spotted on the cycling surface. **Table 2.6** shows vertical curve lengths for different design conditions for paved surfaces under wet conditions. Stopping sight distances for unpaved surfaces should be adjusted accordingly to satisfy reduced lateral friction conditions equal to 50% of those for paved surfaces.

Above the line, stopping sight distances are greater than the curve length, and L=2S-274/A, where S = the minimum stopping sight distance from **Table 2.3**, A = the algebraic difference in grades in %. Below the line, stopping sight distances are less than the curve length and $L=AS^2/274$.

Table 2.6
Crest Vertical Curve Lengths

Minimum Curve Length, m									
Change of Grade %	Design Speed, km/h								
	10	15	20	25	30	35	40	45	50
2	-	-	-	-	-	-	-	-	11
5	-	-	-	-	15	32	51	71	100
10	-	-	13	27	44	69	102	145	199
15	-	10	22	40	67	104	153	-	-
20	3	14	30	54	-	-	-	-	-
25	6	18	37	-	-	-	-	-	-

Source: Geometric Design Guide for Canadian Roads, TAC, 1999.
(TAC Table – 3.4.5.4)

The criterion for bicycles on sag curves is comfort, which is expressed in terms of a vertical maximum radial acceleration of 0.3 m/s^2. However, it is important to consider non-illuminated bikeway facilities, which might be used by cyclists after dark, by providing them with longer vertical curves. **Table 2.7** provides K values corresponding to different design speeds based on the equation $K=V^2/390$. It is recommended that steep grades be widened to allow cyclists the extra space needed to either make corrections to their trajectory at higher speeds going downhill, or to maintain balance at lower speeds heading uphill. It is not necessary to widen bicycle routes on grades shorter than 75 m or shallower than 6%.

Table 2.7
Sag Vertical Curves for Bicycles

Design speed, km/h	25	30	35	40	45	50
Minimum sag curvature (K), m	1.5	2.5	3	4	5	6

Source: Geometric Design Guide for Canadian Roads, TAC, 1999.
(TAC Table 3.4.5.5)

Table 2.8 provides a guideline on the extra cycling route width that may be required on grades as a function of steepness and length.

Table 2.8
Extra Cycling Route Width Required on Grades

	Length, m		
Grade, %	**25-75**	**75-150**	**150+**
3-6	*-*	*20 cm*	*30 cm*
6-9	*20 cm*	*30 cm*	*40 cm*
9+	*30 cm*	*40 cm*	*50 cm*

Source: Technical Handbook of Bikeway Design, Velo Quebec, 1992.
(Table 4.3, p. 50 of Source)

2.2.3 Cross Slope

Cross slope is necessary to provide positive drainage of the trail surface. A route may have a crown or continuous cross slope. It is preferable to use a balanced cross slope on two-way trails for drainage purposes, and also to direct cyclists to the right side of the route. Typical cross slopes depend on the surface type. **Table 2.9** provides guidelines on typical cross slopes

Table 2.9
Typical Cross Slopes

Surface	**Range of cross slope**
Concrete	*1.5% to 2%*
Asphalt	*2% to 4%*
Gravel, crushed stone, earth	*2% to 4%*

Source: Geometric Design Guide for Canadian Roads, TAC, 1999.
(TAC – Table 3.4.6.4) Bikeway Design Guidelines

2.2.4 Footpath / Hiking Trail Alignments

When designing off-road footpaths and hiking in parks, open spaces, natural areas or environmentally sensitive areas, they should be designed in a manner that allows the user to obtain the maximum amount of use and the greatest amount of enjoyment. The general layout of a trail is determined by a variety of factors including the user need, size of the site, terrain and general site conditions. Trail layouts recommended by the Toronto and Region Conservation Authority (TRCA) Trail Planning and Design Guidelines specifically for off-road segments include the linear, loop, stacked loop, satellite loop, spoked loop and maze layouts. These trail layouts are illustrated in **Figures 2.5 to 2.10.** Linear trail layouts are better suited for multi-use recreational pathways which would typically be located in park systems and greenbelts, such as the Bartley Smith Greenway. Loop layouts are better suited for footpaths and hiking trails located in natural lands, open spaces, valleys, and conservation areas.

Linear trails are most commonly goal oriented with a specific destination in mind such as from a parking area to a viewpoint. Although functional, the user must retrace his/her steps to return to the starting point, which could lead to boredom. Spurs may be constructed to add variety to the trail.

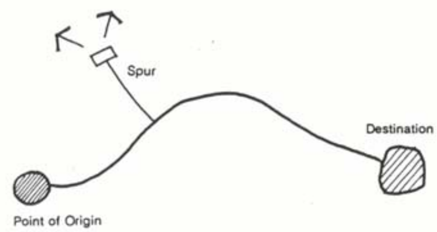

Figure 2.5 Linear Trail Alignment
Source: Toronto and Region Conservation Authority (TRCA,) Trail Planning & Design

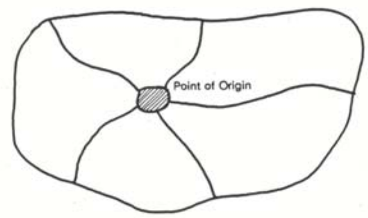

Figure 2.8 Satellite Loop Alignment
Source: TRCA Trail Planning & Design

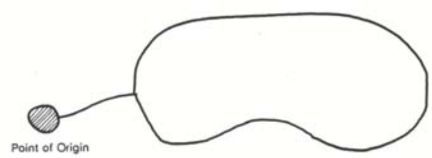

Figure 2.6 Loop Alignment Source: TRCA, Trail Planning & Design Guidelines, (1992)

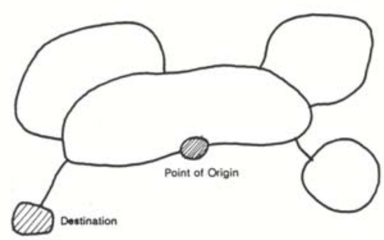

Figure 2.9 Spoked Loop Alignment
Source: TRCA Trail Planning & Design

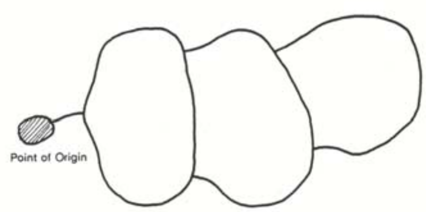

Figure 2.7 Stacked Loop Alignment
Source: TRCA Trail Planning & Design Guidelines, (1992)

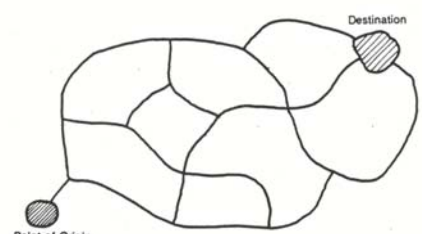

Figure 2.10 Maze Trail Alignment
Source: TRCA, Trail Planning & Design Guidelines, (1992)

Loops provide an interesting round trip of an area and are desirable for all trail situations. Stacked loops are an enhancement of the standard loop trail and can provide more variety for the user.

Loops should also be considered as “branches” off of major or key network routes that serve a specific area and feed into the York Region Pedestrian and Cycling network.

Satellite loops offer users of a common trail different opportunities and experiences in terms of terrain, theme or level of difficulty.

Spoked loops offer trail users a variety of options for their return trip to their point of origin, while never being very far from that point.

Maze layouts provide the maximum amount of alternatives, distances and a variety of decision points for a trail user. These trail types should be designed with care because the higher the density of the trail-maze, the greater the risk of resource degradation.

Guideline:

2.17 Multi-use trails in the urban area of the Region of York should be constructed to a minimum width of 3.0 m to accommodate two-way travel. On pathways that may experience high demand or a significant percentage of pedestrian and/or in-line skating traffic, a width of 4.0 to 5.0 m is recommended.

2.18 Pathway or trail surface types are dependent on requirements of the planned users (e.g. accommodating in-line skaters) and can vary from asphalt to granular surfaces (stone-dust).

2.19 Footpaths / Hiking Trails should be designed to withstand the maximum amount of use and greatest enjoyment by the trail user. Consideration should be given to providing loops to diversify the trail experience. Loops could also be considered as "branches" off of key network routes, serving a specific area.

2.3 Pedestrian and Cyclist Clear Distance to Obstructions

Potential obstructions for pedestrians while walking include passenger standing areas and shelters, tree limbs, shrubs, benches, projections from buildings, signs, vending boxes and trash receptacles. These objects when misplaced may become a tripping hazard or cause people to change direction while walking, detouring onto grass, mud or the street. Tree limbs protruding onto the street can block the visibility of traffic control devices and oncoming traffic, thereby increasing the potential for pedestrian/vehicle collisions. In commercial areas, misplaced trees may block a driver's view of a business, and containers for trees can easily become unintended waste receptacles. Stanchions with various attachments such as lights, traffic signals and parking meters can fragment the sidewalk space, making it less user friendly for pedestrians and drivers.

Table 2.10
Clear Distance to Obstructions

	Minimum	Preferred
Vertical clearance to stationary objects	2.5 metres	3.0 metres
Horizontal clearance to stationary objects	1.0 metre	1.5 metres

Obstructions for cyclists include guy wires, curbs, fences, utility poles, signs and trees. The distances in **Table 2.10** indicate the space beyond the operating space that is required for cyclists to pass by an obstruction. Every attempt should be made to provide this space either by shifting the trail or, if possible, relocating the hazard. If this is not feasible, the obstruction should be made more visible or the potential danger reduced. This can be accomplished by adding warning signage, or painting the obstruction with a bright colour, eliminating projections or padding sharp edges. Trees and trailside foliage should be routinely maintained to ensure that the minimum clearance spaces are provided.

Guidelines:

2.20 Trees and plants placed along pedestrian and cycling routes should be carefully selected to ensure that they do not present any tripping hazards or obstacles for pedestrians.

2.21 The preferred clear distance to obstructions identified in this section should be followed whenever possible to reduce the risk of tripping hazards along pedestrian and cycling routes.

2.4 Environmental Impacts

Off-road pathways and footpaths constructed in parklands, valleys and open-space areas must take into consideration the impacts they may have on the surrounding environment and ecosystem. Such environmentally sensitive areas (ESA's) in the Region of York include wildlife habitat areas, wetlands and other environmentally sensitive areas such as the Oak Ridges Moraine. Since pathways or footpaths may pass through these ESA's, it is important to understand the tolerance level of an ecosystem. The type of activity and the intensity of use along an off-road pathway or footpath is usually directly related to the negative impacts that can be done to the environment. Other types of environmental impacts as identified in the Toronto and Region Conservation Authority (TRCA) Trail Planning and Design Guidelines include those associated with the tertiary trail layout, surveying, construction, final use and management practices.

Each type of natural environment through which a network route may pass should be assessed independently for the proposed network facility type considered. The six primary environmental impacts with off-road pathways and footpaths are usually associated with the clearing of the trail, human contact with wildlife, soil erosion, trailside trampling, short cutting and improper disposal of waste[1]. The following recommendations detail how to minimize environmental impacts associated with these six factors as recommended by the TRCA.

2.4.1 Clearing of Trails / Human Contact with Wildlife

Off-road routes should avoid any important ecological elements such as rare plants, interpretative features and important habitat zones. Generally, wildlife habitat zones should be avoided all together when constructing off-road routes, and the environment should be favoured should any environmental concerns arise. Large-scale equipment should not be used for construction of footpaths / hiking trails since large amounts of noise and vibration could disturb wildlife in the area, or cause significant physical damage to the environment. Locations for large groups and recreational activities should be approximately 100 to 200 m away from environmentally sensitive areas. Human interference with the environment could potentially result in the abandonment of habitats or cause ecological imbalances.

2.4.2 Soil Erosion

Soil erosion can occur when there is excessive removal of vegetation during pathway construction, excessive compaction due to trampling, uncontrolled surface run-off or improper installation of bridges. To minimize soil erosion, pathways and footpaths should be located in areas with coarser and more porous soil for water infiltration, which is more resistant to erosion. Trails should also be cross-sloped accordingly (minimum 2%) to ensure that proper drainage occurs and that there is no excess water build-up along an off-road pathway. Natural dips in hiking trail surfaces should be incorporated into low-use trails, such as hiking trails to ensure that drainage is diverted at frequent intervals. Vegetation along a trail edge should be maintained to encourage percolation of water into the soil. Excessive run-off can be intercepted with ditches, a central

[1] The Toronto and Region Conservation Authority: Trail Planning and Design Guidelines – a handbook for an Inter-Regional Trail System in the Greater Toronto Area

crown along the trail and periodic crossings of culverts to minimize run-off build up.

2.4.3 Side Trampling

Side-trampling can occur when pathways or footpaths are either too narrow, or there are too many users. An ill-defined pathway-edge may lead to users wandering off the route, which in turn could cause damage to adjacent vegetation and soils. Therefore, off-road routes should have an appropriate width so that they can accommodate the expected number of users. At points where people are likely to gather such as features of interest, displays or viewing points, extra width should be provided. Off-road pathway edges may also be marked with logs, branches, rocks, or other natural material to ensure that the route is clearly defined.

2.4.4 Short Cutting

When an off-road route is too difficult or unsafe to traverse, or an interesting feature is located off of the route, users may shortcut across the lands for their own personal convenience. This can cause damage to the vegetation and soils off-trail. Natural features such as landforms, vegetation, or the placing of rocks or plants in certain locations can help to discourage short cutting across valley and parklands.

2.4.5 Improper Disposal of Wastes

Garbage and litter not only deters people from using an off-road route, but it can also cause physical damage to the local environment and wildlife. Waste receptacles should be placed along all off-road routes, and on-road pedestrian routes for that matter, at frequent intervals, and all users should be encouraged not to litter. This can be emphasized through advertisements such as posters and notices located along the route and at pathway entrances. Still, network routes must be maintained and serviced regularly to ensure that all litter and garbage is picked up, since animals have a tendency to scatter garbage. An adequate number of attractive toilets should be provided at access points and activity nodes. A regular maintenance program should be set up to ensure that these facilities are cleaned and supplies are restocked.

Excessive amounts of animal excrement that accumulates on trails will most likely lead to user complaints, and could also lead to water contamination. Therefore, it is recommended that equestrian trails not be located in areas expected to receive high pedestrian use. Additional maintenance procedures are detailed in **Chapter 8.0 MAINTENANCE**.

Guidelines:

2.22 The design and construction of off-road pathways should have regard to the Toronto and Region Conservation Authority (TRCA) and Ontario Regulation 166/06 (2006).

Chapter 3.0 Bicycle Network and Pedestrian System Facility Types

The network has been divided into three classes of facilities for the Region of York:

- On-road bicycle based facilities;
- On-road pedestrian based facilities; and
- Off-road, multi-use facilities.

Design standards associated with each "class" of facility are subject to a number of factors including site conditions, location, potential level of use, and existing or appropriate materials. The entire pedestrian and cycling system is also subdivided into two types:

- Primary "spine system"; and
- Secondary "community system".

Certain systems and facility types are designed specifically for on-road or off-road use. On-road routes refer to network facilities that operate on or along existing roads and are incorporated into the present or future street system.

Off-road facilities refer to routes that operate on their own right-of-way, independent of the existing street network. Off-road routes typically operate through open spaces, valley and parklands, as well as power or transportation utility corridors and stormwater retention ponds.

Connections between different facilities would be provided at locations where the two different classes of facility intersect. Ramps are also constructed in some locations to provide connections between two differing grade-separated facilities.

Chapter 5.0 of the York Region PCMP Report (separate document) outlines the recommended pedestrian system and cycling network and facility classifications. This chapter sets out the design guidelines for each class of facility.

3.1 Bike Lanes

A bike lane is defined as a facility located in the travelled portion of the street or roadway and is designed for one-way cyclist traffic. Bike lanes are defined on the road through pavement markings and signage. Bike lanes should form part of the spine bicycle network, but may also form parts of the community network. Bicycle lanes should be constructed on roads with "urban" cross-section. The following guidelines relating to bike lanes are presented as options, and may not necessarily indicate the final treatment that would be appropriate in parts of York Region as this would depend on local conditions.

In terms of public policy, it is important to acknowledge that a bicycle is formally recognized as a vehicle by the Province of Ontario, as outlined in the *Highway Traffic Act, R.S.O., 1990*. Therefore, bicycles have the right to share all classes of roadways, including highways, arterials, collectors and local streets, with the exception of the 400 series highways or roads where cycling has been prohibited by municipal by-laws. Motorists are prohibited from driving or stopping in designated bike lanes, except for emergency avoidance manoeuvres or breakdowns.

The fact that bicycles have a right to use most roadways leads to an important principle of roadway design, that "every road is a cycling road". Therefore, the Region of York and local municipalities in the region should adopt bicycle friendly design guidelines for all streets, whether a road is designated as part of a cycling network or not. Bicycle friendly roadway features typically include, among other things, wide curb lanes plus drainage grates that are bicycle friendly and ideally located out of the desired path for cycling. Other features include traffic control devices that are programmed with bicycles in mind, particularly detector loops that have their sensitivity adjusted to allow bicycles to actuate a traffic signal.

As discussed in Chapter 1, in-line skaters are currently not permitted on either sidewalks or roadways. For routes that are served by bike lanes, it is expected that pedestrians and in-line skaters will be accommodated on the sidewalk and off-road trails respectively. However, it must be recognized that in-line skaters may prefer to use the bike lane.

Guideline:

3.1 The Region of York should adopt bicycle friendly design guidelines for all streets, whether a road is designated as part of a cycling network or not.

The minimum design width for a bike lane on a street with an urban cross-section without on-street parking should be 1.5 m from the face of the curb. A preferred width of 1.8 m is recommended, especially on roadways with higher AADT's, speed limits, and commercial vehicle volumes (trucks/buses) such as those on busy arterial (regional) roadways. This is consistent with both Ministry of Transportation (MTO) and TAC guidelines.[1] Bike lane widths of 2.0 m should be considered on roads with motor vehicle operating speeds, or posted speed limits between 60km/h and 80 km/h. Bike lane widths should not exceed 2.2 m because the excess width may encourage motorists to drive in the bike lanes, as they will be wide enough to accommodate a motor vehicle.

In constrained rights-of-ways and for short segments, a reduced width of 1.2 m may be acceptable for bike lanes. However, this should not be considered along high-speed roadways with high AADT's and commercial vehicle volumes *(See **Section 4.2** Retrofitting Municipal Roads, on acceptable AADT and Commercial Vehicle thresholds for on-road cycling facilities).* Lane widths less than 1.2 m should not be designated or signed as bike lanes. When the available lane width narrows below 1.2 m, bike lane signs and pavement markings should cease, and a Bike Lane Ends sign be posted (refer to TAC Bikeway Traffic Control Guidelines for Canada).[2] **Table 3.1** summarizes the widths of bike lanes recommended for the Region of York.

Table 3.1
Recommended Bike Lane Widths

Classification	***Minimum Width***	***Desired Width***
Standard Bike Lane.	1.5 m	1.8 m
Bike Lane Adjacent to On-Street Parking Aisle.	1.5 m	1.8 m
Bike Lanes on Rural Roads with Posted Speed Limit between 60 - 80 km/h. [(a)]	1.5 m	2.0 m
Bike Lanes in Constrained Right-of-way	1.2 m	1.5 m

a) Note: On-road cycling facilities are not recommended on roadways with posted speed limits greater than 80 km/h, refer to Table 4-1 for other considerations.

If the edge line does continue along a roadway following the termination of a bike lane along with the cycling route, and the available lane width

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[1] Ontario Traffic Manual, Book II – Pavement Hazard and Delineation Markings, MTO, 2000 and Geometric Design Guide for Canadian Roads, TAC, 1999. (TAC Table 3.4.6.2)

[2] Bikeway Traffic Control Guidelines for Canada, Transportation Association of Canada (TAC), (1999)

between the edge line and the shoulder/curb of the roadway is less than 1.2 m, then the edge line should be removed or, as a minimum, be allowed to wear off. The risk is that cyclists may attempt to ride in the space provided by the edge line although it is less than 1.2 m in width. Cyclists should not be encouraged to ride in this constrained space since a cyclist who accidentally strikes a curb may “bounce” back into the motor vehicle travel lane. Therefore, curbed roadways with edge lines less than 1.2 m from the face of the curb should not be signed or marked as bike lanes. Once the edge lines have been removed or have worn away, bicycle route signs supplemented by “share the road” sign tabs should be implemented.

Figure 3.1 illustrates a typical urban road cross-section standard modified to accommodate bike lanes.

Whenever possible, it is recommended that bike lanes be provided on all collector and arterial roads designated to have cycling facilities, provided that there is sufficient roadway width and AADT volumes and commercial vehicle percentages are within acceptable limits. After review, in locations where a bike lane may not be deemed feasible, consideration should be given to providing a Bicycle Signed Route. These cycling facilities are described in **Section 3.3**.

Bike lanes should be clearly identified on roadways through bicycle route signing, bicycle symbol pavement markings and bike lane signs.

Guidelines:

3.2 The minimum design width for a bike lane in an urban area without on-street parking should be 1.2 m from the face of curb in constrained areas only. Bike lanes 1.5 m in width are recommended as a standard, while a preferred width of 1.8 m should be considered on roadways with higher AADT’s, speed limits, and truck volumes such as found on busy arterial roadways.

3.3 Bike lanes should be clearly identified on roadways through bicycle route signing, bicycle symbol pavement markings and bike lane signs.

3.4 Bike lanes are typically recommended where feasible for collector and arterial roads designated to have cycling facilities. In locations where a bike lane is not deemed feasible following a review, consideration should be given to providing a wide curb lane. If this is not possible, as a minimum, a Bicycle Signed-Only Route should be provided if thresholds permit.

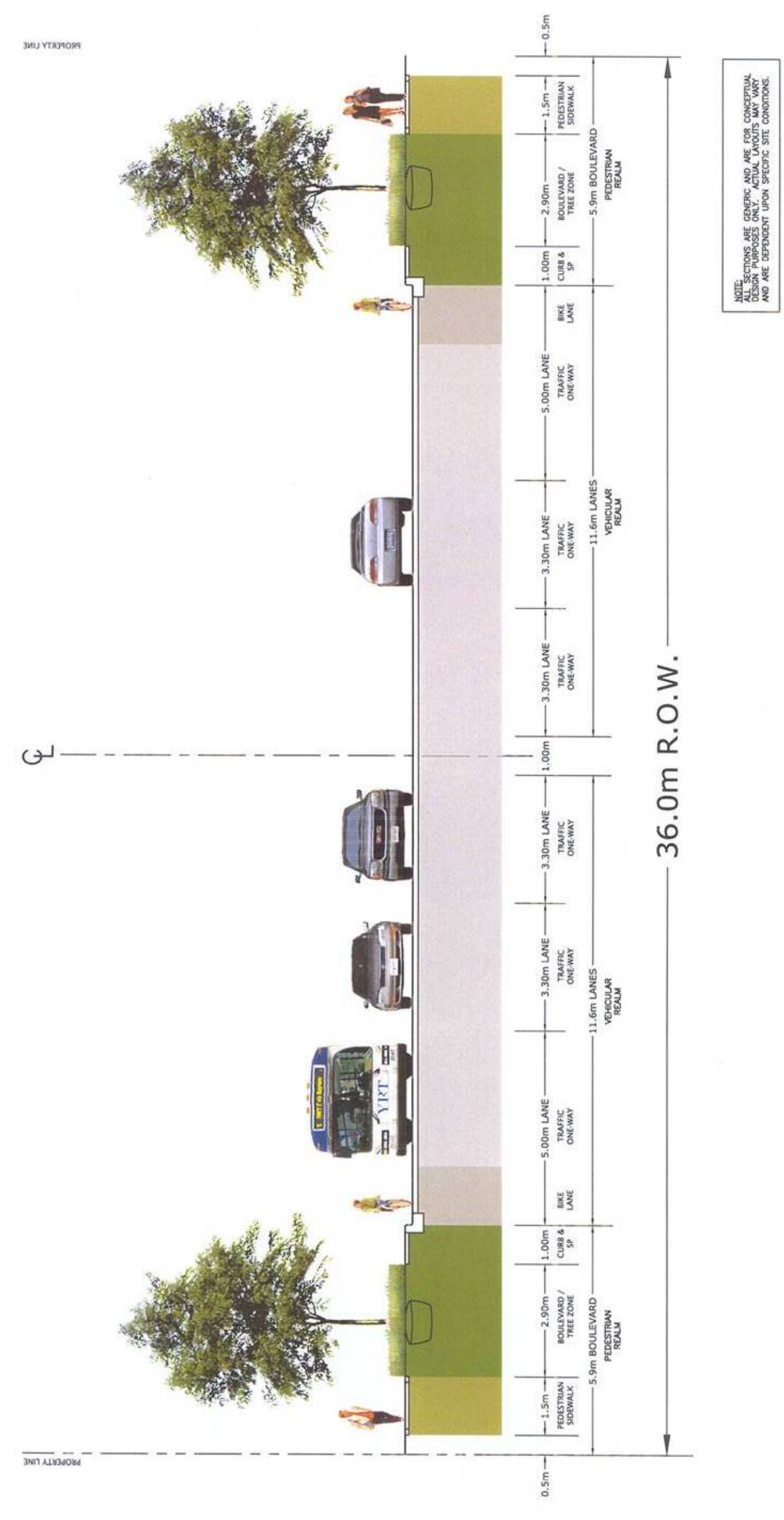

Figure 3.1 Example of an Urban Road Cross Section with 1.5 m Bike Lanes

3.1.1 Bike Lanes with On-Street Parking

Bike lanes on roads with on-street parking are located to the left of and adjacent to parked vehicles along the curb. Designing this type of cycling facility must take into consideration the potential hazard to cyclists of car doors opening into the travelled portion of the bike lane. In order to allow clearance for vehicle doors, and to minimize collisions with cyclists, the combined bicycle/parking lane should be a minimum of 4.0 m wide. This width allows for a 1.8 m bike lane and a 2.2 m wide curbside-parking stall. The extra distance added to the typical 2.0 m wide parking stall provides space for the opening of car doors, and encourages cyclists to travel a safe distance from the parked vehicles. **Figure 3.2** illustrates an example of bike lanes adjacent to on-street parking. As an alternative, the width of the bike lane may be reduced if the parking aisle is greater than 2.4 m wide. Bike lanes on roads with on-street parking should be considered in commercial and residential areas where the demand for and turnover of parking is high, and where commercial and residential property owners may not accept the reduction or prohibition of on-street parking.

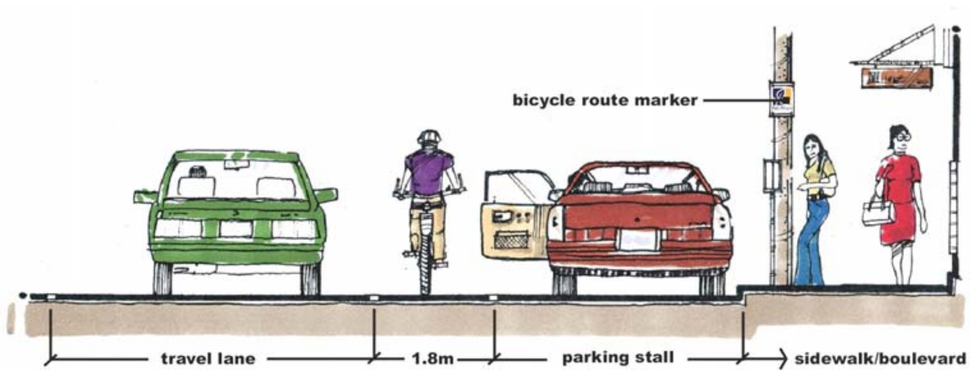

Figure 3.2 Typical Bike Lane with On-Street Parking

Where it is not feasible to install dedicated bike lanes, the applicability of a signed route or a multi-use boulevard trail should be evaluated. Other route alignments may also need to be considered.

Where the road right-of-way or other factors limit the opportunity to provide parking bays, standard on-street curb parking should be assumed. For both applications, the desired width of the parking lane should be a minimum of 2.2 m, with the adjacent bike lane 1.8 m.

Guidelines:

3.5 On proposed bikeway routes in York Region where on-street curb parking exists, an assessment should be undertaken to determine whether the parking can be removed or relocated. In the event that on-street parking is seen as a priority, parking bays should first be considered as a preferred design.

3.6 The desired width of the parking lane should be a minimum of 2.2 m, with the adjacent bike lane 1.8 m. Where the road right-of-way or other factors limit the opportunity to provide parking bays, standard on-street curb parking widths should be assumed.

3.1.2 Contra–flow Bike Lanes

Contra-flow bike lanes on one-way streets carry cyclists in the direction opposite motor vehicle traffic. These lanes may be considered in locations where there are a series of one-way streets and no other feasible alternate cycling route connections exist. Design considerations such as lane widths, horizontal and vertical curves for contra-flow bike lanes are similar to those of standard bike lanes with the exception that signing along the route indicates that the lane is contra-flow. One-way streets with two-way cycling facilities allow cyclists to travel in both directions along the roadway with a contra-flow lane on the left side and a standard bike lane or shared roadway facility on the right. **Figure 3.3** illustrates a typical schematic for a contra-flow bike lane.

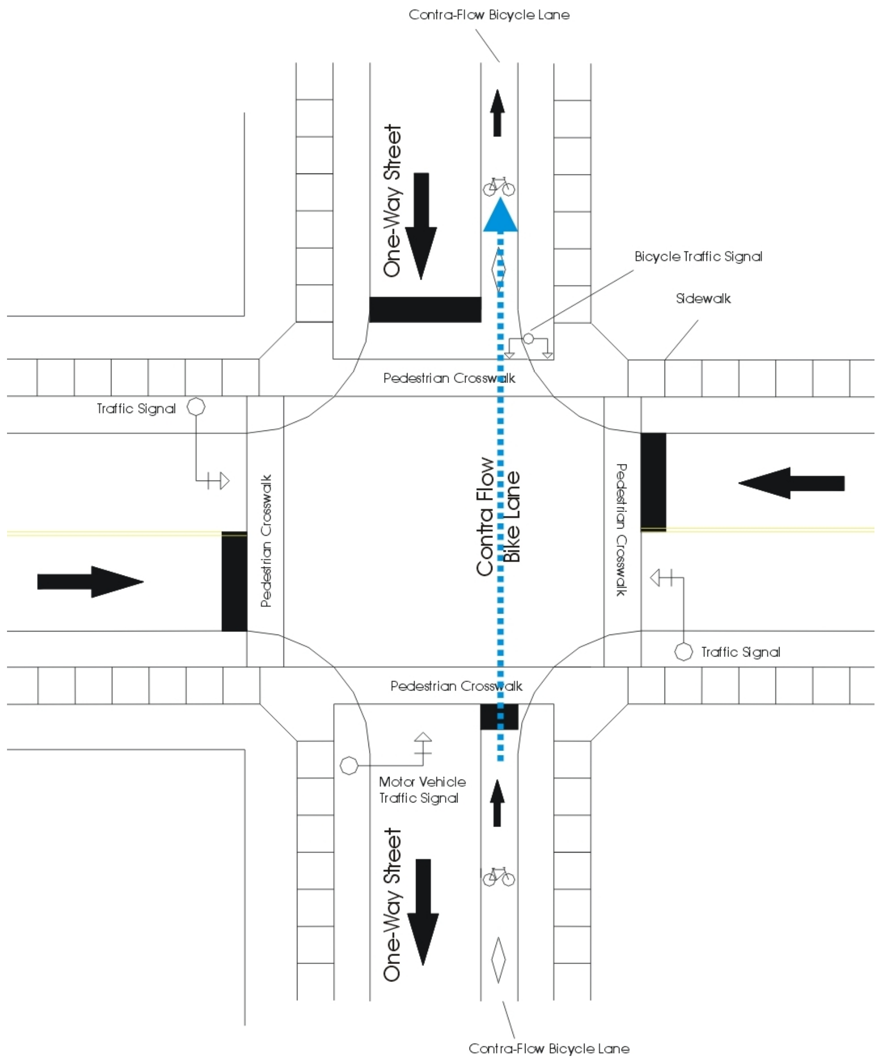

Figure 3.3 Schematic of a Contra-Flow Bike Lane

Guideline:

3.7 Contra-Flow bike lanes may be considered for local streets designated for one-way motor vehicle traffic to permit cyclists to travel in the opposite direction of motor vehicle traffic. Cyclists may also ride in the same direction as motor vehicle traffic in a separate bike lane or share the motor vehicle travel lane.

3.2 Paved Shoulders

A Paved Shoulder cycling route can be located on roads with rural sections and no curbs. Adding or improving existing paved shoulders can be the best way to accommodate cyclists in rural areas and benefit motor vehicle traffic. Paved shoulders can extend the service life of the road surface since edge deterioration will be significantly reduced. Where funding is limited, adding or improving shoulders on uphill sections will give slow moving cyclists needed manoeuvring space and will decrease conflicts with faster moving motor vehicle traffic.[3]

Paved shoulders offer other advantages: they reduce maintenance costs associated with the grading of gravel shoulders, serve as a refuge for disabled vehicles, accommodate emergency vehicles, they extend the life of the vehicle lanes through improving the lateral support for the roadway structure, and can reduce run-off-the-road collisions.

In York Region, most of the existing gravel shoulders have already been partially paved. Where gravel shoulders have not been paved, but the shoulders have the required width and base to support shoulder lanes, a shoulder-paving program could be implemented in order to facilitate shoulder bike lanes on rural roads.

If shoulders are to be provided as part of a new road construction project, the shoulders pavement structure design should be the same as that of the roadway if the shoulder width would one day become part of the pavement structure in an urban cross-section. During shoulder widening projects, some opportunities to reduce costs can be made available by building a thinner pavement thickness. A thinner pavement thickness could be considered provided:

- No future widening planned within the 10 year road program
- Existing shoulder area and road structure is structurally stable and drainable
- Existing travel lanes have suitable width and are in safe and desirable condition
- Horizontal control (curvature) is not excessive

Existing and projected AADT and heavy truck traffic is not considered excessive. The following construction details should be used to add paved shoulders to roadways where no overlay project is scheduled:

1. Saw Cutting: A saw-cut 0.3m inside the existing edge of pavement provides for a tight joint. This eliminates a ragged joint at the edge of the existing pavement.

[3] Guide for the Development of Bicycle Facilities, American Association of State Highway and Transportation Officials, (1999);

2. Feathering: Feathering the new asphalt onto the existing pavement can work if a fine mix is used and the feathering technique does not extend across the area of the travelled bicycle lanes.

3. Grinder: Where there is already some shoulder width and thickness available, a pavement grinder can be used to make a clean cut at the edge of travel lane, grade the existing asphalt to the right depth and cast aside the grindings in one operation. Grinding offers these advantages:

    a. Less of the existing pavement is wasted

    b. The existing asphalt provides additional pavement base

    c. There will not be full-depth joint between the travel lane and the shoulder

    d. The grindings can be recycled as based for the widened portion

    e. New asphalt can then be laid across the entire width of the shoulder lane with no seams

Paved Shoulder Bikeways (a paved shoulder on a road signed for cycling) may form part of the spine and local community systems in rural areas. On rural roads, a marked edge line is typically used to designate a paved shoulder. Signs are used to designate the route and indicate the presence of cyclists. **Figure 3.4** illustrates a typical paved shoulder bicycle route facility.

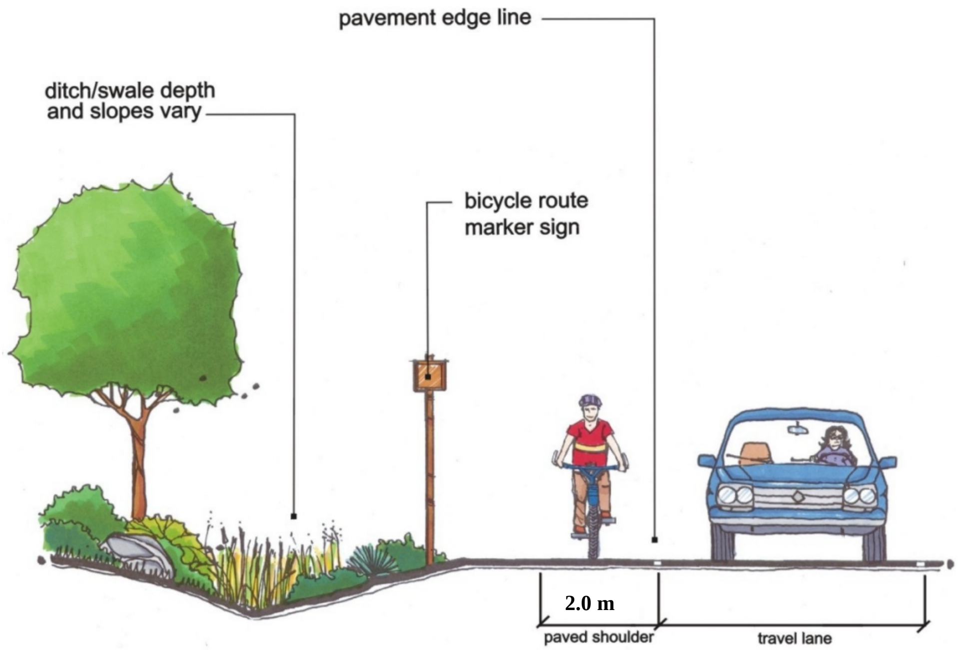

Figure 3.4 Typical Paved Shoulder

Both MTO (Geometric Design Standards for Ontario Highways (GDSOH) and TAC (Geometric Design Guide for Canadian Roads, GDGCR) provide standards for shoulder widths for undivided rural highways are based on design speed and AADT volumes. The widths recommended by both are in some cases sufficient to accommodate a 1.5 m to 2.5 m paved shoulder cycling route and 0.5 m to 1.0 m for additional granular shoulder width.

Figure 3.5 illustrates the shoulder of a typical roadway platform.

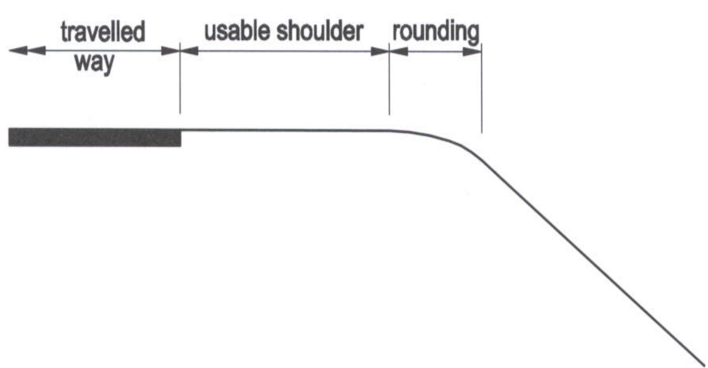

Figure 3.5 Typical Roadway Shoulder

It is recommended that shoulder cycling routes on Regional Roads having a posted speed limit up to and equal 60 km/h should have a preferred design width of 1.5 m. On roads with a high percentage of commercial traffic above 60 km/h and less than 80 km/h, a design width of 2.0 m is preferred. However, in constrained areas, shoulder cycling routes with a design width of 1.5 m may be used if adjacent to a granular surface. That said, it should be recognized that a bicycle is defined as a vehicle under the Highway Traffic Act and therefore, cyclists will continue to use Regional Roads regardless of the posted limit, traffic volume or availability of a paved shoulder. If the preferred design width of 2.0 m for a paved shoulder cannot be achieved, any additional paved shoulder width is better than none at all.

The decision on whether to sign a road with paved shoulders that are less than the desired width (refer to Table 4.2) as a signed-only bicycle route should be based on good engineering judgement. In addition, roadway characteristics such as the AADT volume and percentage of commercial vehicle traffic, as well as a number of other factors such as roadway geometry, gradients, horizontal/vertical curves and sight lines should also be considered. The Region of York may elect to designate some roads as signed-only cycling routes that do not currently meet the suggested minimum shoulder width criteria, as an interim condition. When these roads are scheduled for an overlay or widening, the preferred width would be provided. If the paved shoulder width is less than the desired 2.0 m, and a cyclist chooses to ride to the right of the edge line, an adjacent gravel shoulder would still provide a "recovery" area. Thresholds to assist the Region in making these decisions regarding retrofitting roads for paved shoulders or signed-only cycling routes are provided in **Section 4.2.**

In the Region of York, there may be segments of proposed cycling routes on roads with rural cross-sections (no curb) where it is difficult to accommodate even a minimum 1.2 m paved shoulder. In these cases, edge lines (pavement markings) may be provided to mark the 3.5 m vehicle lane width and to delineate as much additional shoulder width as possible for cyclists to use. This approach, however, is not recommended for urban roads with curbs, due to the risk of cyclists striking the curb and "bouncing" back into the motor vehicle travel lane, potentially colliding with a motorist. Should edge lines be applied to a roadway primarily to support cycling, they should only be applied on roads with rural cross-sections.

Paved shoulders are recommended on all Regional Roads with rural cross sections designated for cycling facilities. In addition, paved shoulders on rural roads should not be denoted as reserved bicycle lanes since they must still be used as a refuge for disabled vehicles. Paved shoulder cycling routes should only be denoted as signed-only bicycle routes.

If a rural road is upgraded to an urban section (with curbs) the paved shoulders should be converted into bike lanes.

Guidelines:

3.8 Paved shoulder bikeways are the preferred facility type for creating connections between rural communities on rural cross section roads.

3.9 Paved shoulder bicycle routes on most roads with a posted speed limit of greater than 60km/h should have a preferred design width of 2.0 m. In locations where this width cannot be achieved, especially in constrained rights-of-way, a minimum paved shoulder width of 1.2 m with an adjacent granular shoulder of at least 0.5 m may be a reasonable compromise, depending on the characteristics of the subject road.

3.10 Paved shoulder cycling facilities should be separated from the motor vehicle travel portion of the road by an edge line (pavement marking), and should be clearly identified through bicycle route signing. Edge lines should typically only be used on rural roads where there are no curbs, and should be a single line placed on the right side of the travel lane to delineate the paved shoulder.

3.11 The addition of edge lines to denote a bike route are only recommended for paved shoulders in rural areas since these roads typically have an adjacent gravel shoulder for a cyclist to recover should they be forced off of the paved section of the roadway.

3.12 Paved shoulders on rural roads should not be denoted as reserved bicycle lanes since they should still be used as a refuge for disabled motor vehicles. Paved shoulder cycling routes should only be signed as bicycle routes and not as bike lanes.

3.3 Shared Roadway Facilities

This section focuses on all cycling facilities where a separate right-of-way (e.g. bike lane or paved shoulder) cannot be provided or is not necessary.

3.3.1 Signed Only Cycling Routes

Signed-Only cycling routes are bicycle routes designated by bicycle route signing along a street. Signed-Only routes are typically installed on quiet, residential, local/collector streets. Apart from “bicycle route” signs, there are generally no changes made to the roadway.

It is recommended that paved shoulders or bike lanes should be provided on all collector and arterial roads designated for cycling facilities which have an adequate ROW. However, Signed-Only Routes can be used on lower volume roads, or on collector or arterial roads as an interim solution or where a road segment has an insufficient ROW.

Streets with signed-only cycling routes should typically only be signed as on-road bike routes if there is adequate pavement width to safely accommodate both motor vehicles and cyclists, and when adequate sight lines and acceptable AADT volumes exist. Otherwise, alternative routes should be investigated or paved shoulders/bike lanes implemented when the opportunity presents itself at a future date.

Existing roads that are recommended as part of the cycling network should not be prematurely signed or identified as part of the network if the right-of-way available to cyclists is too narrow, AADT's are high, or if the roadway is in poor condition. Roads that are presently not suitable for on-road cycling facilities but are recommended for installation in the future should be upgraded to at least minimum standards before being signed as part of the cycling network.

Signed-only bicycle routes are especially appropriate for the community system that consists of cycling routes that are "local" in nature and feed into the primary network.

In many parts of the Region of York, existing rural roads have narrow pavement widths of 6.1 m to 7.0 m with no edge line and narrow gravel shoulders. Some of these roads would be suitable for designation as signed-only routes because they have good sight lines and typically experience low to moderate automobile and truck volumes. However, it is recommended that "Share the Road" signs be erected along these sections of cycling routes to increase driver awareness of cyclists on the narrow roadway.

Guidelines:

3.13 Signed-only cycling routes are appropriate for the community system that consists of cycling routes that are "local" in nature and feed into the spine network.

3.14 Streets with signed-only cycling routes should typically only be signed as on-road bike routes if there is adequate pavement width to safely accommodate both motor vehicles and cyclists, and when adequate sight lines and acceptable AADT volumes exist.

3.15 On very low volume rural roads with limited truck traffic, good sight lines and sometimes physically constrained ROW's, the existing travel lane may be designated as a cycling route, with cyclists and motorists expected to share the same lane. In these cases, "Share the Road" signs should be erected at strategic locations to communicate this message to all road users.

3.3.2 Signed Only Cycling Routes on Wide Curb Lanes

Signed-Only cycling routes within wide curb lanes are similar to signed-only cycling routes, with the exception that the travel lane shared by motorists and cyclists is wider than a standard motor vehicle travel lane (> 3.5 metres).

Wide curb lanes should have sufficient width to allow motorists to pass cyclists without encroaching on an adjacent travel lane (if one exists). Wide curb lanes should be encouraged for all road classifications to provide cycling friendly streets, whether they are designated as part of the cycling network or not.

Research indicates that as lane widths begin to exceed 4.0 m, this tends to increase confusion and improper lane use by motor vehicles in congested urban environments, and may encourage unsafe passing manoeuvres in rural environments.

The recommended wide curb lane width for roads that are proposed for designation as on-road cycling routes is 4.0 m to 3.5 m.

Signed-only cycling routes along wide curb lanes greater than 4.0 m in width should have pavement markings added to the curb lane, such as those illustrated in **Figure 3.6**, to help to deter unsafe passing manoeuvres by motorists and increase driver awareness of cyclists on the road. Bicycle route signing should also be applied along the cycling route.

Figure 3.6 Wide Curb Lane with Bicycle Pavement Markings and Signing (City of Ottawa)

A schematic illustration of a typical signed-only cycling route in an urban area with a wide curb lane is provided in **Figure 3.7**.

Guidelines:

3.16 The preferred width for a wide curb lane is between 3.5 m and 4.0 m.

3.17 In urban areas, proposed signed-only cycling routes should be implemented along roads with wide curb lanes and bicycle route signs where possible.

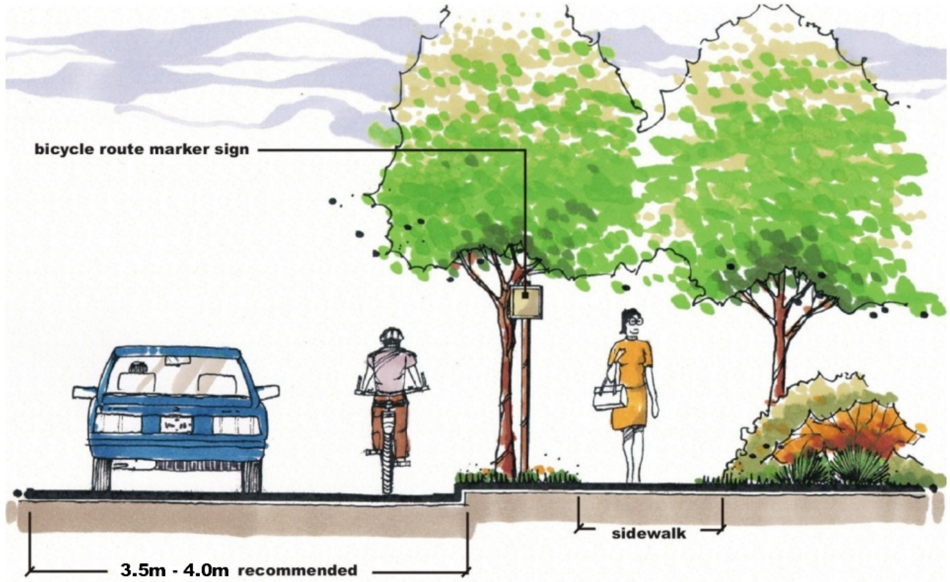

Figure 3.7 Signed-Only Cycling Route Along a Wide Curb Lane

3.18 Where the width of a wide curb lane extends beyond 4.0 m along a designated cycling route, the application of pavement markings such as a bicycle stencil should be considered to indicate the presence of cyclists on the roadway to motorists.

3.4 Separated Bike Lanes (On-street Bikeways)

One alternative to standard on-road bike lanes now being considered by a number of municipalities in North America, most notably New York City, is *separated bike lanes*. The concept is based on two-way on-street bikeways and bikeway boulevards popular in some European countries, especially Holland. The facility is similar to an in-boulevard multi-use trail except that it is located on the road surface and not above the curb in the boulevard.

One of the challenges with standard bike lanes in urban areas, especially where on-street parking is provided is that cyclists often find themselves "sandwiched" between parked cars and moving motor vehicles, including trucks and buses in the adjacent travel lane. The opportunity for conflict is higher in this condition as motor vehicles cross the bike lane to park or exit parking. Cyclists are also at increased risk from motorists in parked or stopped vehicles who open the vehicle door into the bike lane at the same time a cyclist is approaching (dooring). Delivery trucks, buses and taxis can also be found blocking the bike lane from time to time forcing the cyclist to divert into the adjacent general purpose travel lane or wait for the vehicle to move on.

In an effort to reduce these types of conditions, reduce the risk to cyclists and encourage more people to cycle the bike lanes are combined into a two-way bikeway located on one side of a road and separated by a buffer that may consist of a 0.5 to 1.0 m hatched pavement marking and / or ideally a physical barrier. On streets where full time parking is permitted, the parking lane may be shifted away from the curb and the bikeway inserted between the curb and the parking lane, with the later separated from the bikeway by a raised planted median. On roads with HOV or reserved bus lanes, the two-way bikeway could be located between the general purpose travel lane and the reserve lane (bus/HOV) as illustrated in the photograph from Minneapolis (note this example does not include a buffer).

In 2006, New York City announced its plans to install 200 miles of bicycle facilities, including five miles of what they call Class 1 Separated Paths (on-road separated bike lanes) as well as 150 miles of standard bike lanes and 45 miles of Class III signed-only routes. In Canada, on-street two-way bikeways have been implemented in a number of locations in the City of Montreal and one location in Ottawa. The following photo illustrates the Ottawa example on Percy Street, which has no buffer or physical barrier but does have the bikeway elevated slightly through an additional lift of asphalt compared to the motor vehicle travel way. This type of facility is not recommended without the provision of a minimum buffer or physical barrier.

Two-way Bikeway, Percy Street, Ottawa

Carpenteria, CAPhoto credit: Mathew Ridgeway, ITE Pedestrian and Bicycle Council

Minneapolis, MN Photo credit: Mathew Ridgeway, ITE Pedestrian and Bicycle Council

Although separated bike lanes (on-street two-way bikeways) can provide a higher degree of separation between bikes and vehicles, can reduce the risk of conflicts with parked vehicles and may be more appropriate for novice cyclists, and in particular young children and the elderly who may not feel comfortable riding in a standard bike lane on a major high volume road, there are disadvantages. Intersection crossings may require special treatments, such as traffic control and/or traffic calming facilities at intersections. Pedestrians may use the bikeway as an extension of the sidewalk in busy commercial areas and when on-street parking is present, a motorist’s ability to see cyclists may be compromised. In addition, motor vehicles will need to yield to bicycle traffic, particularly right-turning vehicles at intersections. [4] The cost to implement the facility, educate users and maintain it, including snow clearing in winter months are also areas that need further investigation.

It is recommended that the Region of York, perhaps in partnership with a local municipality, consider implementing an on-street two-way bikeway segment with the facility separated from adjacent travel lanes by a physical barrier as a pilot project. A minimum operating space of 3.0 m is recommended for design. One way of achieving an on-road bikeway boulevard is through the conversion of an existing vehicle lane by adjusting pavement markings, similar to the approach adopted by New York City.

Regional staff may want to follow up with other jurisdictions that have implemented and monitored the use of these types of facilities to determine whether such facilities may be appropriate in the Region of York.

Guidelines:

3.18 Separated bike lanes or on-street two-way bikeways should be separated from regular motor vehicle travel lanes through the use of buffer zones and/or physical barriers.

3.19 Appropriate signing at intersections where bi-directional bikeways are present is very important to warn and provide clear direction to both motorists and cyclists as to where they should proceed when travelling through an intersection.

3.5 Sidewalks

A sidewalk is located within the road right-of-way but separate from the travelled portion of the roadway. Sidewalks are typically made of concrete, are a minimum width of 1.5 m and are designed primarily for pedestrians. Existing and future pedestrian sidewalks should be incorporated into the spine and neighbourhood systems in urban areas for all system segments proposed within road rights-of-way. As a minimum, sidewalks should be provided on at least one side of every urban street in the Region of York, and as required by demand on rural streets. Where feasible, sidewalks should be constructed on both sides of the street which have or will have transit service. Once sidewalks are constructed within the public right-of- way, the local municipality assumes responsibility for

[4] Innovative Bicycle Treatments, An Informational Report, Jumana Nabti, Mathew Ridgway and the ITE Pedestrian and Bicycle Council, Institute of Transportation Engineers, May, 2002.

all future repair, reconstruction, maintenance, and operation during the life of the asset. Therefore, it is important that long-term financial liability be recognized when the local municipality decides when and where sidewalks are required.

A "buffer" zone should also be provided where applicable to separate pedestrians from the street. Buffer zones may vary depending on the nature of the area they serve.

Sidewalks should provide a safe, comfortable area for pedestrians separated from the flow of traffic.

3.5.1 New Rights-of-Way

Local municipalities within the Region of York generally have development policies that outline which types of new streets require sidewalks, and whether sidewalks are required on one or both sides of the street. The developer will undertake, by agreement with the municipality, to ensure the sidewalk is constructed to the current municipal design standards and specifications and transfer the completed sidewalk to the municipality.

3.5.2 Existing Rights-of-Way

Local municipalities should give consideration to the following criteria when developing their own methodology and selection procedure for locating new sidewalks. For older sections of a municipality, especially for residential areas, sidewalks may not have been included with the original roadway construction. The following factors should be considered when determining where in the community additional sidewalks should be constructed.

- Addition of transit or school bus routes;
- Providing access for the elderly and persons with disabilities;
- continuity of sidewalks (avoid missing sections of sidewalk where possible);
- Increased pedestrian volumes; addition of new facilities including schools, institutions, parks, and sports complexes;
- The presence of other pedestrian generators (library, community centre, church, hospital, shopping precinct or mall);
- Community input; vehicle speed, traffic, and truck volumes; collision data related to pedestrians;
- Existing sidewalk on the other side of the street; weather implications (prevailing winds or sun/shade);
- Type of roadway shoulder and width; and
- Population density.

When sidewalks are not available, pedestrians normally walk on the roadway, increasing the potential for pedestrian/vehicle injuries. Therefore, in order to reduce pedestrian risk and encourage walking, sidewalks should be considered on a minimum of one side of the street for arterial and collector roads. In Regional Centres, sidewalks should be located on both sides of regional roads and on key local municipal arterial and collector roads. For local streets, the factors outlined above should be evaluated to determine where sidewalks should be constructed. There is a risk to installing, but there may also be a risk in not installing a sidewalk. A risk assessment should be undertaken by the municipality to determine potential liability in areas without sidewalks.

3.5.3 Pedestrian Zone

The width of the pedestrian zone for the sidewalk should be related to pedestrian demand, which is determined in part, by the type and scale of adjacent land uses. Each municipality should set its own guidelines for the minimum width of the pedestrian zone, depending on factors, such as pedestrian volumes, road classification, adjacent land use, and right-of-way width.

A clear pedestrian zone is required to accommodate pedestrians. No street furniture, trees, utilities, poles, signs, mailboxes, or other streetscape elements should be allowed in the pedestrian zone. The sidewalk grades and finishes in the pedestrian zone should be compatible with design guidelines outlined in Section 3.6.

A minimum vertical clearance of 2.0 metres is recommended in the pedestrian zone from the sidewalk to potential obstacles such as tree branches, hanging baskets, signs and banners.

The Institute of Transportation Engineers (ITE) recommends a minimum sidewalk width of 1.5 metres. When the sidewalk is located adjacent to the curb on major roadways, the width should be increased to 1.8 metres. The preferred width to provide for the safe passage between an adult and a person pushing a baby carriage or in a wheelchair, or a child on a tricycle is 1.8 metres.

Near hospitals, schools, offices, industrial and commercial shopping and entertainment areas, where large pedestrian volumes may occur, sidewalk widths of 3.0 m should be considered. Wider sidewalks should also be installed near schools, at transit stops, and in any other areas where there are high concentrations of pedestrians. Bicycle parking racks, water fountains, benches, and other urban design elements should be provided in areas with high pedestrian traffic, but should be carefully placed so that they do not obstruct the path for pedestrians. Sidewalks should be continuous and be part of a system that provides access to goods, services, transit and homes.

Sidewalks in residential areas should be located away from the roadway adjacent to the property line. A buffer zone should be considered to ensure the sidewalk is constructed within the public right-of-way. The buffer zone also allows for a utility corridor for a variety of uses. A buffer zone with a minimum width of 0.5 metres is recommended. The buffer zone also provides a clearance to private retaining walls, fences and driveway curbs thereby facilitating municipal sidewalk winter maintenance activities.

In downtown urban areas, parked cars, bicycle lanes, street furniture, or landscaping can act as an acceptable buffer zone. In suburban areas, a buffer zone may consist of trees or shrubs or a landscaped strip.[5]

Most sidewalks located in commercial or residential areas are oriented with reference to the adjacent street and are continuous axially. Minor acute-angled discontinuities may occur requiring slight reorientation of movement. Sudden or unexpected discontinuities requiring a right-angle change in direction are disorientating and, at street crossings, can be a safety hazard. Three sidewalk layouts are illustrated in **Figure 3.8**, with the middle showing the preferred form of continuity.

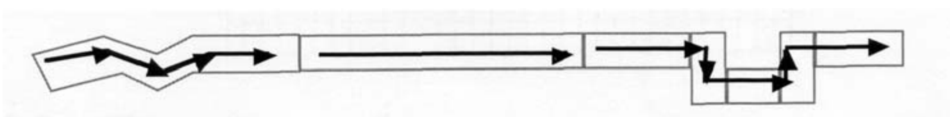

Figure 3.8: Sidewalk Continuity Pattern
Source: M. Gordon Brown, Healthy Sidewalks – A Guide, 2002

Sidewalks should be kept clear of poles, signposts, newspaper boxes, and other obstacles that could block the path, become a tripping hazard, or obscure a driver's view.

3.5.4 Pedestrian Friendly Streets

In order to encourage alternative means of travel, such as transit and walking, a safe pedestrian crossing and access environment is essential. Signalized intersections provide relatively safe pedestrian crossing locations. In order to accommodate older pedestrians and pedestrians with disabilities, ideally signal timing plans should assume a lower walking

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[5] Pedestrian Facilities User Guide – Providing Safety and Mobility; U.S. Department of Transportation, Federal Highway Administration March 2002

speed (e.g. 1 metre per second or lower). However, with a seven-lane cross-section, it could be very challenging to provide for sufficient pedestrian time to cross the major arterial street, while maintaining an acceptable level of service for the arterial. To mitigate the situation, signal operations which allow pedestrians to cross only half of the arterial street at a time are recommended at intersections where side street/driveway traffic volumes are relatively low. As such, pedestrian refuge areas in the medians and pedestrian actuation buttons within the median, should be provided where feasible and a study has confirmed a need.

Travel time increases as signal density increases. However, infrequent signalized intersection spacing can result in pedestrians crossing the roadway at mid-block locations. The issue of marked versus unmarked crosswalks is often a controversial one. A study in the United States found that for multi-lane roads with traffic volumes greater than 12,000 vehicles per day, a higher pedestrian collision rate occurred at marked crosswalks, as compared to unmarked crosswalks. Thus, if marked crosswalks are to be provided, complementary safety enhancements are highly recommended at marked crosswalk locations (e.g. pedestrian signals).

However, marked or unmarked crosswalks at mid-block locations may not be able to address the problems of inadequate gaps in traffic and high traffic speeds typically found along major arterial streets. Pedestrian signals can provide a relatively safe and protected location for crossing, but signal warrants for pedestrian crossings at mid-block location often cannot be met because of the unfriendly pedestrian crossing environment that deters pedestrians from crossing at that mid-block location. Thus, the basic signal warrant requirement should be reconsidered when the community has raised the issue related to the need for pedestrian crossing signals.

In order to ensure a pedestrian friendly and walkable environment along the existing or proposed 6/7 lane regional road corridors, sidewalks should be provided along both sides of major arterial streets. It is recognized however that the local municipalities, not the Region, are responsible for the installation of sidewalks along Regional roads. As such, the cooperation of the local municipalities is required to ensure that sidewalks are installed along both sides of Regional roads, particularly within the urbanized parts of the Region, and selectively in the rural parts of the Region (eg. where a hamlet exists, etc.).

It is recommended that the Region continue the use of lower walking speeds (1 m/s) when designing signal timing plans to accommodate older pedestrians particularly at locations where seniors tend to cross (e.g. near a seniors' housing or recreational complex). Signal operations which allow pedestrians to cross only half of the arterial street at a time at intersections where side street/driveway traffic volumes are relatively low, should also be considered. Pedestrian refuge areas in the medians and pedestrian actuation buttons within the median should be provided in this case. Basic pedestrian signal warrants should be reconsidered when the community has raised an issue related to the need for pedestrian crossing signals.

Marked crosswalks should only be installed where adequate protection is provided. Conversely, the Region may consider breaks in raised medians to allow pedestrians to cross at their own risk at uncontrolled mid-block locations.

As noted, sidewalks should be provided along both sides of the streets, with a minimum width of 1.5 metres and wider in areas of higher pedestrian demands.

3.6 Sidewalk Design Considerations

3.6.1 Grades and Crossfall

Generally, sidewalk grades follow the roadway. The grade of the sidewalk is permitted to be as steep as the adjacent roadway. When the sidewalk grade is steeper than the roadway grade and exceeds 8%, then the sidewalk should be treated as a ramp with appropriate rest areas and handrails. Sidewalks constructed at intersections and approaches should follow the guidelines for ramp design as noted below.

The recommended crossfall is 2 percent. The crossfall can range from 1 to a maximum of 4 percent to provide adequate drainage and minimize concerns of a sliding hazard on the sidewalk.

If there is a boulevard area between the sidewalk and the roadway, the grade and crossfall should be properly designed to facilitate drainage from the sidewalk area.

3.6.2 Driveway Aprons

It is desirable that driveway aprons not intrude into the pedestrian zone. It is recommended to design the driveway apron slope to a maximum of 8 percent between the curb and the front of the sidewalk. To achieve this guideline, it may be necessary to drop the sidewalk partially through the driveway, when the sidewalk is located close to the curb. This approach is recommended instead of increasing the crossfall in the pedestrian zone, which should be kept at a recommended 2 to 4 percent crossfall.

When the boulevard is narrow or the sidewalk is integral to the curb, a depressed sidewalk may be used to meet wheelchair design guidelines.

The depressed sidewalk should have maximum grades of 8 percent on the approaches to the depressed driveway area. The crossfall should be kept to a recommended 2 percent across the driveway.

At driveway locations, the sidewalk cross-section should be increased to support the additional vehicular loading. The following minimum concrete sidewalk thicknesses are recommended:

- Residential driveways - 150 mm; and
- Commercial and industrial driveways - 180 mm or more.

In driveway and laneway areas where wheelchair accessibility is required to the roadway, consideration should be given to providing an even transition between the curb and the roadway.

3.6.3 Curb Ramps

Curb ramps allow universal access between the sidewalk and the street. The ramps are normally found at intersections, but can also be located between intersections.

A variety of curb ramp designs contain some or all of the following components: (U.S. Department of Transportation, Federal Highway Administration, Designing Sidewalks and Trails for Access Part I of 11: Review of Existing Guidelines and Practices, July 1999).

- Landing - The area at the back of the sidewalk, in the middle of the curb ramp. Landings allow the wheelchair user to move around the intersection corner without using the curb ramp. The recommended minimum landing width is 1.5 metres and maximum grade is 2 percent.
- Approach - The area on each side of the landing, extending from the back to the front of the sidewalk. The recommended maximum grade should not exceed 8 percent according to the accessibility guidelines.
- Flare - The transition area between the curb ramp and the approach areas. It is desirable that the slope on the flare not exceed 8 percent. However, if the grade is steeper, then it is recommended that the landing width be increased accordingly. The transition area can be grass in residential areas.
- Ramp - The sloped transition between the landing and the curb. To meet accessibility guidelines, the curb ramp grade should not exceed 8 percent. The preferred width of the curb ramp should be at least 1.2 metres, not including the width of the flairs.
- Gutter - The gutter is located at the bottom front face of the curb and provides drainage along the street. The preferred maximum slope on the gutter surface immediately adjacent to the curb should not exceed

5 percent. The curb should be trowelled level to the gutter on the roadside edge at the curb ramp. It is recommended that catchbasins not be located in the gutter in front of the ramp area to aid accessibility for wheelchairs.

At an intersection corner, a municipality may decide to have one diagonal curb ramp located in the middle of the curb radius or two separate perpendicular curb ramps, one at each pedestrian crossing location.

Two perpendicular curb ramps with level landings are recommended, because they are considered to be generally safer and more usable for pedestrians than a single diagonal curb ramp. For the diagonal curb ramp, the width of the ramp must be sufficient to allow wheelchairs to continue across the intersection without directing them into the centre of the intersection. The installation of ramps should take place on all four corners of the intersection.

Additional information on the design of curb ramps can be found in the report prepared by the U.S. Department of Transportation, Federal Highway Administration (1999) for *Designing Sidewalks and Trails for Access, Part I of II: Review of Existing Guidelines and* practices. Only the ramp and landing areas need to be constructed of even, solid materials. The flairs and area between ramps can be landscaped or decoratively paved.

Pedestrians with visual impairments utilize curb ramps differently than pedestrians with or without mobility impairments. Several methods are available to assist people with visual impairments at an intersection, including raised tactile surfaces, materials with contrasting sound properties, grooves in the sidewalk, and installation of audible warnings at intersections with signals.

3.6.4 Surface Finish and Jointing

Different surface materials should also be used when designing sidewalks, with patterns varying depending on expected use, environmental conditions, subsurface conditions, maintenance expectations and the need for durability, tactility and attractiveness. A wide variety of surface patterns are possible depending on the materials available and the design intent.

To aid accessibility, it is important that the decorative jointing/scoring is minimized in the pedestrian zone. For concrete surfaces, saw cutting the control/construction joints and a broom finish is recommended. Any joints in the sidewalk should be as even, level and as narrow as possible to facilitate movement of wheeled vehicles, seniors and the visually impaired. For interlocking pavers, the maximum variation in height between adjacent units should be 2 mm.

Surface patterns should be even, consistent, have adequate friction and not be confusing. Distinctive patterns are not simply for decorative purposes, but are used to provide cues for users – for store entrances, street crossings, or changes in grade. The visually impaired, for example, use surface patterns to detect their position relative to street crossings. A pattern of cross-hatching, dimpling or scoring is usually applied at sloped or potentially slippery areas.

Figure 3.9 illustrates some examples of sidewalk surface patterns that Region of York should consider when installing new pedestrian facilities.

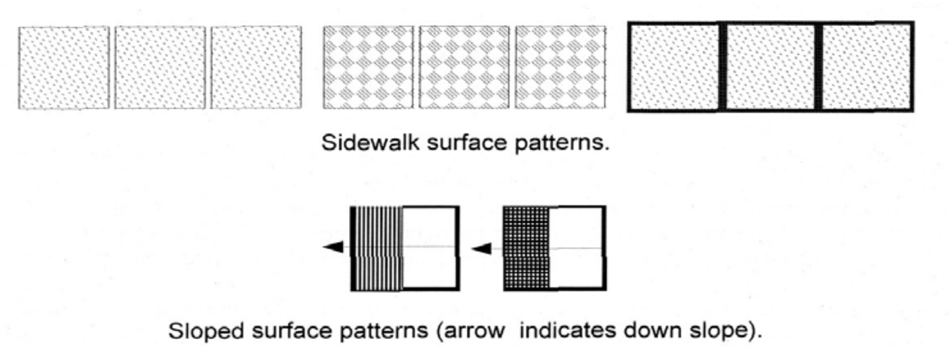

Figure 3.9 Sidewalk Surface Patterns
Source: M. Gordon Brown; Healthy Sidewalks: A Guide, 2001

Guidelines:

3.20 Existing and future pedestrian sidewalks should be incorporated into the spine and neighbourhood systems in urban areas for all system segments proposed within road rights-of-way.

3.21 A "buffer" zone should also be provided where applicable to separate pedestrians from the street.

3.22 Different sidewalk surface materials should also be used when designing sidewalks. Patterns of cross-hatching, dimpling or scoring should be applied at sloped or potentially slippery areas.

3.6.5 Trees and Landscaping

Trees are an important component of the urban landscape and provide aesthetic, environmental, and social benefits. Trees add value to the area and must be taken into account and balanced as part of the street infrastructure requirements.

Tree root damage to sidewalks varies drastically from city to city, block to block, and tree to tree. In some cases, a sidewalk may never be damaged by a tree growing directly adjacent to it. On the other hand, a small tree can completely upheave a sidewalk causing a major pedestrian hazard. The degree of damage to a sidewalk is not always known, however, variables such as soil type, tree species, growing space and construction practices appear to play a pivotal role. Recognizing this damage requires on-going management and is critical to the existence of both the tree and the sidewalk. For example, trees can lead to considerable maintenance costs to repair damage to sidewalks and other infrastructure including curbs, sewers, and driveways.

Selecting the appropriate tree species for the proposed planting space is one of the key preventive strategies to avoid conflicts later with sidewalks and other infrastructure. Tree species which generate roots that grow near the soil surface have a high potential to damage sidewalks unless the planting area is sufficiently large, ideally to the size of the tree drip line area. Increasing space around established trees by curving the sidewalk is another option. An alternative is to reduce the width of the roadway or remove parking spaces to create space for trees and landscaping. Directing roots away from the sidewalk area can reduce potential damage. Root barriers installed at the edge of the sidewalk may also deflect roots. The root barrier can be thermoplastic panels, or sheets. Various methods to channel the growth of roots in specific areas can also be used, such as trenches or pipes filled with soil favourable for root development [6]

Structural soil can also be used to distribute tree roots through the soil to reduce the potential for damage to adjacent sidewalks. Structural soil is a mixture of soil and stone, or soil and a derived aggregate, such as expanded slate or shale. The mixture may also use a stabilizing material to encourage consistency. When planting space is limited, use of structural soil as a replacement for native soils should be considered.

As a guideline, up to 30 percent of the tree roots within the drip line can be removed without any adverse effect on the tree. Furthermore, changes in grade by placing fill or removing soil within the drip line area should be minimized whenever possible. Finally, where projects involve removing and replacing sidewalks near large trees, an arborist should be consulted in the planning stages.

[6] Costello, L.R. and K.S. Jones, 2003. Reducing Infrastructure Damage by Tree Roots – A Compendium of Strategies

3.6.6 Winter Design Considerations

Sidewalks should be designed to increase user friendliness and minimize effects of winter snow and wind.

The prevailing wind in the northern hemisphere is from the northwest. When sidewalks are constructed on only one side of a roadway, consideration should be given to placing the sidewalk on either the north or west side of the roadway.

Bridge retaining walls, abutments, piers, and pedestrian protections such as a Jersey Barrier act as snow fences, resulting in accumulation of drifts from blowing snow. Wind direction should be considered when selecting the location of sidewalks on and under bridges.

A boulevard area between the roadway and the sidewalk provides a location for snow storage from roadway plowing operations. When the sidewalk is located immediately adjacent to the roadway, the snow plowed from the roadway will be placed on the sidewalk. For municipalities who plow sidewalks, it is important to schedule the sidewalk clearing after the roadway plowing.

A Jersey Barrier and similar barriers placed in front of sidewalks should have large openings at the bottom to allow snow to blow away from the sidewalk. These openings also allow snow melt to run off away from sidewalks and boulevard area to the roadway.

3.7 Multi-Use Trails

3.7.1 Multi-Use Boulevard Trails

Multi-Use Boulevard Trails (also sometimes called in-boulevard trails) are bi-directional off-road trails and located within the boulevard of a road right-of-way and parallel to motor vehicle travel lanes. They are typically designed for a wide range of users including pedestrians, cyclists, and in-line skaters. A schematic illustration of a multi-use boulevard trail is provided in **Figure 3-10**.

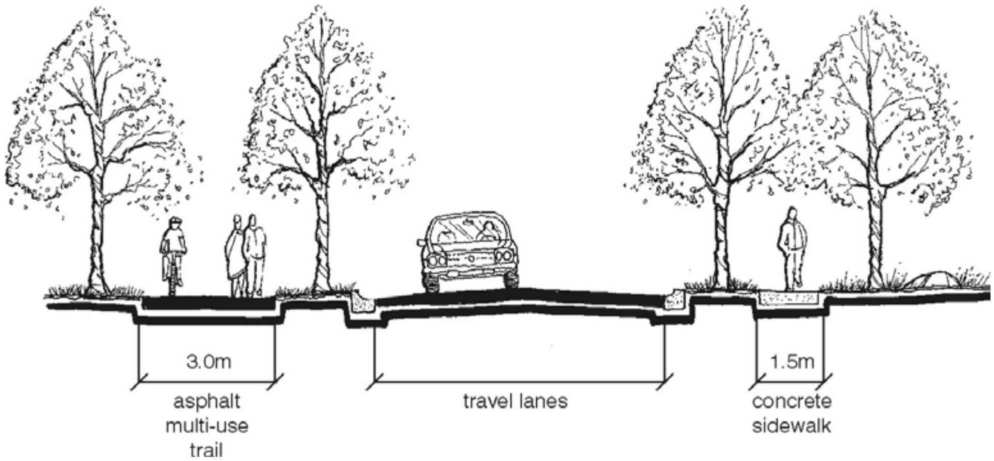

Figure 3.10 Multi-Use Boulevard Trail

Although constructed within the road right-of-way, boulevard trails are separated from regular motor vehicle travel lanes through either a change in roadway elevation (a boulevard trail is usually placed at the same height as a sidewalk) and / or by barriers or medians.

Motorists tend to prefer boulevard trails because they get cyclists off of the roadway, but pedestrians tend not to like them because they place faster moving bicycle traffic into a space that is traditionally reserved for walking.

Many cyclists who are uncomfortable operating in traffic believe that boulevard trails provide increased safety as cyclists are removed from the traffic stream on a roadway. However, safety professionals and experienced cyclists tend to disagree because collision statistics suggest that cyclists using boulevard trails are more frequently involved in bicycle/motor-vehicle collisions at intersections compared to cyclists riding in a curb lane.

It is suggested that only when it has been determined that on-road improvements are not feasible along arterial streets, or when a primarily multi-use trail facility is preferred by a municipality over a sidewalk and on-street bicycle lanes to achieve a recreational facility objective, should a multi-use boulevard trail be considered as a primary cycling route. When this is the case, additional criteria **should** be considered to promote user safety. These criteria includes:

Available Rights-of-Way

To accommodate the minimum standard for a multi-use boulevard trails, there should be 6 m of available right-of-way. This is necessary to provide for a 1 m clear zone from obstructions, a 3.0 to 3.5 m wide trail, and a 1.5m buffer/open space that separates the trail from the road. (AASHTO standards suggest if there is less than a 1.5 m buffer width, a 1.4 m high physical barrier is required).

Number of Street and Driveway Intersections

Studies show that cyclists who ride on multi-use trails incur 1.8 times greater risk of being involved in a collision with a motor vehicle than those who ride on a roadway. The risk increases for path users who are traveling against traffic – they have been found to be 4.5 times at risk as right-way trail travelers because motor vehicle operators are not looking for cyclists or other traffic off of the roadway and / or coming from the opposite directions.[7]

For this reason, multi-use boulevard trails should not be considered when there are more than 12 residential driveways, 6 commercial drives/minor streets, or 3 major street intersections per kilometre. Beyond this, a cyclist would face more than 1 driveway every 30 seconds, or 1 street every minute, whereby the safety and utility of the path deteriorates dramatically. Commercial strips and other areas with heavy vehicular turning movements can also be a risk management concern.

Final Design Considerations

The above two criteria are most important to assess feasibility during the planning stages of a project. However, when a trail moves into the design and construction phase, additional problems will need to be resolved, including providing access to destinations located on the opposite side of the street from the trail, modifying signal timing to permit non-motorized users to move through an intersection, removing obstructions from sight triangles, locating crosswalks at a proper distance from the parallel roadway, and providing curb cuts and transition areas so that cyclists may access the path from both the parallel and intersecting streets.

However, in no instance should development of a multi-use boulevard trail preclude cyclists, from using an adjacent roadway.

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[7] Kane County Bicycle and Pedestrian Plan; Kane County/Council; December 2002

Additional Cautions Regarding Multi-Use Boulevard Trails

AASHTO notes the following problems associated with multi-use trail boulevard trails:

- Unless separated and set back from the road, they require one direction of cycling traffic to ride against motor vehicle traffic, contrary to normal rules of the road;
- When the path ends, cyclists going against traffic will tend to continue to travel on the wrong side of the street. Likewise, cyclists approaching a shared-use path often travel on the wrong side of the street in getting to the path. Wrong-way travel by cyclists is a major cause of cyclist / automobile collisions and should be discouraged at every opportunity;
- At intersections, motorists entering or crossing the roadway often will not notice cyclists approaching from their right, as they are not expecting contra-flow vehicles. Even cyclists coming from the left often go unnoticed, especially when sight distances are limited;
- Signs posted for roadway users are backwards for contra-flow cycling traffic; therefore these cyclists are unable to read the information without stopping and turning around;
- When the available right-of-way is too narrow to accommodate all roadway and shared-use path features, it may be prudent to consider a reduction of the existing or proposed widths of the various road (and trail) cross-sectional elements such as travel lane and shoulder widths, for example. However, any reduction to less than MTO, TAC, AASHTO or municipal approved design criteria should be supported by a documented engineering analysis;
- Many cyclists will use the roadway instead of the boulevard trail because they have found the roadway to be more convenient, better maintained, or perceive it to be safer. Some motorists who feel that in all cases cyclists should be on the trail may harass cyclists using the roadway;
- Although shared-use multi-use boulevard trails should be given the same priority through intersections as the parallel roadway, motorists falsely expect cyclists to stop or yield at all cross-streets and driveways. Efforts to require or encourage cyclists to stop or yield at each cross street and driveway, as required under the Highway Traffic Act, are frequently ignored by cyclists; and
- Stopped cross-street motor vehicle traffic exiting side streets or driveways may block the path crossing.

Example of a Boulevard Trail as a designated cycling facility immediately adjacent to a roadway (Ottawa, Ontario)

The application of boulevard trails as cycling facilities directly adjacent to a roadway is not recommended unless separated by a curb and clear zone.

Guideline:

3.23 Multi-use trails in the Region of York should be constructed to a minimum width of 3.0 m to accommodate bi-directional flow. On popular, heavily traveled multi-use trails widths of 3.5 m to 4.5 m are suggested to allow for a wider variety and greater number of users.

3.24 Trail Surface type is dependent on requirements of planned trail users (e.g. accommodating in-line skaters) and can vary from asphalt to granular surfaces (limestone screenings).

3.25 The application of multi-use boulevard trails immediately adjacent to a roadway, especially as a cycling facility should only be considered for cycling when an on-road facility is not feasible or when a municipality seeks to provide a primarily multi-use recreational boulevard trail and cannot or chooses not to provide a parallel on-road facility for cycling.

3.7.2 Off-Road Multi-Use Trails

Off –Road Multi-Use Trails should be designed to accommodate a variety of user groups. A review of various cycling and trail design guidelines from throughout North America indicates that standards vary depending upon the trail's location, the anticipated number of users and the permitted uses. The minimum width is typically 3.0 m, which allows for bi-directional flow. On popular, heavily traveled multi-use trails, such as the

Tom Taylor Trail in Newmarket, widths of 3.0 m to 4.0 m are recommended to allow for a wider variety and greater number of users.

Multi-use trails are typically incorporated into parkland and valley land, or within the boulevards of a road right-of-way. Cyclists may choose, however, to remain on the road, even if a parallel route exists. A schematic illustration is provided in **Figure 3.11**.

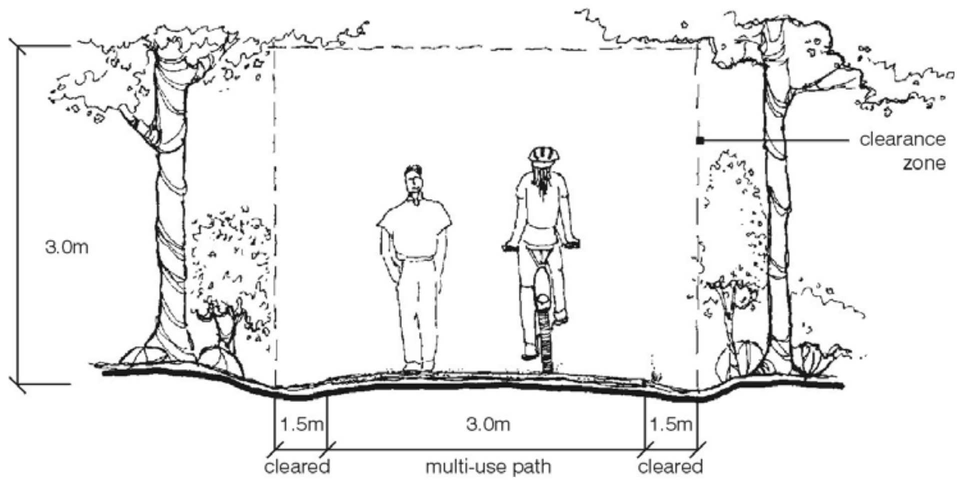


Figure 3-11 Multi-Use Trail

3.8 Footpaths/Hiking Trails

Footpaths and hiking trails are typically narrow single-track routes with a soft surface (earth or granular) and are intended for pedestrian use only unless otherwise noted. Existing and future footpaths and hiking trails should be built into the tertiary system in open spaces and woodlots where feasible.

3.8.1 Variations of Footpaths and Tertiary Trails

In valleys and open spaces, typical off-road trail designs include hiking and walking trails. Other possible variations include cross-country skiing, equestrian and cycling trails, however, these latter two would likely be located in rural areas and conservation lands. These are the main types of off-road trails in rural areas as defined by the Toronto and Region Conservation Authority, (TRCA) Trail Planning and Design Guidelines. **Figures 3.12 to 3.13** detail typical cross sections for hiking and walking off-road trail designs in rural areas.

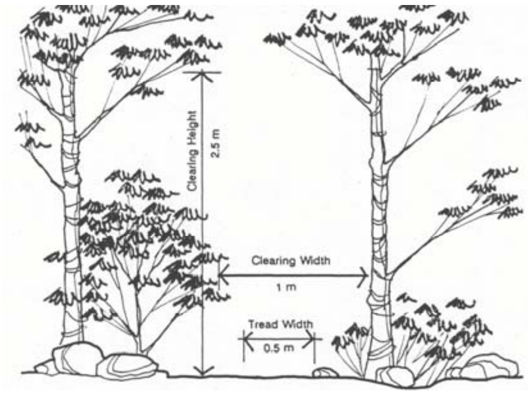


Figure 3.12 Hiking Trail Cross Section
Source: TRCA, Trail Planning & Design Guidelines 1992

Guideline:

3.26 Hiking trails or footpaths should nave a natural terrain tread surface. The clearing height for a hiking trail should be at least 3.0 m. Desirable grades should be between 0 and 20% with a maximum sustained grade of 25%. Hiking trails should be at least 1 kilometre in length, with an optimum length of 5 to 10 kilometres

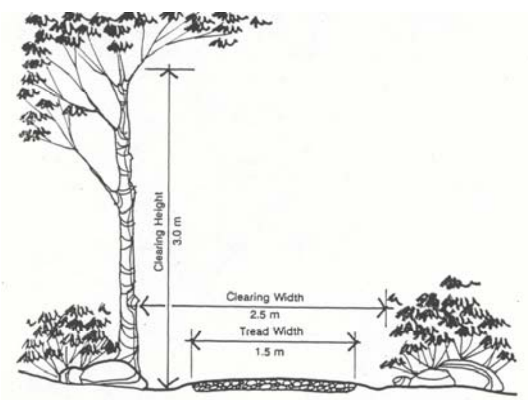


Figure 3.13 Walking Trail Cross Section
Source: TRCA, Trail Planning & Design Guidelines 1992

Guideline:

3.27 Walking trails should have a clearing height of 3.0 m and should be made from compacted granular materials such as gravel and shale. Desirable grades should be between 0 and 3% with a maximum sustained grade of 5%. Generally, walking trails are less than two kilometres in length.

For more detailed information regarding off-road trail design in natural and conservation areas, we suggest referring to the "Toronto and Region Conservation Authority Trail Design Guidelines."

Chapter 4.0 Bicycle Network and Pedestrian System Design Features

4.1 Lane Widths

4.1.1 Road Narrowing (Road Diets)

Road narrowing or lane reduction can be used to reduce vehicle speeds and enhance the movement and safety of pedestrians. It is also an effective method of utilizing excess space. A reduction in the travelled portion of a roadway can allow for sidewalks to be widened and pedestrian areas to be increased. This would also reduce pedestrian crossing times and help to optimize traffic signal timings. Traffic lanes can also be re-striped for fewer lanes; for example, a four-lane street may be re-marked to accommodate one lane in each direction, a centre turn lane, bicycle lanes and extended sidewalks.

Road narrowing must also consider school bus, emergency vehicle access and truck volumes. A reduction in travel lanes can affect the carrying capacity of a roadway which may cause traffic to divert onto adjacent residential streets[1] [2]. **Figure 4.1** illustrates a schematic example of road narrowing.

Currently, continuous two-way left turn lanes (TWLTL) are found in many areas of the Region, even at locations where there are no intersecting streets or driveways, in order to maintain a straight road alignment. However, this results in an excessive amount of pavement. Based on the input obtained from the Visioning Sessions (as part of the Towards Great Regional Streets Study), raised medians were identified as the preferred treatment along any 6 lane corridors, given the safety benefits over the TWLTL treatment, and the potential for landscaping, therefore a far more attractive environment than TWLTL’s.

[1] Pedestrian Facilities User Guide – Providing Safety and Mobility; U.S. Department of Transportation, Federal Highway Administration March 2002

[2] Alternative Treatments for At-Grade Pedestrian Crossings, Nazir Lalani & the ITE Pedestrian and Bicycle Task Force, ITE 2001

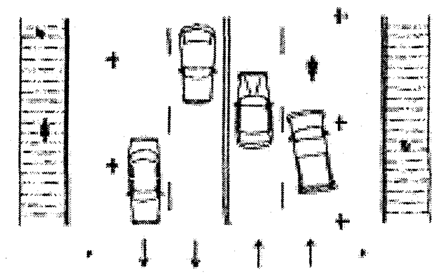


ILLUSTRATION RESTRIPING BEFORE

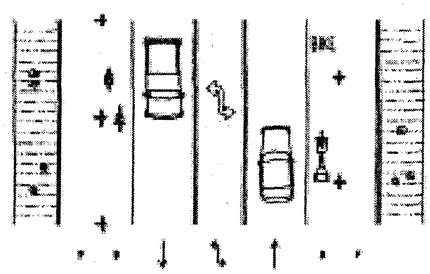


ILLUSTRATION RESTRIPING AFTER

Figure 4.1 Narrowed Lanes
Source: Pedestrian Facilities Uses Guide – Providing Safety and Mobility, Federal Highway Administration, McLean Virginia, 2002

Guideline:

4.1 Road narrowing can be used to slow vehicle speeds and enhance pedestrian areas. Roadway carrying capacity, bicycle lane, and emergency vehicle access must be considered before implementing this procedure.

Road diets have been successful in several communities for roadways with an average daily traffic (ADT) of 18,000. It is important to remember that intersections determine roadway capacity, not the number of lanes mid-block. Road diets provide turning lanes to handle capacity.

A road diet changes the "feel" of the roadway. It offers traffic calming benefits by modifying perception of appropriate travel speeds. Lane manoeuvring is simplified while maintaining capacity. Left-turning motorists are removed from the travel way. This results in through cars maintaining continuous movement throughout the corridor without speeding and passing. Entering motorists only need to cross one lane of traffic; if needed, they have a median refuge area in which to wait for a second gap in traffic. Non-motorized users benefit when space is provided for on-street bike lanes, turning movements are simplified, and crossings in non-signalized locations are made easier.

Reduced lane widths 3.3 metres are used on roadways in many jurisdictions with limited rights-of-way to accommodate different elements of the cross-section. Narrower lanes can reduce the pedestrian crossing distance and vehicular traffic speed. Drivers drive more cautiously given the reduced space between vehicles in the adjacent lane. This could also be viewed as a traffic calming measure.

On the other hand, lane widths greater than 3.7 metres can be detrimental to safety. Drivers tend to drive at higher speeds and less cautiously with wider lanes. Speeding is more prevalent along wider lanes. This can lead to more accidents and a less safe environment, especially for pedestrians. In addition, wide curb lanes may encourage drivers to park or stop momentarily on-street where they are not permitted to do so.

The literature review indicates that safety is maximized for lane widths somewhere between 3.3 metres and 3.7 metres. Thus, there is little safety benefit to widen the lanes beyond 3.3 metres and that widening beyond 3.7 metres can be detrimental to safety.

Thus, lane widths greater than 3.7 metres are not recommended. Rather, a 3.5 metre wide curb lane is recommended to accommodate buses and heavy vehicles. This slightly wider curb lane width is desirable to accommodate cyclists where delineated bike lanes are not provided. This can also provide additional space between vehicles and pedestrians, thus further enhancing the walking environment along sidewalks.

In general, on roads with a posted speed limited of 70 km/h or less, reduced lane widths (3.3 metres) should be considered for inner lanes (middle and median lanes), whereas curb lanes should be kept at 3.5 metres wide. However, in industrial areas or other roadways which carry relatively high truck traffic volumes, wider inner lanes (3.5 metres) should be considered. It is recognized that a change in design standards will be required in York Region in order to implement this.[3]

[3] Towards Great Regional Streets – A Path to Improvement, Regional Municipality of York; January 2006

4.2 Retrofitting Municipal Roads for Cycling and Pedestrian Facilities

Many of the new cycling routes or pedestrian systems that are implemented through the PCMP will involve retrofitting of existing roadways. This section discusses this issue roadways.

4.2.1 Cycling Facilities

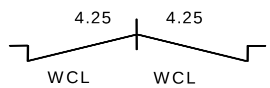
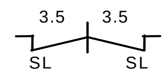
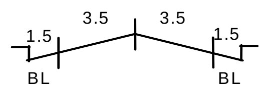
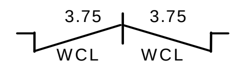
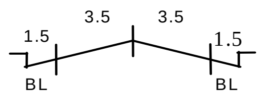
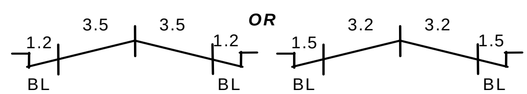
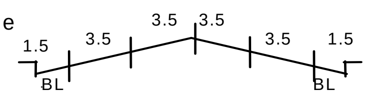
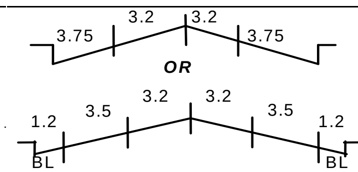
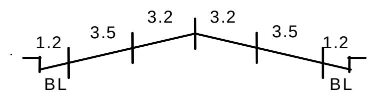
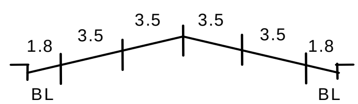
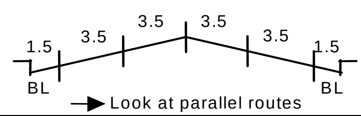
The majority of new cycling routes recommended in master plan will involve retrofitting existing arterial and local roads. Narrow rights-of-way, roadway platform and pavement widths as well as other geometric issues related to roadway design and drainage will impact both the feasibility and cost of implementing the recommended facility type and respective preferred design. It is important to establish minimum thresholds for applying appropriate design guidelines.

Tables 4.1 and 4.2 outline a set of recommended guidelines for retrofitting roads in the Region of York to accommodate cycling facilities in both ideal and constrained conditions.

Guideline:

4.2 The Region of York should refer to the retrofitting guidelines recommended in Tables 4.1 and 4.2 of these Planning and Design Guidelines when planning and designing cycling infrastructure.

Table 4.1
Retrofitting Urban Roads for Cycling Facilities in the Region of York

	Road Configuration and Characteristics	Preferred Solution	Minimum or Interim Solution (Constrained Projects)
a)	2 Lane Urban ≤ 3,000 AADT / Lane ≤ 60 km/h ≤ 6% Trucks		
b)	2 Lane Urban > 3,000 AADT / Lane ≤ 60 km/h 6% ≤ 12% Trucks		
c)	2 Lane Urban > 3,000 AADT / Lane > 60 km/h > 12% Trucks		
d)	4+ Lane Urban ≤ 10,000 AADT / Lane ≤ 60 km ≤ 12% Trucks		
e)	4+ Lane Urban > 10,000 AADT / Lane ≤ 60 km/h > 12% Trucks		
f)	4+ Lane Urban > 10,000 AADT / Lane > 60 km/h > 12% Trucks		

BL = Bike Lane WCL = Wide Curb Lane SL = Shared Lane 3.5 = Vehicle Travel Lane Width (metres)

BL = Bike Lane measured to face of curb (includes gutter)

NOTES:

1. Motor vehicle travel lane widths can vary (e.g. 3.25 m to 4.25 m). If a travel lane is less than 3.25 m the adjacent bike lane should typically be a minimum of 1.5 m unless it is an interim condition. That said, good engineering judgement must be applied at all times.

2. **The values indicated in these tables are suggested thresholds and are not meant to be prescriptive. Rather, these thresholds are meant to serve as a guide to assist bikeway planners and designers in the decision-making process when attempting to retrofit existing roads for cycling facilities.** A decision to select one cycling facility type over another will also be influenced by other factors. These may include the type and density of adjacent land uses, driveway frequency, collision information, municipal streetscape and / or urban design planning objectives for a particular road or road segment, and local community preferences.

Sources:

- Ministry of Transportation of Ontario (MTO), Ontario Bikeways Planning and Design Guidelines (1996);
- Transportation Association of Canada (TAC), Geometric Design Guide for Canadian Roads (1999);
- United States Department of Transportation - Federal Highway Administration, Selecting Roadway Design Treatments to Accommodate Bicycles (FHWA-RD-92-073);
- University of North Carolina, Highway Safety Research Center and Pedestrian and Bicycle Information Centre, Bicycle Facility Selection: A Comparison of Approaches;
- American Association of State Highway and Transportation Officials, Guide for the Development of Bicycle Facilities, (1999);

Table 4.2
Retrofitting Rural Roads for Cycling Facilities in the Region of York

	Road Configuration and Characteristics	Preferred Solution	Minimum or Interim Solution (Constrained Projects)
a)	2 Lane Rural ≤ 3,000 AADT / Lane ≤ 80 km/h ≤ 6% Trucks Good Sight Lines	1.5 PSL · 3.5 · 3.5 · 1.5 PSL ≥ 1.2 PSL · 3.5 · 3.5 · ≥ 1.2 PSL	OR ≥ 0.5 (Edge line) · 3.5 SL · 3.5 SL · ≥ 0.5 (Edge line)
b)	2 Lane Rural > 3,000 AADT / Lane ≤ 80 km/h 6% ≤ 12% Trucks Good Sight Lines	2.0 PSL · 3.5 · 3.5 · 2.0 PSL	1.5 PSL · 3.5 · 3.5 · 1.5 PSL
c)	2 Lane Rural > 10,000 AADT / Lane ≤ 80 km/h > 12% Trucks Good Sight Lines	2.5 PSL · 3.5 · 3.5 · 2.5 PSL	2.0 PSL · 3.5 · 3.5 · 2.0 PSL → Look at parallel routes
d)	4 Lane Rural < 10,000 AADT / Lane ≤ 80 km/h ≤ 12% Trucks Good Sight Lines	2.0 PSL · 3.5 · 3.5 · 3.5 · 3.5 · 2.0 PSL	1.5 PSL · 3.5 · 3.5 · 3.5 · 3.5 · 1.5 PSL
e)	4 Lane Rural > 10,000 AADT / Lane < 80 km/h > 12% Trucks Good Sight Lines	2.5 PSL · 3.5 · 3.5 · 3.5 · 3.5 · 2.5 PSL	2.0 PSL · 3.5 · 3.5 · 3.5 · 3.5 · 2.0 PSL → Look at parallel routes

PSL = Paved Shoulder Lane   SL = Shared Lane   3.5 = Vehicle Travel Lane Width (metres)

NOTES:

1. On roads with poor sight lines, preferred guidelines should always apply. Consideration should also be given to an additional clearance width of 0.5 m in the paved shoulder.
2. Assumes paved shoulders have an adjacent granular shoulder, which is typically 0.5 m or more in width.
3. **The values indicated in these tables are suggested thresholds and are not meant to be prescriptive. Rather, these thresholds are meant to serve as a guide to assist bikeway planners and designers in the decision-making process when attempting to retrofit existing roads for cycling facilities.** A decision to select one cycling facility type over another will also be influenced by other factors. These may include the type and density of adjacent land uses, driveway frequency, collision information, municipal streetscape and/or urban design planning objectives for a particular road or road segment, and local community preferences.

Sources:

- Ministry of Transportation of Ontario (MTO), Ontario Bikeways Planning and Design Guidelines (1996);
- Transportation Association of Canada (TAC), Geometric Design Guide for Canadian Roads (1999);
- United States Department of Transportation - Federal Highway Administration, Selecting Roadway Design Treatments to Accommodate Bicycles (FHWA-RD-92-073);
- University of North Carolina, Highway Safety Research Center and Pedestrian and Bicycle Information Centre, Bicycle Facility Selection: A Comparison of Approaches;
- American Association of State Highway and Transportation Officials, Guide for the Development of Bicycle Facilities, (1999);

4.2.2 Pedestrian Facilities

For pedestrian facilities, boulevards within road rights-of-way and adjacent land should be examined to determine if there is sufficient width to install an adjacent pedestrian facility if one is not already present. It should also be noted that in older, established neighbourhoods, which have functioned throughout their existence without sidewalks, the cost of installing sidewalks could be unnecessary. Additionally, there could be opposition from residents to the installation of sidewalks.

Guideline:

4.3 Sidewalk widths vary but are typically 2.0 m in width. In constrained areas the sidewalk may be 1.5 m if immediately adjacent to a multi-use trail, as is the practice in the Town of Aurora.

4.3 Intersection Treatments (Cycle Based)

4.3.1 Pavement Markings

The application of comprehensible pavement markings helps to direct both motorists and cyclists to safely manoeuvre through intersections as well as directing them along roads. The application becomes even more important at complex intersections or at locations where there is a significant amount of cyclist traffic.

In Ontario there are three primary references for cycling facility pavement markings; the Ontario Traffic Manual - Book 11 (MTO, 2000), Transportation Association of Canada's (TAC) Geometric Design Guide for Canadian Roads, 1999, and TAC's 1998 Bikeway Traffic Control Guidelines for Canada. Although there are some minor differences, the pavement marking guidelines from each of these references are similar with one exception. The Ministry of Transportation's OTM – Book 11, does not include the diamond reserve symbol in its recommended bikeway pavement markings. In place of the symbol, the OTM recommends the use of the word "ONLY". However, OTM Book 5, Regulatory signs (2000) continue to require on-road lanes reserved for bicycles to be signed with Reserved Bike Lane signs (Rb-84). These signs include the diamond symbol in the top left corner of the sign. **Figure 4-2** illustrates the OTM guidelines for bicycle lane pavement markings.

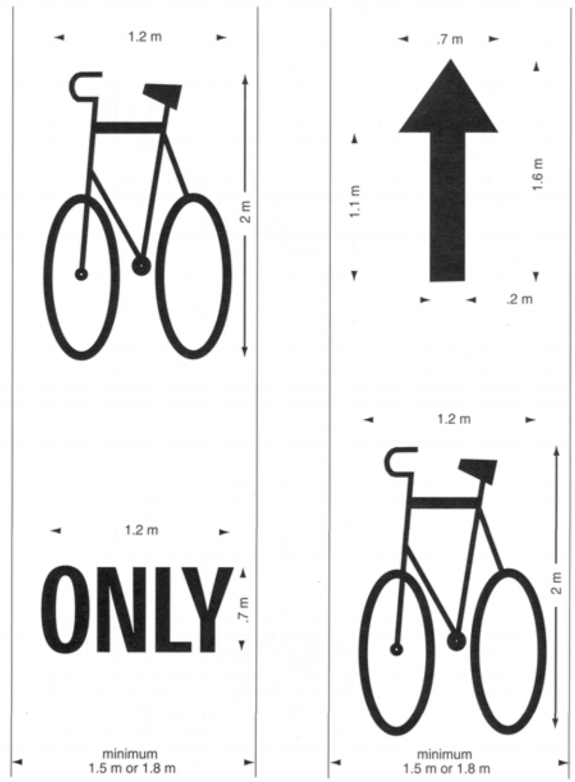


Figure 4.2 Bicycle Lane Pavement Markings
Source: Ontario Traffic Manual, Book 11, 2000 (OTM Book 11 – Figure 39)

In the United States, the Manual of Uniform Traffic Control Devices (MUTCD), 2000 Edition, has removed the diamond symbol from the recommended pavement markings for bike lanes. This has been done to eliminate any potential for confusion for motorists regarding the difference between a High Occupancy Vehicle (HOV) lane and a bike lane. Moreover, the MUTCD requires that all jurisdictions in the United States comply with this new standard by 2006.

It is recommended that the Region of York adopt the OTM pavement marking guideline with the directional arrow illustrated in Figure 4-2.

The addition of a directional arrow above the bicycle stencil is recommended to communicate to cyclists that bicycle lanes are one-way and users are not to cycle in the opposite direction facing motor vehicle traffic.

The application of the "ONLY" text in the pavement markings is optional. The Region's future by-law for bicycle lanes should state that any cyclists may be ticketed if travelling in the wrong direction.

In Ontario, signed bicycle routes with paved shoulder bikeways typically do not include pavement markings. These types of cycling facilities are usually designated by way of bicycle route signs, supplemented in some areas by “Share the Road” signs.

Paved shoulder bikeways proposed in the PCMP resemble reserved bike lanes, but they are not. Paved shoulders are not reserved lanes, rather they are intended for all types of vehicles to use in the event they need to pull over to the side of the road. The diamond reserved lane symbol is not recommended for use on paved shoulder bikeways in the Region of York.

Signed only routes require cyclists to share the road with motorists in a standard or wide curb lane. Municipalities in Ontario have typically not implemented bicycle pavement symbols on signed only bicycle routes, as the route markers (signs) are thought to be sufficient for the types of roads that are recommended for signed only routes. However, the TAC Bikeway Traffic Control Guidelines for Canada does provide for the use of the bicycle symbol in a wide shared lane. TAC states that:

“The bicycle symbol pavement marking may also be used to identify a wide shared use lane. This symbol should be installed on the right side of the curb lane at 200 m intervals. The words SHARED USE or SHARED LANE may be used below the bicycle symbol to identify a shared use lane.” [4]

In addition to the TAC guideline, a number of jurisdictions in North America are currently investigating and/or implementing pavement markings to supplement the standard signed bicycle route markers in an effort to improve the visibility of Class 3 bikeways (signed routes). A San Francisco study currently underway (Phase 1 draft published in March of 2003) is looking at the effectiveness of shared-lane bicycle markings in achieving four key objectives.[5] These objectives include informing motorists and cyclists of the appropriate position for cyclists to ride on a roadway without bike lanes; reducing aggressive motorist behaviour; encouraging correct cyclist riding behaviour; and improving safety.

Figure 4.3 identifies the results of the San Francisco study. It is important to recognize that the effectiveness of pavement markings and signs is directly related to the ability of the public to understand their intended meaning.

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[4] Transportation Association of Canada (TAC), Bikeway Traffic Control Guidelines for Canada, December 1998, Section 7.4.1

[5] San Francisco Department of Parking and Traffic, San Francisco Shared Lane Pavement Markings Study, Phase 1 Draft Report, March 2003.

CONCLUSION: Based on this study and review from a Technical Advisory Committee, the City has decided to use a modified bike-inside-arrow marking, as shown below. The arrow has been elongated, the cyclist enlarged, and a bike wheel channel created at the bottom to encourage cyclists to ride on the arrow. This modified marking was selected because it allows for comparison with the Florida shared pavement arrow marking, creates a more visible cyclist inside the arrow, and encourages rider placement. Should the study–particularly the survey–show the marking is poorly understood, then further modifications or study will be undertaken. The need for an education/outreach campaign will be determined based on the results of the study.

San Francisco Shared Lane Pavement Markings Study

Figure 4.3 San Francisco Share Lane Bikeway Symbol

Guideline:

4.4 The Region of York should adopt the OTM pavement marking guideline with directional arrow (OTM Book 11 – Figure 30). The application of the "ONLY" text in the pavement markings is optional.

4.5 The Region's future by-law for bicycle lanes should state that a cyclist must travel one way in a bike lane (same direction as motor vehicle traffic flow) and that a cyclist may be ticketed if travelling in the wrong direction.

Lane Lines

Bicycle lane lines delineate the edge of a travelled lane dedicated for bicycle use, where travel is permitted in the same direction on both sides of the line. Bicycle lane lines direct motor vehicles and bicycles into appropriate lanes, and provide for efficient and safe use of the road.

TAC's Bikeway Traffic Control Guidelines for Canadian Roads (1998) suggests bicycle lane lines should be solid, white in colour, with a width of 100 mm. Edge lines used to delineate a curb lane from a paved shoulder bikeway should conform to the requirements of the OTM.

Bike lane lines are solid, except where motor vehicles are permitted to move into or cross the lane to perform a turning movement. In such a situation, a 15 m minimum broken line is used, with 1.0 m segment and 1.0 m gap.

For paved shoulder bikeways, it is recommended that these bikeways be marked using a standard edge line to separate the travel from the paved shoulder, complemented by bikeway route signing.

Guideline:

4.6 Lane lines for bikeway facilities in the Region of York should conform to the requirements of the Ontario Traffic Manual or the TAC Bikeway Traffic Control Guidelines for Canada.

Off-road

Off-road multi-use trails should be signed and provided with pavement markings that are similar to roads.

Two-way multi-use trails should include a solid yellow longitudinal centre lane line. On approaches to intersections, the lane line should be broken with 1.0 metre markings and a 1.0 m gap.

Guideline:

4.7 Pavement markings and associated signing for on-road bike lanes in the Region of York should be consistent with the Ontario Traffic manual and/or TAC's Bikeway Traffic Control Guidelines for Canada.

4.8 Paved shoulders or signed routes in York Region should be delineated by way of standard edge lines and complimented by bikeway route signing.

4.3.2 Bike Lanes/Paved Shoulders at Intersections

Cycling facilities at intersections should be carefully designed to encourage the safe and predictable movement of pedestrians, motorists and cyclists. Since intersections are the most likely area for conflict between various users of the roadway, care should be taken to design and mark the intersection approach such that all users understand and can anticipate the potential movements of other road users.

One of the most common conflicts at intersections occurs between right turning motor vehicles and cyclists proceeding straight through, since it is necessary for these two road users to cross paths. Pavement markings and appropriate signing should be installed at intersections to encourage such crossings in advance of the intersection, rather than within it (e.g. through the provision of an exclusive right-turn lane or an advanced stop bar for cyclists).

Left turning cyclists must also undertake a similar weaving manoeuvre through vehicular traffic. Cyclists may elect to undertake a "vehicular style" left turn by using the motor vehicle left turn lane, or they may choose to complete a "pedestrian style" turn by proceeding straight through the intersection, then turning left to cross again on the intersecting road.

In the case of both paved shoulders and bike lanes, pavement markings should change from a solid to a broken line on the approach to the intersection. Alternatively, though not preferred, the bike lane can be discontinued if there is insufficient pavement width. The bike lane or edge line markings should be discontinued at the start of the taper when right turn lanes or channelizations are provided, or otherwise a broken line should be used, a minimum of 30 m from a signalized intersection and 15 m from an unsignalized one. This allows cyclists to merge with other traffic and prevents right turning motorists from having to cross through a bike lane to make their turn, thereby cutting off cyclists at the intersection. By discontinuing the solid bike lane/edge line pavement marking, both the cyclists and motorists are made aware of the fact that they are sharing a common lane and should react accordingly.

Figures 4.4 to 4.6 illustrate a series of recommended intersection configurations with on-road bike lanes or paved shoulder cycling facilities. Figures 4-4 to 4-6 are from the TAC's Bikeway Traffic Control Guidelines for Canada (1998). The TAC Guidelines include a series of 31 figures that illustrate typical bikeway applications at intersections.

It is recommended that the Region of York adopt the OTM pavement marking guideline with the directional arrow (OTM Book 11 – Figure 30) and not the TAC guideline that recommends the diamond symbol shown in figures 4.4 to 4.6.

Guideline:

4.9 Cycling facilities at intersections should be carefully designed to encourage safe and predictable movement of pedestrians, motorists and cyclists.

Figure 4.7 illustrates a bike facility through a rural road intersection, which is very similar to a facility design for an urban road intersection. The approach uses a stencil and signed route with a bike pocket implemented adjacent to an exclusive right turn lane. On the other side, the same configuration continues but with the stencil eliminated. More specifically, in this scenario, there may or may not be curbs used throughout the intersection.

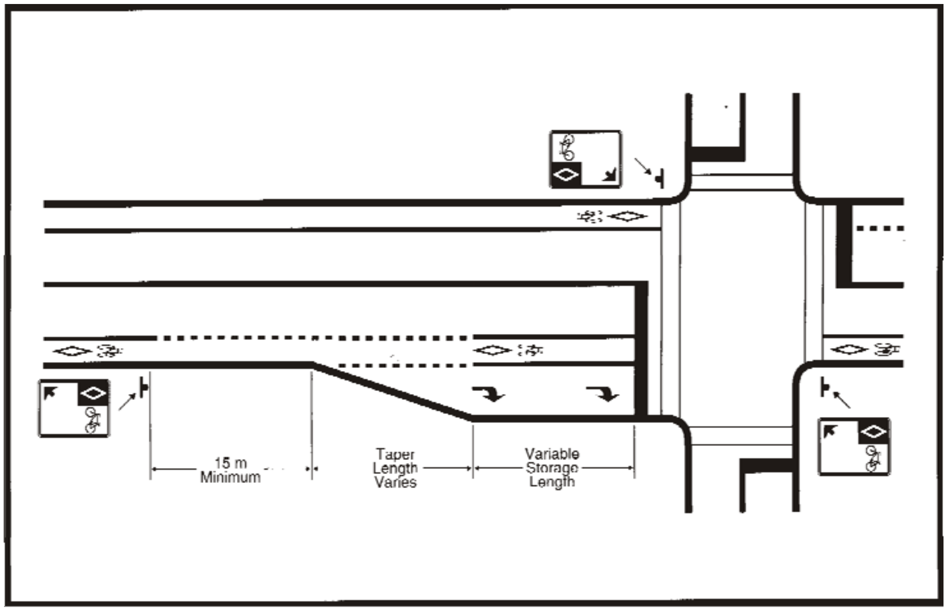

Figure 4.4 Bicycle Lane Adjacent to an Exclusive Right Turn Lane, TAC Bikeway Traffic Control Guidelines, 1998 – (TAC Table 8.1-2)

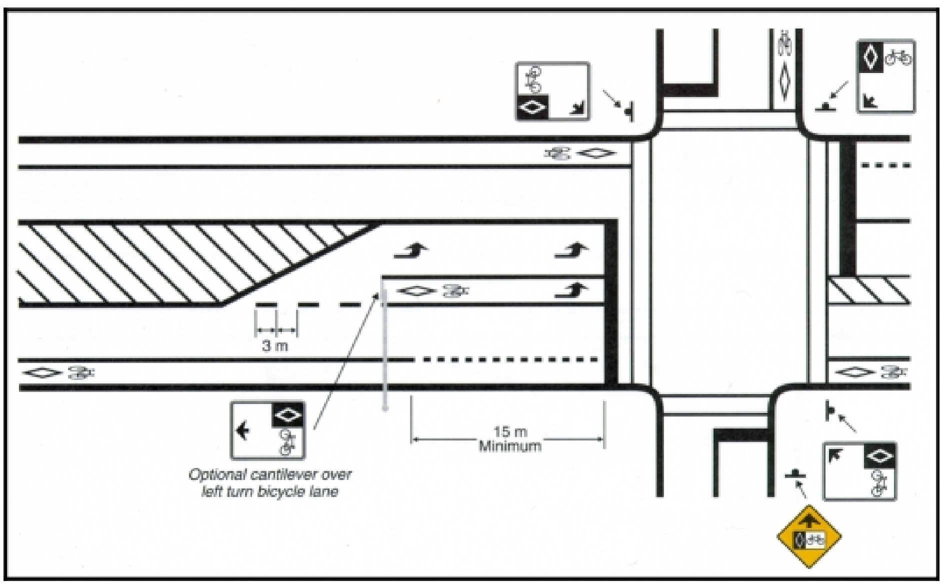

Figure 4.5 Left Turn Bicycle Lane, TAC Bikeway Traffic Control Guidelines, 1998 (TAC Table 8.1- 4)

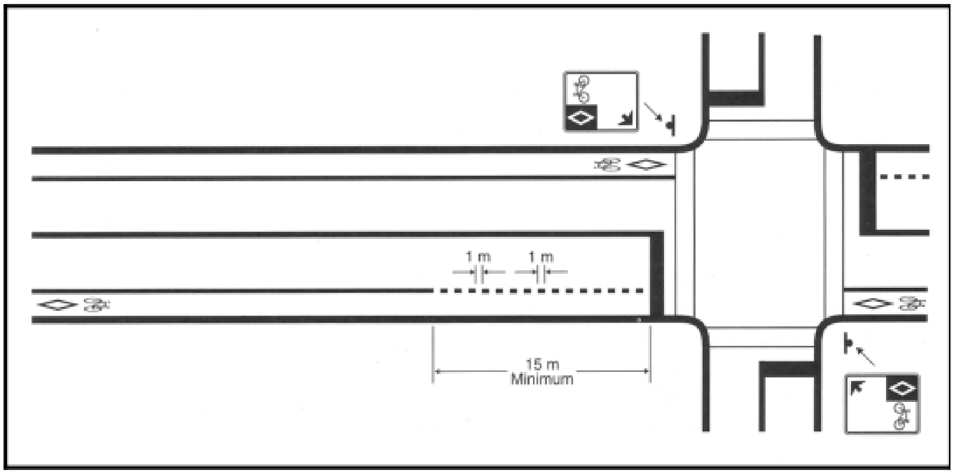

Figure 4.6 Bicycle Lane Adjacent to Through/Right Turn Lane,
TAC Bikeway Traffic Control Guidelines, 1998 – (TAC Table 8.1-1)

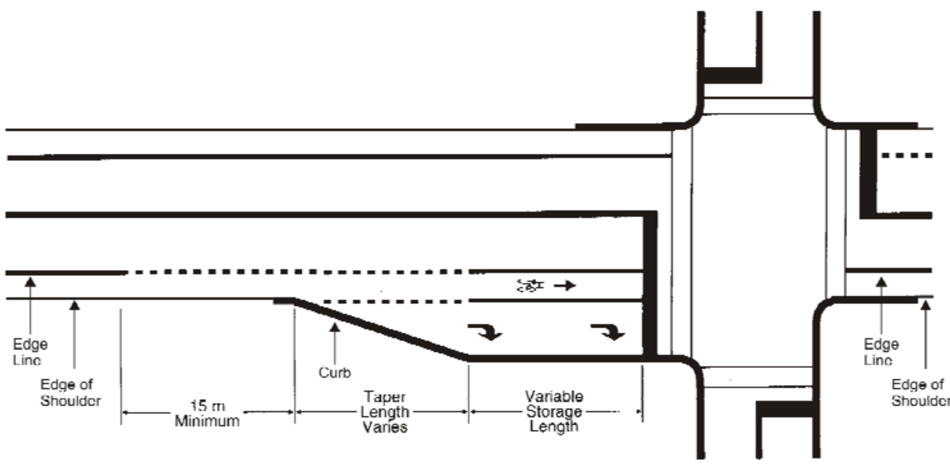

Figure 4.7 Bike Facility through a Rural Road Intersection
MMM Group Limited

Figures 4.8 to 4.10 illustrate a series of recommended intersection treatments for bike lanes and paved shoulders developed by the Region of York for urban and rural cross section roads, including transitions between rural to urban sections on Regional roads.

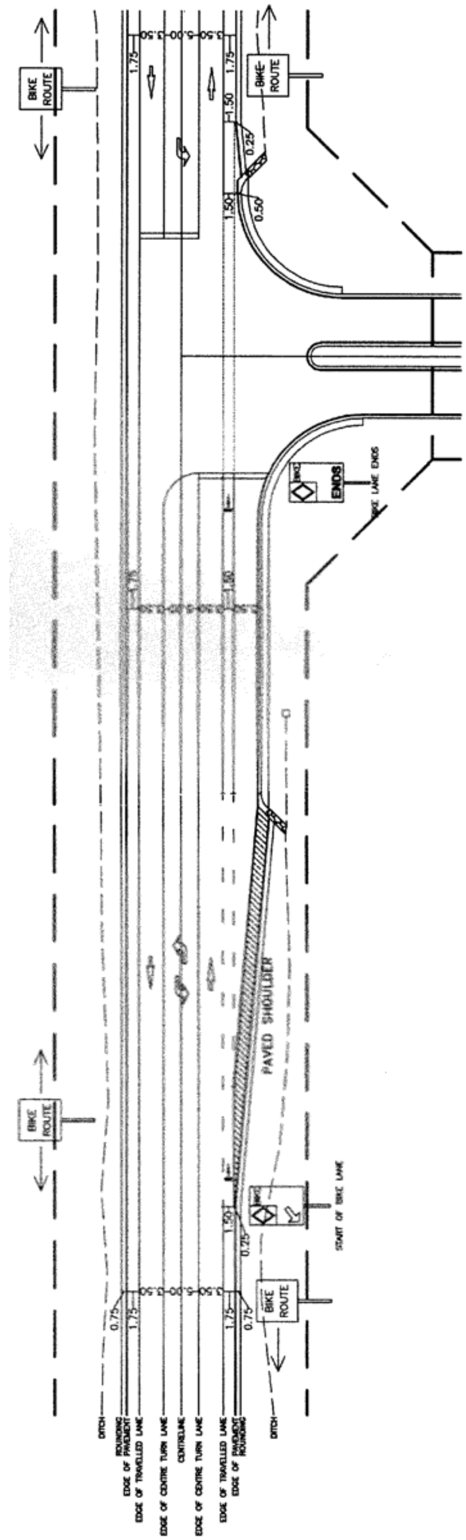

Figure 4.8 Proposed Bike Route/Lane Treatment For Transition From Rural to Urban to Rural Sections On Regional Roads

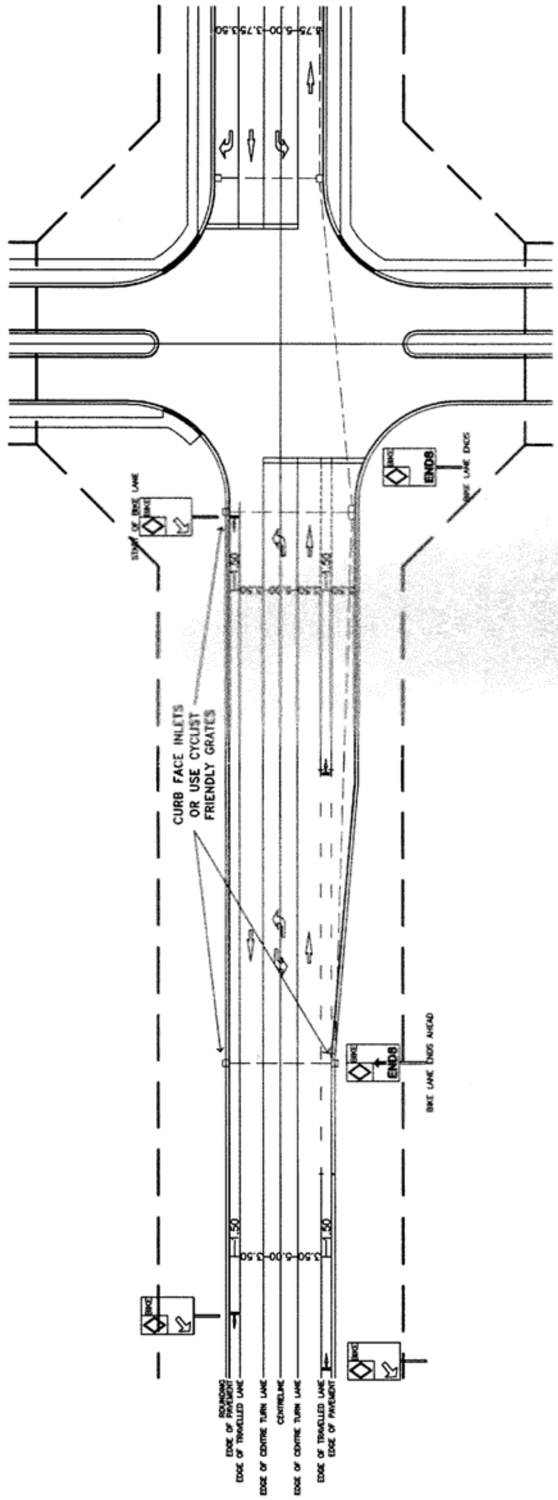

Figure 4.9 Proposed Lane Start/End At Urban Intersections On Regional Roads

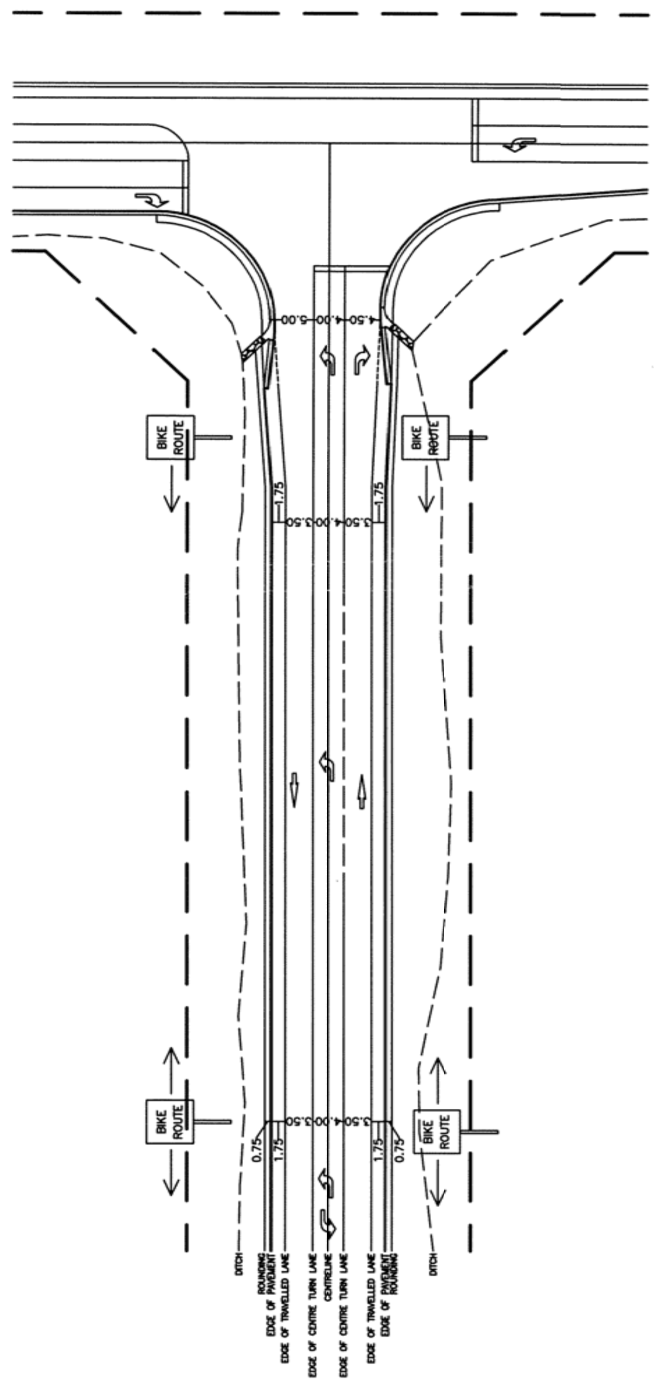

Figure 4.10 Proposed Bike Route Start/End Treatment For Rural Sections On Regional Roads

There is also the potential for standard bike lanes along roadways to become substandard in widths at intersections due to spatial constraints. At these locations, the bike lane should not be signed as such or delineated with any bicycle-stencil pavement markings; however, bicycle-route signs may be erected at these locations. It is recommended that when these intersections are improved, that they be upgraded to accommodate standard bike lanes. A detailed evaluation of the intersection should be undertaken at times when such intersections are improved to determine if there is enough public land available or to ensure that there are no competing interests for space, such as pedestrian or utility space. Therefore, a detailed review should be undertaken to address these issues.

Guideline:

4.10 A detailed review of intersections with sub-standard bike lanes should be undertaken when intersections are improved to determine if sufficient right-of-way can be obtained to provide standard bike lanes at these locations.

4.3.3 Coloured Pavement Surfaces

The application of coloured surfaces and asphalt to indicate the presence of bike lanes on merge zones has been used in numerous cities around the world, especially in Europe. Red surfacing is used in the Netherlands and blue pavement colouring has been tested in Montreal and in Portland, Oregon. **Figure 4.11** illustrates an example of coloured pavement surfaces from Sunnyvale, California.

Figure 4.11 Coloured Pavement – Sunnyvale, California
Source: Innovative Bicycle Treatments, ITE Web Seminar Presentation. Photo by John Brazil

In the City of Portland, cyclist and motorist behaviour was observed before and after the application of "blue" bicycle lanes to determine which users, cyclists or motorists, yielded to the other at intersections. It was observed that 28% of cyclists yielded to motorists and 72% of motorists yielded to cyclists. After the application of the coloured bicycle lanes, 8% of cyclists yielded to motorists and 92% of motorists yielded to cyclists.[6] The application of the coloured pavement helped to identify priorities at intersections, as motorists were made more aware of the presence of cyclists. The blue bike lanes gave cyclists an increased feeling of safety when passing through intersections, resulting in fewer cyclists slowing, stopping or turning their heads when entering a "blue" area. Approximately 75% of the cyclists surveyed felt that the areas with the coloured pavement were safer than before, and 58% of cyclists stated that motorists were yielding more than they were before the blue bike lanes were installed.[7]

Results from a similar survey conducted in Montreal indicated a small decrease in motor vehicle/cyclist conflicts, an increase in motorists yielding, and a decrease in cyclists slowing or turning their heads when crossing through intersections.[8]

Although the application of coloured pavement has not been standardized in Canada, its application may be beneficial at complex intersections with high conflict areas where cyclist priority is not respected and standard pavement markings do not suffice. It should also be noted that special signing is typically used at locations where coloured pavement is applied, indicating the priority movements at an intersection. **Figure 4.12** illustrates an example of the signing used in Portland at intersections with blue bike lanes.

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[6] Portland's Blue Bike Lanes: Improved Safety through Enhanced Visibility; City of Portland, Office of Transportation; July 1,1999

[7] Ibid

[8] Portland's Blue Bike Lanes: Improved Safety through Enhanced Visibility; City of Portland, Office of Transportation; July 1,1999

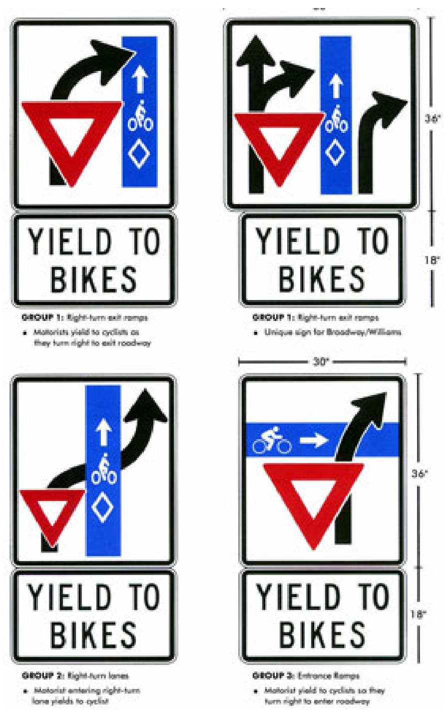

Figure 4.12 Signing Used in Conjunction with Coloured Pavement - City of Portland, Oregon

The cost of coloured pavement varies depending on the colour being selected for use. Based on a review of paving companies, blue pavement colouring is typically more expensive than red. However, the selection of blue coloured pavement tends to be the most sensible solution when compared to other colours such as red, yellow and green, some of which are used for bike lanes elsewhere around the world.

The colours red and green have specific meaning in regards to traffic engineering, where "red" implies stop, green implies "go" and amber indicates an opposing traffic flow.[9] The colour blue is a "neutral" colour in the context of traffic engineering. Furthermore, the colour blue will show up in limited visibility conditions such as during fog, light rain and other wet conditions. Also, persons who are colour blind have difficulty identifying earth tone colours such as red and green. The cost of blue bike lanes using microsurfacing techniques and a clear binder can range in the $12 to $16/linear metre range while full depth coloured asphalt is approximately $65/linear metre.

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[9] Bicycles, Blue Bike Lanes for Bicycle Safety, Bicycle Programs – Blue Bike Lanes – Portland Transportation; http://www.trans.ci.portland.or.us/bicycles/bluebike.htm, 2004

The Town of Richmond Hill is currently experimenting with a treatment known as microsurfacing, in which a colour pigment is mixed with asphalt when it is laid, resulting in a surface that is coloured, but has the same tactile features of bare asphalt. This method is significantly less expensive than traditional pavement colouring. It is currently being tested to determine its durability. An application of microsurfacing is shown below in **Figure 4.13**.

Figure 4.13 Microsurfacing – Town of Richmond Hill, ON

While not much is known about the long-term durability of microsurfacing, it is recommended that the Region of York explore this option further should it be decided to proceed with coloured bike lanes.

Should coloured bike lanes be considered for installation for segments of the cycling network, the colour blue is thought to be the best colour for application.

Guidelines:

4.11 Coloured pavement treatments should be considered at intersections with complex geometry or in areas with high conflict zones between cyclists and motorists.

4.12 Appropriate signing should be used in conjunction with the coloured pavement to identify to both motorists and cyclists the priority at an intersection.

4.13 Should the Region of York decide to pursue coloured pavement, the emerging technology of "microsurfacing" should be investigated.

4.3.4 Cyclists Crossing at Traffic Signals

Just like other motor vehicles, it is important for bicycles to be able to proceed through intersections safely and efficiently. One method to aid cyclists in crossing at traffic signals is the application of bicycle detection methods at signalized intersections. Many traffic signals in York Region are activated by detector loops embedded in the roadway, which respond to the magnetic field induced by the metal in a motor vehicle. Bicycles should also be considered in the timing of traffic signals and in the selection, sensitivity and placement of vehicle detection devices. Since bicycles have much less ferrous metal than automobiles, the sensitivity of the detector loop will need to be adjusted accordingly for greater responsiveness to bicycles. The installation of detector loops with different configurations, such as a quadruple loops, are capable of detecting more than just motor vehicles. **Figure 4.14** illustrates the layout of Quadruple and Diagonal Quadruple loop detectors.

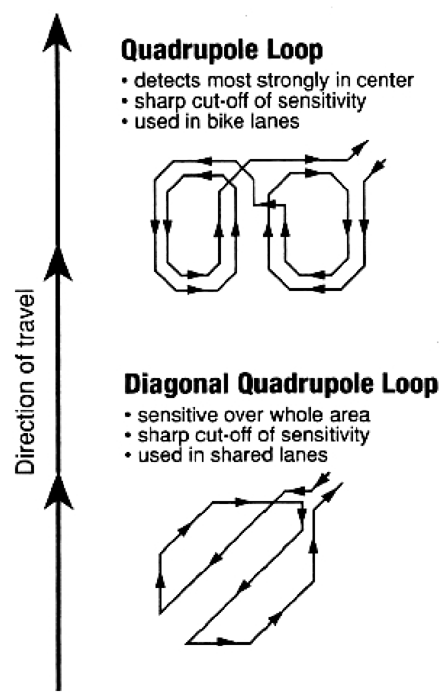


Figure 4.14 Quadrupole and Diagonal Quadrupole Loop Detectors
Source: Traffic Signal Bicycle Detection Study, City of San Diego, 1985.

The detection of bicycles at signalized intersections is very important as it minimizes the potential for a cyclist to disobey the unchanged signal. It is recommended that the Region of York initiate this practice at intersections in Regional centres which use detector loops, along with any intersection where detector loops are subsequently installed where feasible.

Even though the sensitivity of the detectors may be adjusted, the effectiveness of the detectors is limited if the cyclist is not properly located in the "actuation zone".

The application of three yellow or white dots on a road has been used in Ottawa and Toronto respectively, with the dots placed at the location where cyclists should position themselves at an intersection to be detected. This is illustrated in **Figure 4.15**. Reviews of this application indicate that in some circumstances, cyclists are not aware of the purpose of the three dots, or even that they must be present in the zone of detection to initiate a signal change. The success of a bicycle actuating a signal is dependent on the cyclist not only knowing that there is a detection system, but also knowing how to use it. Even though the sensitivity of the detectors may be adjusted, the effectiveness of the detectors is limited if the cyclist is not properly located in the actuation zone.

Figure 4.15 "Three dots" Traffic Signal Actuation Indicator

More distinct pavement markings such as a small bicycle symbol with a directional arrow and additional signing may be investigated to improve the effectiveness of this form of bicycle detection advisory system. **Figure 4.16** illustrates an example of pavement markings that may be applied at intersections to help direct cyclists to the appropriate actuation zone.

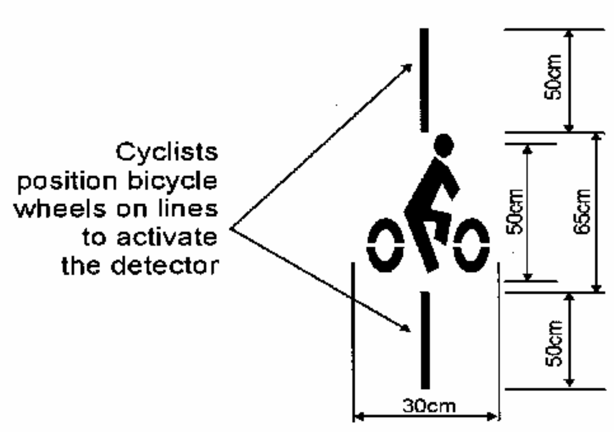


Figure 4.16 Example of Detector Loop Pavement Markings

Another alternative is to utilize a pedestrian style push-button to actuate traffic signals for cyclists. These should be located on the curbside, separate from the pedestrian push-button.

The Transportation Association of Canada (TAC) is currently developing traffic signal guidelines for bicycles (Project #226). The purpose of this project is to develop a guideline for the safe accommodation of bicycles at signalized intersections. The expected outcome is the acceptance of an exclusive "Bike Signal", similar to that in use in Quebec, the United States and throughout Europe. **Figure 4.17** illustrates a Bicycle Signal head that TAC is currently assessing as a potential national standard. It should be noted, however, that the bicycle traffic signal currently under development are not meant to be rigorously applied as standard traffic signals can be used to adequately accommodate cyclist movements through intersections. Therefore, the installation of bicycle traffic signals should only be considered in "extreme" situations, such as where a signalized intersection may not be standard in geometry, or where the right-of-way for a cyclist riding through an intersection may not be clear.

Figure 4.17 Example of a Bicycle Signal,
Currently Being Assessed by TAC (2004)

A Vulnerable Road User (VRU) is a term used to encompass many different groups who utilize a transportation network. Vulnerable users include those who are not the occupants of a personal, commercial, transit, emergency or other common motorized vehicle.[10]

Vulnerable road users include:

- Pedestrians;
- Cyclists; and
- In-line skaters/Scooter riders/Skateboard riders.

Since cyclists are classified as vulnerable road users, consideration and care must be given when designing facilities for their use.

VRU conflicts can take many forms, have multiple contributing factors, and occur in different places within our transportation systems. Common cycling related conflicts with other road users include:

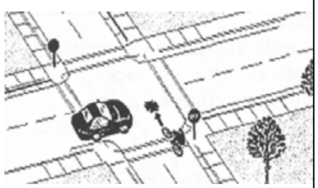
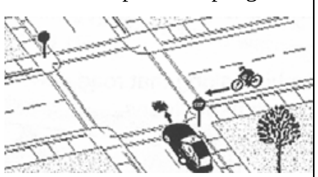
- Cyclist proceeding through an intersection past a stop sign conflicting with an approaching motor vehicle;
- Motorist proceeding through an intersection past a stop sign conflicting with an approaching cyclist;
- Motorist making a left-turn through an intersection conflicting with a cyclist proceeding straight across the intersection; and

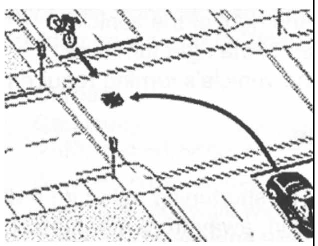
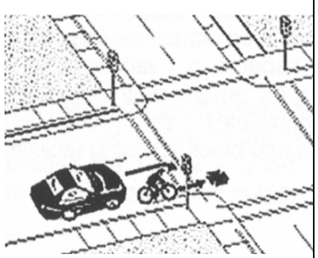
[10] Safety Conscious Design for Vulnerable Road Users, McCormick Rankin Corporation for Transportation Association of Canada (TAC), 2004.

- Motorists making a right turn conflicting with a cyclist proceeding straight across the intersection.

Table 4.3 identifies and illustrates these common cycling related collisions and provides preventative measures for minimizing their potential to occur.

Table 4.3
Common Cyclists/Motor Vehicle Collisions at Intersections

Conflict	**Possible Causes**	**General Countermeasures**
Cyclist riding through intersection past a Stop Sign. 	Cyclist ignores the traffic controls Cyclist incorrectly assumes there aren't any vehicles on the road. There are visual obstructions. Cyclist is unable to stop. Vehicles approach the intersection at high speeds. The motorist has incorrect expectations. The cyclist is unfamiliar with correct traffic control procedures.	Cyclist obey traffic controls Improve sightlines for cyclists and motorists. Educate cyclists on traffic control, bike maintenance and performance. Educate motorists on common cyclist behaviours. Provide STOP or YIELD pavement markings, advanced warning signs or pavement texturing.
Motorist driving into an intersection past a stop sign. 	The intersection has a high incidence of driver stop violations. The motorist stops beyond the stop bar, impacting cyclists on the sidewalk or in the nearest lane. There are visual obstructions. The cyclist is travelling facing traffic but beyond the motorist's primary viewing area.	Reconfigure the intersection as a general roundabout. Improve sightlines for cyclists and motorists. Install "Stop Here" signs. Install "Watch for Cyclists" signs. Paint "Use Caution" on the sidewalk at hazardous locations. Add a crosswalk and an adequate stop bar setback. Provide cyclist and driver education programs.

Motorist making a left-turn – facing a cyclist. 	Intersection has wide turning radius that encourages high speeds. The motorist, coming to a stop, travels into the intersection. The cyclist's travel path is outside the motorist's primary viewing area. The cyclist incorrectly anticipates the motorist's left turning behaviour.	Tighten the left turn radii. Channelize the intersection. Reconfigure the intersection as a modern roundabout. Improve sightlines for cyclists and motorists. Prohibit permissive left turns. Provide protected left turns. Reroute pathways a minimum of 30 metres from the intersection. Alert motorists with a "Yield to Approaching Cyclists" sign. Alert cyclists with a "Watch for Turning Vehicles" sign and/or pavement markings in bike lanes or multi-use pathways.
Motorist making a right-turn at intersection beside a cyclist. 	The vehicle approaches the turn at high speed. The cyclist overtakes a slow moving vehicle. The bicycle sign stops immediately to the right of the vehicle. Weaving conflicts occur at the start of the right turn lane. The motorist or cyclist misjudges the vehicle's turning requirements.	Reduce vehicle approach speeds by shortening right turn radii. Provide a separate crossing location, away from the intersection, for bike lanes. Place the vehicle stop line in advance of the bike lane stop line. Educate cyclists and motorists. Install a "Begin Right Turn, Lane, Yield to Bikes" sign. Improve signing in general for cyclists and motorists.

Source: Safety Conscious Design for Vulnerable Road Users, McCormick Rankin Corporation – Licensed to Transportation Association of Canada (TAC), 2004.

The design of cycling facilities must account for a number of facility types such as shared roadways, bicycle lanes and off-road cycling trails. The main points to consider regarding safety conscious design for cyclists at intersections include:

Heavy right turn cycling movements: If the majority of cyclists are turning right, a bike lane can be placed to the right of the vehicle turn lane and wrapped around the corner;

Tee Intersections: If bike lanes are present on a T-intersection approach, the bike lane should be dropped early enough for cyclists to slide across into the proper turning lane;

Dedicated bike lanes in high volume intersections: Where there is a very high traffic volume, consideration should be given to providing dedicated left and right-turning bicycle lanes;

Offset through lanes and pavement markings: Where intersection through-lanes are offset, pavement markings should be clear enough to guide the driver and cyclist through safely;

Provide cyclists options to walk or ride through: For through-moving cyclists, the option should be available for cyclists to either navigate the intersection like a vehicle, or dismount at the curb and walk their bike over the crosswalk; and

Provide left-turning cyclists options to walk or ride: Cyclists making a vehicular-style left turn on a multi-lane roadway have to cross over one or more through travel lanes, which may intimidate inexperienced riders. Therefore, the option should be available for them to dismount and walk their bikes across two legs of the intersection to proceed.

Guidelines:

4.14 The Region of York should initiate a practice of considering bicycles in the timing of traffic signals at intersections and in the selection, sensitivity and placement of vehicle detection devices wherever there is bicycle traffic.

4.15 The application of pavement markings is recommended to increase the efficiency of bicycle detection at intersections to actuate either a mixed traffic or bicycle signal phase. These pavement markings could also help to direct cyclists to the actuation zone and to position themselves properly in the lane.

4.16 Since cyclists are considered vulnerable road users, consideration and care must be given to them when designing facilities for their use.

4.17 The general countermeasures indicated in Table 4.3 should be considered for minimizing common motor vehicle and cyclist collisions.

4.3.5 Bike Boxes

Bike Boxes are used at locations where left-turning cyclist volumes may be very high approaching an intersection. In this situation, the motor vehicle stop bar is set back approximately 4 m, helping cyclists move from the curb lane and turn left by positioning themselves in front of the motor vehicles. **Figure 4.18** shows an application of a bike box at an intersection. It should be noted that the application of bike boxes restricts right turns on red displays for motor vehicles. Advanced stop bars and bike boxes may be considered at locations where cyclist volumes are high and measures are being considered to give cyclists more priority at intersections, for example by adjusting signal timings or phasing sequences.

Figure 4.18 Bike Box – Germany

Guideline:

4.18 Bike boxes may be considered at locations in York Region where cyclist volumes are high and measures are being considered to give cyclists more priority at intersections (e.g. adjusting signal timings or phasing sequences).

4.3.6 Bike Pockets

"Bike pockets" can be defined as a discontinuous dedicated space on the travelled portion of the roadway intended for use by cyclists that are delineated by pavement markings. An example of a bike pocket used in conjunction with a bicycle lane is illustrated in **Figure 4.19.**

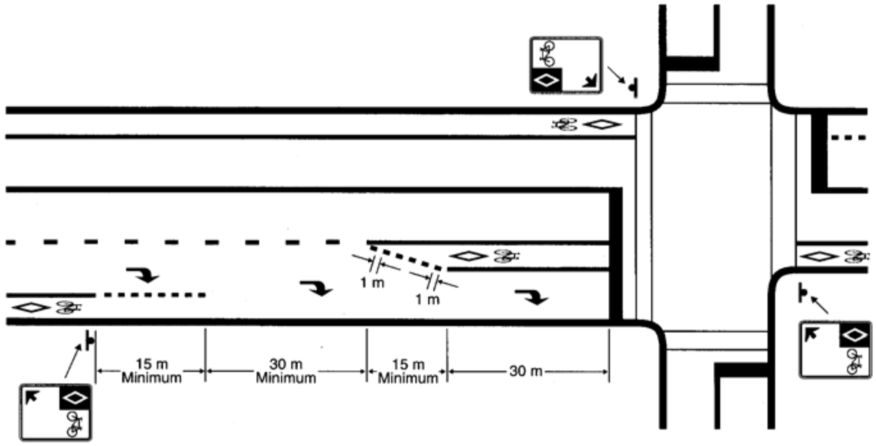


Figure 4.19 "Bicycle Pocket"
(Bicycle Lane Adjacent to Curb Lane Transition)
Source: Bikeway Traffic Control Guidelines for Canada TAC, 1998, Figure 3.

It should be noted that bike pockets have been effectively used in a variety of locations where no bike lanes are present or where a bicycle lane ends. The most common use for a bicycle pocket is to show where cyclists should position themselves when adjacent to a right turn lane or a right turn channel.

The critical dimension, as illustrated in Figure 4.16, is the 6 0m segment between end of the curbside bike lane and the beginning of the bike lane on the left side of the right turn lane. This minimum 60 m transition zone should be maintained between the curbside cycling facility and the bike pocket, left of the right turn lane/channel, whether the curbside facility is a bike lane, paved shoulder or signed-only route.

Guideline:

4.19 The minimum 60 m transition zone between the curbside cycling facility, and the bike pocket, left of the right turn lane/channel, should be maintained, whether the curbside facility is a bike lane, paved shoulder or signed-only route.

4.4 Bike Lanes Between Two Motor Vehicle Travel Lanes

Very long ancillary lanes adjacent to the curb on arterial roads, notably merge/diverge lanes on arterial roads at expressway interchanges, can create a situation where a bike lane is "sandwiched" between two traffic lanes over a considerable distance. Locations where these situations occur typically take place on roadways with posted speed limits of 80 km/h with merging and diverging traffic. These conditions may not be comfortable for cyclists, and designers should consider limiting the maximum length for such a situation.

Based on the TAC Bikeway Traffic Control Guidelines for Canada, the distance required to bring a cyclist from a curbside bike lane into a bicycle pocket on the left side of a right turn lane is 90 m as illustrated in Figure 4.16 *(See Section 4.3.6 – Bike Pockets)*. As indicated in Figure 4.16, the 90 m distance includes the length of the bicycle lane on the left side of the right-turn lane. In actuality, the 60 m merging distance between the curbside bike lane and the bike lane between the two travel lanes is the most critical since it is the merging area between cyclist and motor vehicle traffic.

Doubling the 60 m distance to represent the total distance that a bike lane would be brought back across the right-turn lane on both ends of a roadway segment equates to a total distance of 120 m. If the roadway segment between two intersections is greater than 240 m (120 m x 2) and a bike lane is present between two motor vehicle travel lanes, consideration might be given to relocating the bike lane to the curbside of the roadway and the application illustrated in Figure 4.16 applied at each end of the roadway.

If the roadway segment is less than 240 m in length, then it is recommended that a 2.0 m bike lane be placed between the two motor-vehicle travel lanes.

Guideline:

4.20 When a bicycle lane situated between two motor vehicle travel lanes extends for a distance greater than 240 metres, consideration may be given to relocating it to the curbside of the roadway with the applications recommended by TAC for a Bicycle Lane Adjacent to a Curb Lane Transition applied at each end of the roadway.

4.5 On-Road Cycling Facilities on Bridge Structures and Highway Interchanges

The key consideration in designing bicycle facilities across bridges and through interchanges is the safety of cyclists. The separation of non-motor vehicle traffic from motor vehicle traffic, either through pavement markings or fully separated facilities, is often recommended to reduce the potential for conflict between these two types of road users, especially on arterial and collector roads.

The width of bridge structures tends to be significantly less than the right-of-way width of the abutting roadway, typically only providing sufficient width for the travelled lanes plus a raised sidewalk. Hence, these types of structures tend to constrict the flow of bicycle traffic. This section serves to review the needs of pedestrians and cyclists, and the design considerations associated with bridge structures.

4.5.1 Current Bridge Standards

The design of new structures or the modification of existing bridges must now comply with the standards of the Canadian Highway Bridge Design Code (2002). The following is an excerpt relating to the structure geometry:

"Roadway and sidewalk widths, curb widths and heights, together with all other geometrical requirements not specified in the Code, shall comply with the standards of the Regulatory Authority, or in their absence, with the TAC Geometric Design Guide for Canadian Roads."

"Sidewalks and cycle paths shall be separated from traffic lanes by a barrier or guide rail, or by a curb having a face height of at least 150 mm and a face slope not flatter than one horizontal to three vertical. Sidewalks and cycle paths not so separated shall be designed as part of the roadway."[11]

In Ontario, the current Geometric Design Standards for Ontario Highways (GDSOH) 1994, does not provide guidelines on offsets (horizontal clearances) at bridges. In the past, the Ontario Highway Bridge Design code was the guiding document, but this code is no longer in force since it has been replaced by the Canadian Highway Bridge Design Code effective June 1st, 2002. The TAC Geometric Design Guide for Canadian Roads and the Canadian Highway Bridge Design Code also do not provide details on the side clearances required on bridge decks. Side clearances are the distance between the edge of the travelled way and adjacent curb or barrier. Where side clearances on a bridge are wider than the approach roadway shoulder width/side clearance, the bridge side clearance should match that of the approach roadway.[12]

Given that neither the Canadian Highway Bridge Design Code, nor Geometric Design Standards for Ontario Highways prescribe current structure clearances and cross section dimensions, the Ontario Ministry of Transportation's (MTO) in August of 2002 issued a "Revision Information Sheet for Geometric Design Standards for Ontario Highways".

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[11] CAN/CSA-S6-00 Canadian Highway Bridge Design Code, Section 1.6.2.1
[12] Revision Information Sheet for Geometric Design Standards for Ontario Highways, Section D.7.2.2.

Section D.7.2.3 of this document, which now forms part of the Geometric Design Standards for Ontario Highways, provides the following direction with regard to sidewalks, curbs and bicycle routes on bridges, where required, the widths of sidewalks and bicycle routes on bridge decks should meet the following requirements:

- The edge of a sidewalk adjacent to the roadway on a bridge should match that of the approach sidewalk;
- Where the approach roadway is not provided with a curb, the sidewalk width should be at least 1.5 m;
- Paved bike lane and bicycle route widths should be in accordance with the Ministry's Ontario Bicycle Routes Planning and Design Guidelines. Bicycle routes should be at least 1.5 m wide for one-way traffic;
- The height of curbs should not be less than 150 mm above the adjacent roadway except to match the height of curbs on the approach roadway and
- Curbs should not be used in conjunction with barrier walls except where the curb and the barrier wall are separated by a sidewalk. [13]

Section D.7.2.5 of the same source also states that:

- Where practicable, underpassing roadway cross-sections should match that of the approach roadway; and
- Horizontal clearances from the edge of the through travelled way to the face of an abutment or pier should also meet or exceed the minimum clear zone widths specified in the Ministry's Roadside Safety Manual.

Table 4.4 sets out the minimum side clearances at bridges prescribed by MTO.

[13] Revision Information Sheet for Geometric Design Standards for Ontario Highways, Section D.7.2.2.

Table 4.4
Minimum Side Clearances at Bridges

		Urban Roads			Rural Roads		
	Design Speed (km/h)	Left	Right		Left	Right	
			No Sidewalk	Sidewalk		No Sidewalk	Sidewalk
FREEWAY 4-LANE DIVIDED	100 to 120	2.5a	3.0 a		2.5a	3.0 a	
FREEWAY MULTI-LANE DIVIDED	100 to 120	2.5 a	3.0 a		2.5 a	3.0 a	
ARTERIAL DIVIDED	90 to 110	2.0 a	2.5 a	1.5	2.0	3.0 a	
	80	2.0 a	2.5 a	1.5	1.5	2.5 a	
ARTERIAL UNDIVIDED	90 to 110	-	2.0	1.5	-	3.0 a	2.5 a
	80	-	2.0	1.5	-	2.5 a	2.0 b
COLLECTOR UNDIVIDED	90 to 100	-	1.25 c	1.0	-	2.5 a	1.5 c
	70 to 80	-	1.25 c	1.0	-	1.5 d	1.25
	60	-	1.0	1.0	-	1.5 d	1.25
LOCAL UNDIVIDED	60 to 80	-	1.0	0.5	-	1.25	0.5 d

Notes:
1. If a barrier is to be placed between the sidewalk and roadway, then clearance should be the same as when there are no sidewalks.
2. All clearance should meet requirements for sight distance.
3. The width of a median on a bridge should match that of the approach roadway.
4. L = Length of bridge between centreline of abutment bearings.

a - For bridges with L>50 m, consideration can be given to decreasing the clearances to 1.5 m.

b - For bridges with L>50 m, consideration can be given to decreasing the clearance by up to 0.5 m.

c - For bridges with L>50 m, consideration can be given to decreasing the clearance by 0.25 m.

d - For bridges with L>50 m, consideration can be given to increasing the clearance by up to 0.75 m.

e – The values of the clearances given above are the minimum values. Consideration may be given to providing more than the minimum if justification is provided.

Source: Ontario Ministry of Transportation, Geometric Design Standards for Ontario Highways, Revision Information Sheet, February 8, 2002, Table D7-1, pg. D7-2.

Additional guidance is provided by the Ministry's Ontario Bicycle Routes Planning and Design Guidelines (1996). The following is an excerpt from this provincial guideline reference related to accommodating cyclists on existing bridges:

- To allow cyclists to cross an existing bridge safely, the structure may require alterations to provide adequate width for all bridge users. A bicycle route can be routed across the bridge in one of three ways:
  - Creating a bike lane or shoulder bikeway on the travelled way;
  - Reserving a sidewalk for cyclists only, or for shared use with pedestrians if there is adequate width; or
  - Widening the roadway to permit shared use of the right lane by motor vehicles and bicycles.
- The creation of a bike lane on a bridge is an option if the bridge has shoulders, or if the traffic lanes are wide enough to permit the creation of a wide curb lane to accommodate bicycles on the travelled way.

Guidelines:

4.21 Given the absence of applicable local guidelines, the values indicated in Table 4.4 should be referenced for determining the minimum side clearances on bridges when the installation of cycling facilities on bridges is being considered.

4.22 The creation of a bike lane on a bridge may be considered if the bridge has shoulders, or if the traffic lanes are wide enough to permit the creation of a wide curb lane to accommodate bicycles on the travelled way.

4.5.2 Highways Interchanges

Crossing expressways such as 400-series highways pose difficult problems for designers of bicycle routes. Mixing relatively high speed, high volume motor vehicle traffic making frequent turning movements with bicycle traffic is a challenge. It is recommended that the best practices for a designer should be to provide clearly delineated space for cyclists and to provide them ample time to choose when to cross merging and diverging traffic. The following configuration illustrated in **Figure 4.20** is recommended for on-road cycling routes crossing over uncontrolled ramps.

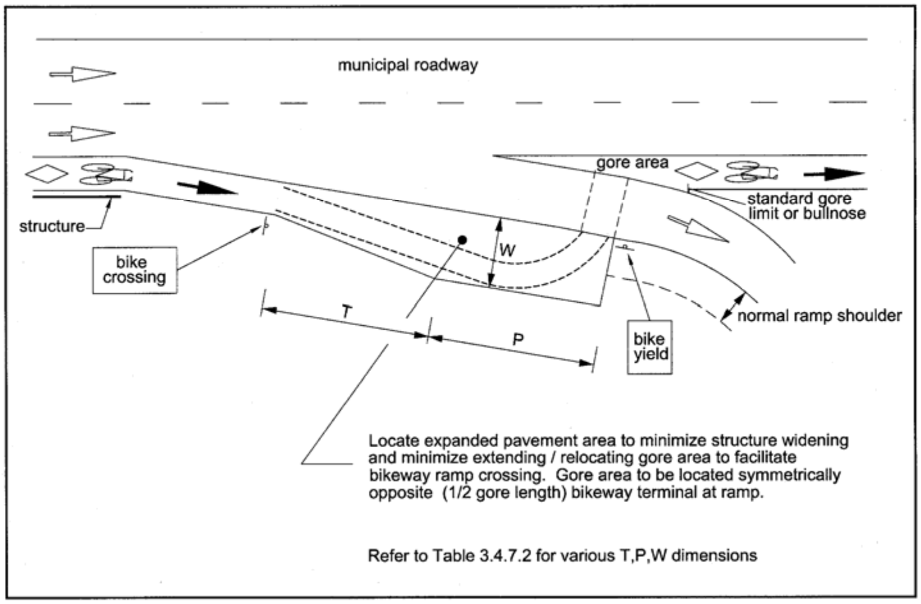

Figure 4.20 On-Ramp Treatment

TAC's 1999 Geometric Design Standards for Canadian Roads provides recommended designs for accommodating on-road cycling facilities over expressway off-ramps. It is recommended that either the TAC standard illustrated in **Figure 4.21** or the configuration shown in **Figure 4.22** be assumed as the guideline for the Region of York.

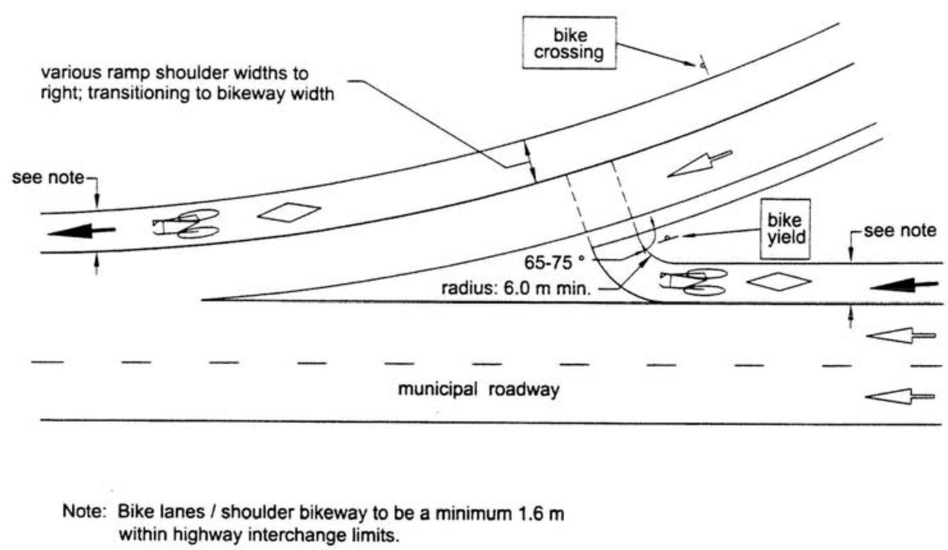

Figure 4.21 TAC Standard – Bikeway Crossing Expressway Exit Ramp
(TAC Figure 3.4.7.7)

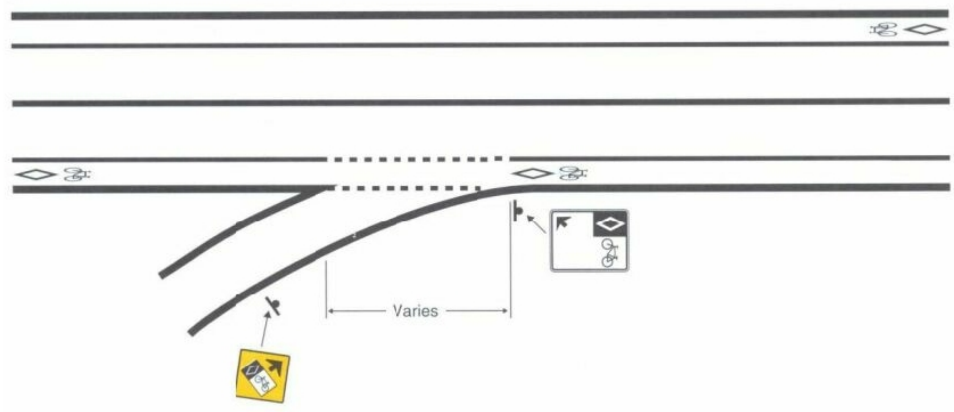

Figure 4.22 Off-Ramp Treatment

In situations where it may be more desirable to allow a cyclist to choose their own merge, weave or crossing manoeuvres, it is recommended that the pavement markings for the bicycle lane be discontinued through the crossing area and the configuration illustrated in **Figure 4.23** should be considered.

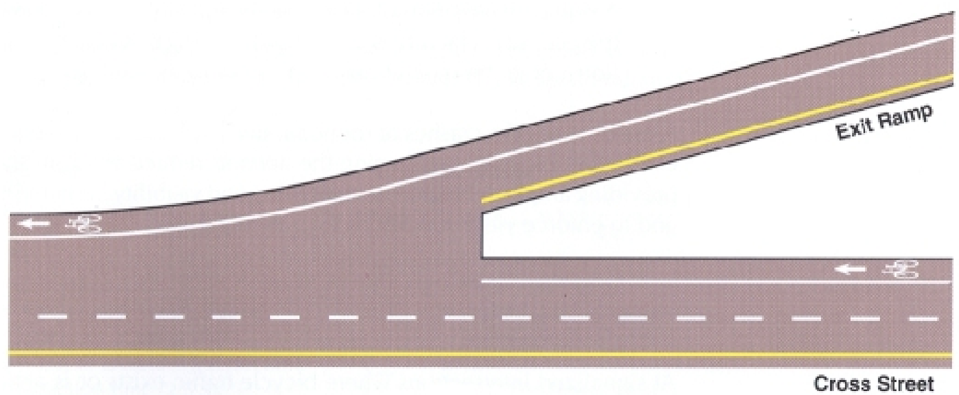

Figure 4.23 Bikeway Crossing Interchange Ramp
Source: Guide for the Development of Bicycle Facilities, American Association of State Highway and Transportation Officials

The TAC design standards for bicycle routes crossing expressway entrance ramps are located in **Table 4.5**.

Table 4.5
Design Standards for Bikeways Crossing Expressway Entrance Ramps

Design Standard	Taper (T) Length (m)[a]	Parallel (P) Length (m)[a]	Width (W) Length (m)[b]	Bike Path Radius (°)	Path Inter. Angle (°)	Terminal Radius (m)
Minimum	11	11	4	20	65	6
Desirable	13	13	5	20	70	8
Preferred	14	14	6	20	75	10
Notes:	a) Measured parallel to edge of ramp pavement. b) Measured perpendicular to edge of ramp pavement.					

Source: Geometric Design Standards for Canadian Roads, TAC, 1999
(TAC Table 3.4.7.2)

Coloured pavement may also be considered for the portion of the bicycle route crossing the motor vehicle travel lane.

Guidelines:

4.23 The TAC standards for accommodating on-road bikeways over expressway interchanges should be adopted by the Region of York for future cycling facilities.

4.24 In situations where it may be more desirable to allow a cyclist to choose their own merge, weave or crossing manoeuvres, it is recommended that the pavement markings for the bicycle lane be discontinued through the crossing area.

4.25 Coloured pavement may also be considered for the portion of the bicycle route crossing the motor vehicle travel lane.

4.6 Accommodating Pedestrians and Cyclists in Construction Zones

During construction/rehabilitation of a roadway, the environment through the construction zone, featuring rough pavement, narrow or restricted lanes, impeded sidewalks and heavy machinery, can be particularly uncomfortable for a pedestrian or cyclist.

When reconstructing a roadway section, especially ones that have high pedestrian and bicycle volumes, it is important to maintain a safe and convenient access for pedestrians and cyclists through the construction zone. As a general principle, if access is maintained for motor vehicles, then access should also be maintained for pedestrians and bicycles. Ideally, the contractor should provide a temporary facility for pedestrians and bikes if space is available within the road allowance. While this is not always possible, alternatives to accommodate pedestrians and cyclists should always be considered. If phasing of the construction requires that access to the roadway is closed to vehicular, pedestrian and bicycle traffic at any time during construction, a well-signed detour route should be provided.

Temporary road conditions through the construction zone that are compatible with motor vehicles may not be compatible with pedestrians or bicycles. For example, steel plates and timber decking are typically used to cover holes in the roadway. Steel plates should be coated with a non-slip surface and timber decking should be placed at right angles to prevent a bicycle wheel from falling into the cracks.

Appropriate signage is also important in providing information to pedestrians, cyclists and drivers. A review of this signage to determine both appropriate and consistent signage for construction projects across the Region of York is required.

Guideline:

4.26 The Region of York should ensure the accommodation of pedestrian and cyclist safety and access during all road construction activities. This should include, but not be limited to:

- *Construction notices posted on the Region's website;*
- *Advance signing for construction activities;*
- *Temporary conditions that are compatible with bicycles such as non-slip surfaces, ramped utility cuts and timber decking placed at right angles to the direction of travel; and*
- *Pedestrian and bicycle specific detours where appropriate.*

4.7 Pedestrian Intersection Treatments

4.7.1 Coloured/Textured Pavement

Intersections, crossings and interchange ramps are considered to be the most difficult elements in a pedestrian system. It has been recognized that the application of coloured and textured pavement to illustrate pedestrian crossing points at intersections may significantly improve the safety of users by informing pedestrians, cyclists and motorists of a trail crossing and the space it comprises. Coloured pavement treatments are currently widely used in North American and European cities.

It is recommended that the Region of York explore the possibility of using coloured and/or textured pavement at high volume crossings. This treatment should also be considered at on and off-ramp locations for 400 series Highways.

Guideline:

4.27 The Region of York should investigate the possibility of using coloured and/or textures pavement at high volume crossings and at 400 series Highways on and off ramps.

4.7.2 Pedestrian Crossings at Traffic Signals

Signal timings allotted to pedestrians should provide adequate time for pedestrians to cross for both able-bodied pedestrians and those using mobility devices and walking aids. Additional time should be provided in areas where there are typically heavy concentrations of elderly people or children, such as near schools or hospitals. Pedestrian displays should be used for all crosswalks at traffic signals wherever pedestrians are permitted to cross, consistent with the Ontario standard for pedestrian display heads. An example of these display heads is shown in **Figure 4.24.** When pushbuttons are installed at pedestrian crossings, they should be well marked, clearly visible and within reach from a hard flat surface for all crossing pedestrians, including those in wheelchairs. Each pushbutton should have both a tactile and visual and audible response to alert the pedestrian that their call has been received.

Figure 4.24 Example of an Audible Pedestrian Signal Push Button

Other traffic signal enhancements include countdown and audible traffic signals. Countdown or "shot clock" signals are designed to begin counting down at the beginning of the WALK display, and continue counting down through the flashing DON'T WALK interval. An alternative solution to installing countdown signals is to increase public education on the use of pedestrian signals. Audible pedestrian signals may also be used to alert visually impaired pedestrians as to when they are permitted to cross.

Guidelines:

4.28 Pedestrian displays should be installed at all signalized intersections and should be placed at levels that are clearly visible to pedestrians and motorists. Push buttons for pedestrian signals should be placed at heights that are within reach of all pedestrians, including children and those in wheelchairs or other mobility devices. Countdown and audible traffic signals are other enhancements that may be considered for signalized intersections in the Region of York.

4.7.3 Sidewalk Extensions

Sidewalk extensions are another option that may considered by York Region. A sidewalk extension is a sidewalk continued across a local street or intersection. Sidewalks can either be lowered to street level, or local roadways may be raised to the level of the sidewalk at the intersection. Sidewalk extensions act as an additional indicator to approaching motorists that they must yield to traffic and pedestrians on the cross street. They also help to visually improve pedestrian priority at intersections, but should only be applied where traffic on the cross street is stop-controlled. **Figure 4.26** illustrates a schematic of a sidewalk extension. **Figure 4.25** illustrates an example of a sidewalk extension.

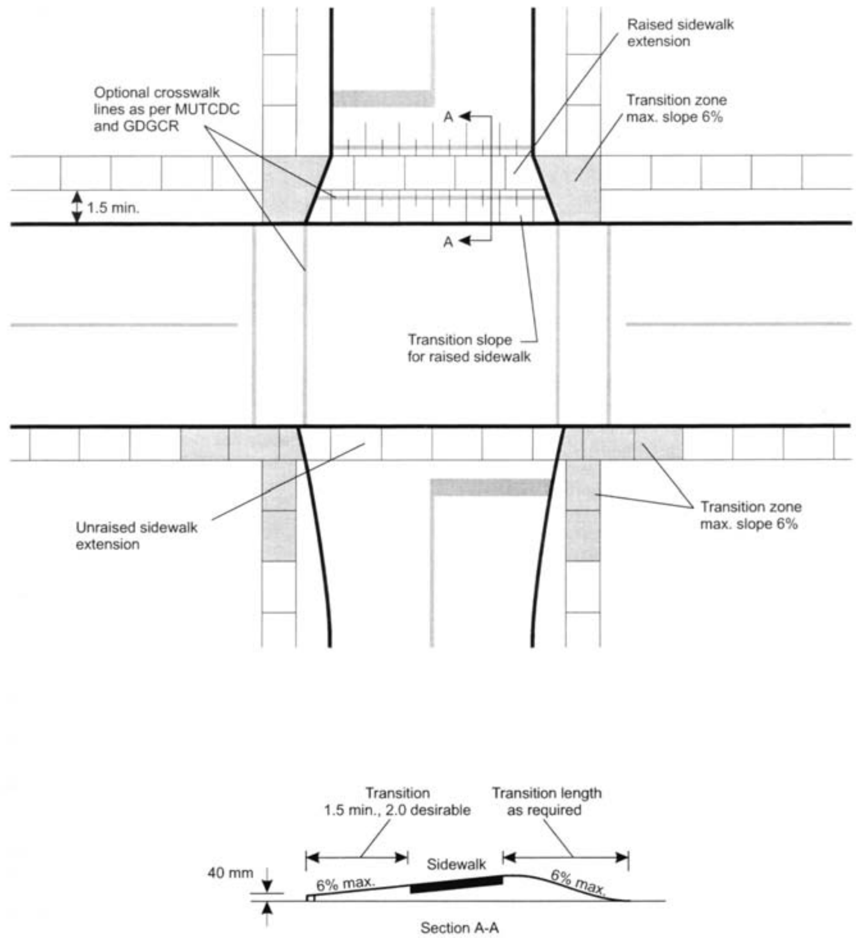

Figure 4.25 Sidewalk Extension Schematic
Source: Canadian Guide to Neighbourhood Traffic Calming, TAC (1998)

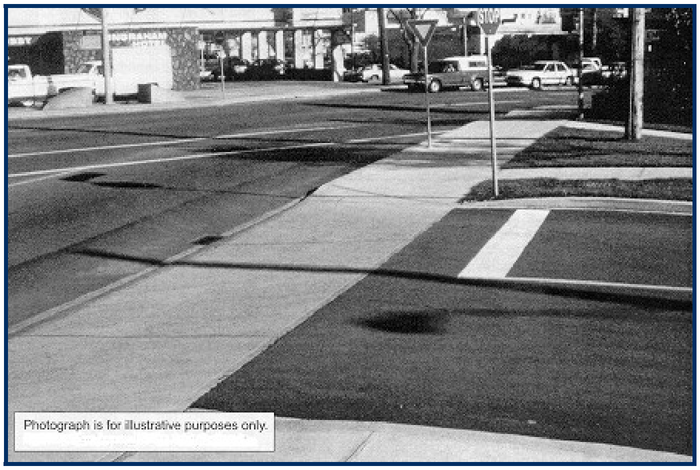

Figure 4.26 Sidewalk Extension
Source: Canadian Guide to Neighbourhood Traffic Calming, TAC (1998)

Guideline:

4.29 The Region of York and local Municipalities should consider the installation of sidewalk extensions along key pedestrian routes, especially along routes that form part of the community pedestrian system.

4.7.4 Curb Ramps

Curb ramps provide increased mobility for sidewalk or network users with disabilities. However, there are safety concerns surrounding the system-wide provision of such features. The approach to improving accessibility through curb ramps varies between municipalities. Mississauga, for example, provides a narrowing of the actual curb to force users to pass through the adjacent offset gates rather than avoid them. Toronto typically does not install a drop curb on arterial roadways, but they are common on local streets.

It is recommended that as a minimum, curb ramps and curb narrowings, be implemented on all network segments that are identified and signed to accommodate wheelchairs. **Figure 4.27** illustrates a typical curb ramp.

Figure 4.27 Typical Curb Ramp
Source: US Federal Highway Administration: How to Develop a Pedestrian Safety Action Plan, Page 61 (2006).

Guideline:

4.30 Curb ramps should be provided on all route segments that are identified or signed to accommodate wheelchairs. Curb ramps should be added where any new sidewalks are constructed.

4.7.5 Curb Extensions (Bulb-Outs)

Curb extensions, also referred to as bulb-outs, reduce the crossing distance for pedestrians and increase the visibility between motorists and pedestrians. Curb extensions also provide additional room for people waiting to cross streets, prevent cars from parking illegally at corners, and shorten the distance required for pedestrians to cross a road. The additional space provided from bulb outs can be used to accommodate street furniture, benches, trees and bike racks while also providing a space for curb ramps. Curb extensions may potentially increase snow removal costs and may require the use of smaller snow removal equipment for clearing the curb lane, if no cars are present. However, curb-extensions provide more storage room for snow. An example of a curb extension is shown in **Figure 4.28**, and a schematic illustration detailing the recommended dimensions is provided in **Figure 4.29**.

Figure 4.28 Curb Extensions
Source: Canadian Guide to Neighbourhood Traffic Calming

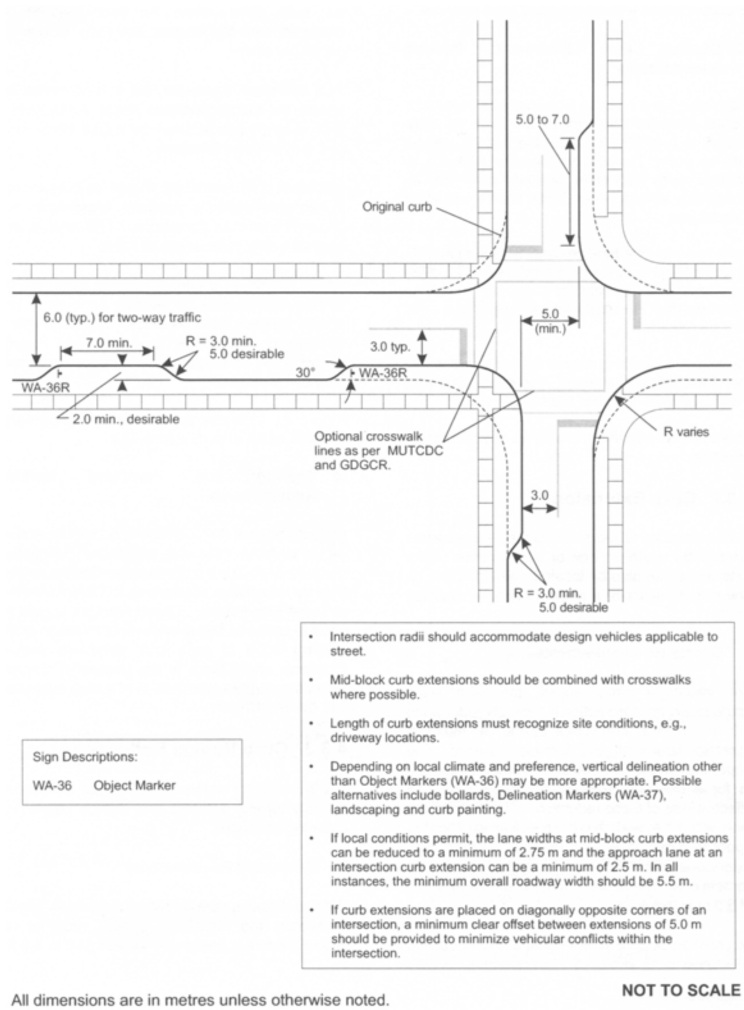

Figure 4.29 Curb Extension Diagram
Source: Canadian Guide to Neighbourhood Traffic Calming, TAC (1998)

Curb-extensions should not block an adjacent bike lane if one is present. The ideal location for curb extensions is along roads with on-street parallel parking and a bike lane, with the curb extending as far as the width of the parking lane.

Bus bulb-outs, which are essentially larger curb extensions, can provide space for bus shelters, which in turn can increase the drop off and pick up efficiency of a transit vehicle.

A typical curb extension or bulb-out should be designed as a bus bulb-out whenever possible. Tree bulb-outs may also be constructed in areas where the sidewalk would be too narrow to accommodate a row of plantings. Curb extensions are even more beneficial when used in conjunction with pedestrian refugee islands, later discussed in Section 4.8.[14]

4.7.6 Curb Radius Reduction

Wide curb radii typically result in motorists making high-speed turning movements at intersections, especially right-turns. One of the most common pedestrian/vehicle collisions occurs when a right-turning vehicle strikes a pedestrian. Reconstructing the turning radius to create a tighter turn helps to reduce turning speeds, as well as shortening the crossing distance for pedestrians. This also helps to optimize signal timings by reducing the required amount of pedestrian clear time. In addition, the sight distances between both pedestrians and motorists can also be improved. Nearby land uses and types of road users should be considered when designing an intersection so that curb radii are sized appropriately. Curb radii may be too small to accommodate large trucks or buses, which may ride over the curb, placing pedestrians in danger.[15] An example of a reduced radius curb is shown in **Figure 4.30**. A schematic curb-reduction diagram is provided in **Figure 4.31**.

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[14] Pedestrian Master Plan, The City of Oakland - Part of the Land Use and Transportation Element of the City of Oakland's General Plan; 2002

[15] Pedestrian Facilities User Guide – Providing Safety and Mobility; U.S. Department of Transportation, Federal Highway Administration March 2002

Figure 4.30 Reduced Curb Radius
Source: Canadian Guide to Neighbourhood Traffic Calming, TAC (1998)

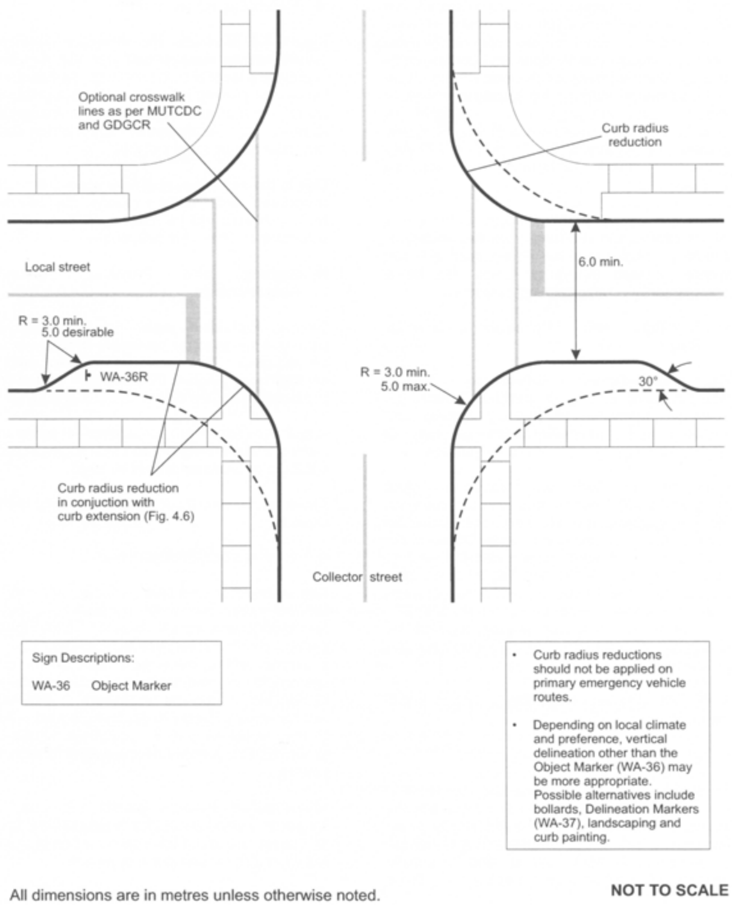


Figure 4.31 Curb Radius Reduction
Source: Canadian Guide to Neighbourhood Traffic Calming, TAC (1998)

4.7.7 Advanced Stop Lines

Vehicle stop lines can be moved farther back at signalized intersections and mid block crossings, improving safety and visibility for pedestrians and cyclists. They allow pedestrians and drivers to have a clearer view of each other and more time in which to assess each other's intentions. Advanced stop lines also allow pedestrians to proceed into a crosswalk before motor vehicles can turn. Advanced stop lines also allow motorists to have a clearer view of cyclists on their right, and can actually reduce the potential for collisions between right-turning motorists and straight-through travelling cyclists.

In practice, stop lines have been moved back 4.6 m to 9.1 m (15 to 20 ft) relative to the marked crosswalk. The effectiveness of advanced stop lines is dependent on the likelihood that motorists will obey the stop line.[16] Advanced stop bars are recommended in locations where there are heavy right-turning traffic volumes and no exclusive right turn lanes are provided.

Guideline:

4.31 Advanced stop bars are recommended in locations where there are heavy right-turning traffic volumes and no exclusive right turn lanes are provided.

4.7.8 School Zone Improvement

The Region of York should continue its various roadway improvements that are used to enhance the safety and mobility of children in school zones. The provision of adult crossing guards in assisting children in crossing streets safely, and other measures such as parking prohibitions near intersections and school crossings, usage of signs and markings such as school advance warning signs, and speed limit reductions in school zones are all effective practices that should be continued by the Region. Marked crossings, to help direct children to the best routes to school, and appropriately designed roads as well as education and enforcement should all continue to be in place to ensure that motorists behave appropriately in school zones.

[16] Pedestrian Facilities Users Guide – Providing Safety and Mobility; U.S. Department of Transportation, Federal Highway Administration; 2002

4.8 Pedestrian Mid-block Crossing Treatments

One of the key challenges for implementing a connected multi-use recreational and boulevard trail network is how to accommodate a trail crossing of a roadway that is not located at a signalized intersection. Ideally, a trail crossing should occur at an existing signalized or stop controlled intersection, or if at a mid-block location, by way of a grade separated crossing such as an underpass or bridge. Unfortunately, these ideal crossing solutions cannot always be achieved.

The location of the trail and its existing or preferred alignment and desire line for trail users may mean that crossing at an existing or future protected crossing is impractical. In addition, when retrofitting a roadway to accommodate a trail crossing, constructing an underpass or bridge for the trail is not always a feasible solution from both a design and cost perspective.

When a mid-block crossing is necessary, it should be designed to provide advance warning of the impending crossing to motorists, pedestrians and cyclists. The trail should be designed and signed to encourage the user to reduce speed and stop. Grade changes on the trail in advance of the crossing combined with adequate sight distances, signing, textural surface contrast and bollards should be considered. Mid-block crossings of arterial or collector roads may warrant consideration of a separate traffic signal or a pedestrian crossover.

Figure 4.32 illustrates one example of a typical mid-block trail crossing.

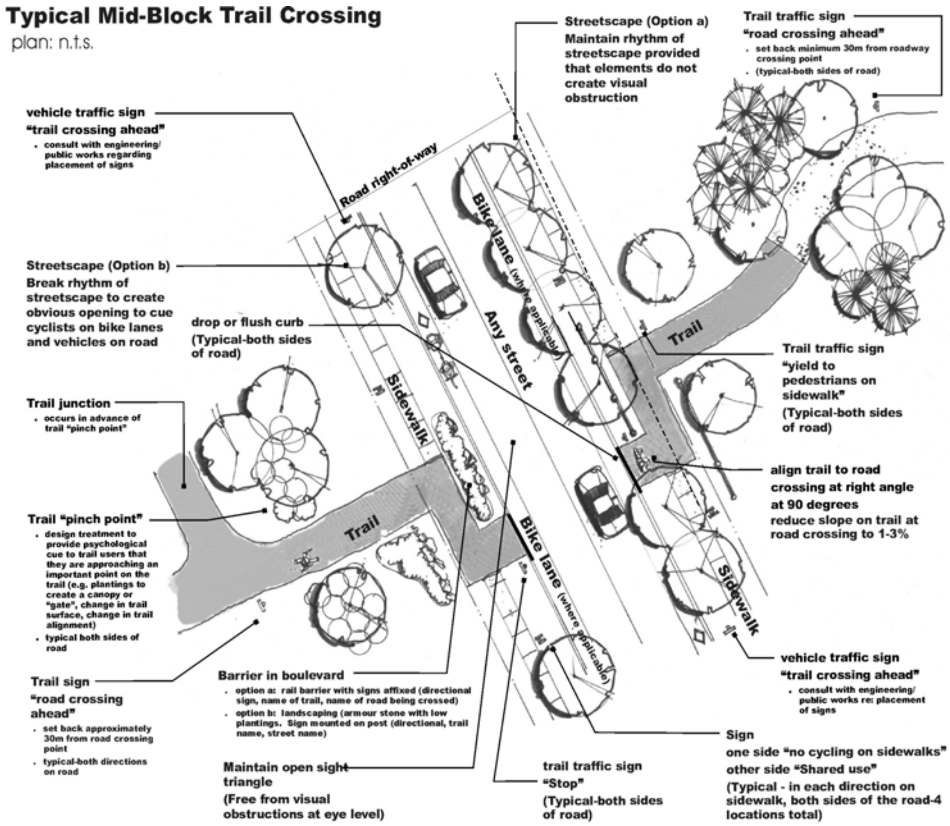


Figure 4.32 Elements of Trail Crossings of Roadways

Consideration should also be given to changing the texture / colour / elevation of the roadway itself (in addition to the detail that is paid to the treatment of the approach) to provide drivers with a visual cue to exercise caution.

Highly visible street markings should be present at uncontrolled pedestrian crossings, and it is recommended that double-posted pedestrian crossing signs be installed on both sides of the roadway. This would help make drivers more aware of the pedestrian crossing upon their approach.

Mid-Block Crossing Warrant

If the trail crossing is within the given distance of a signalized or stop-controlled intersection, or a formal pedestrian crossing, trail users should be directed to cross at this location. The following are considered acceptable threshold distances for mid-block crossings:

2 Lane Roadway:	60 metres from nearest protected crossing
4 to 6 Lane Roadway:	120 metres from nearest protected crossing

In addition, adequate site distance along the roadway is required for a cyclist who has dismounted at the "stop" sign at a mid-block crossing, to be able to completely cross the entire roadway without impeding the progress of a vehicle approaching from the cyclists' right side. **Figure 4.33** illustrates how sight distance is determined, while **Table 4.6** provides values for a range of widths and design speeds.

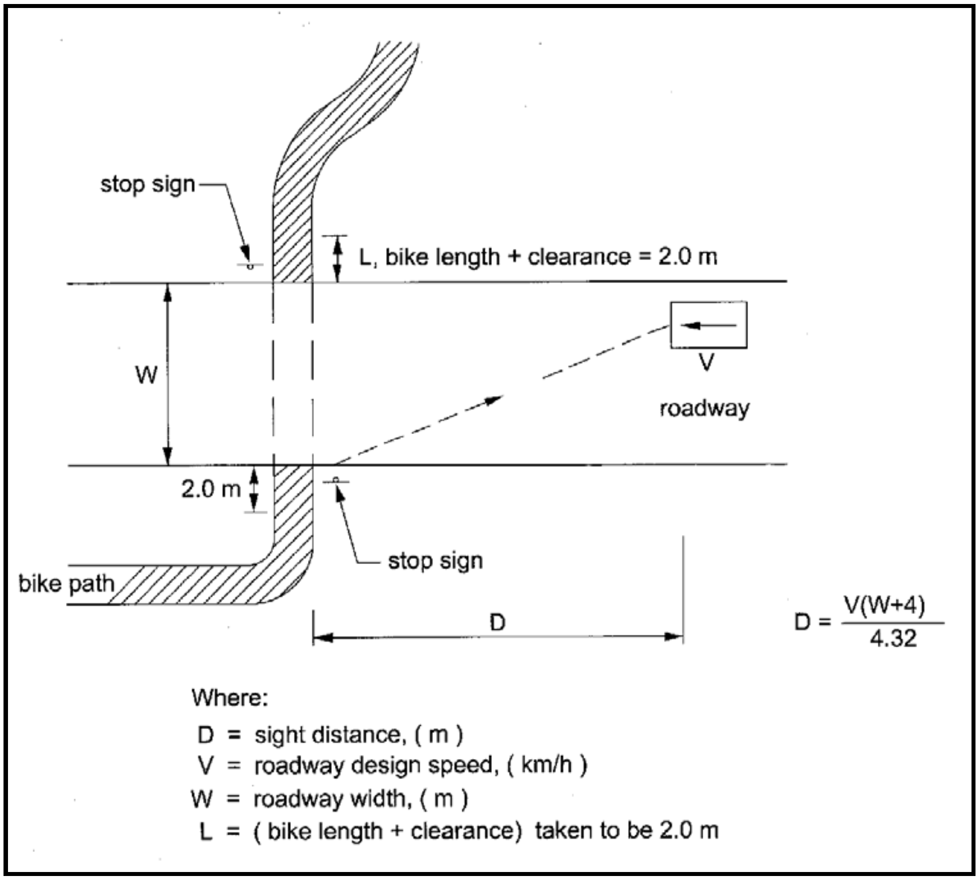


Figure 4.33 Minimum Sight Distance for Bike Path Crossing
(TAC GDGCR, 1999 Figure 3.4.7.2)

4.8.1 Raised Crosswalk (Urban Areas)

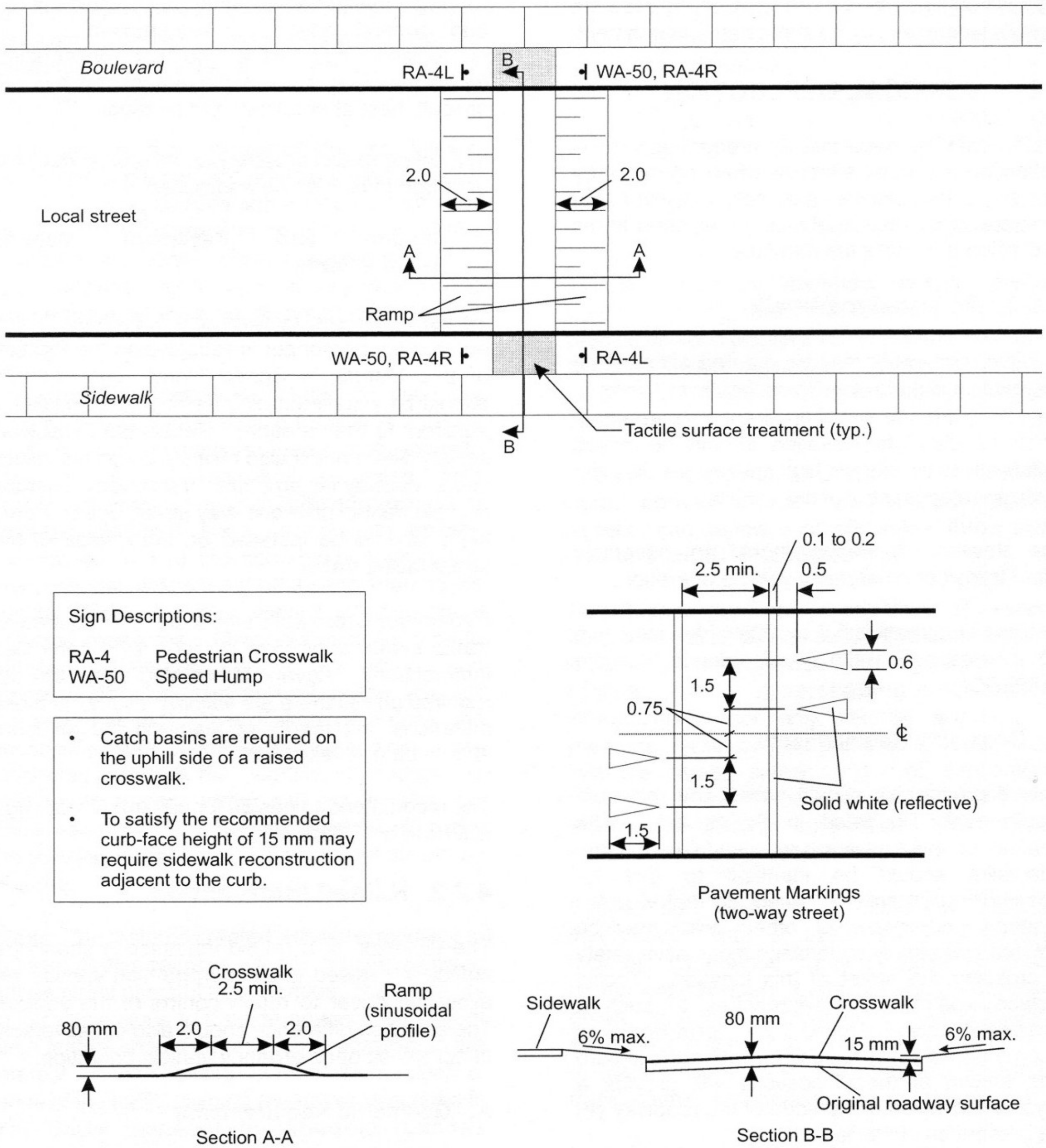
Raised crosswalks have been introduced by a number of municipalities as a design solution for mid-block crossings in urban areas or near schools. The purpose of a raised crosswalk is to reduce vehicle speeds, improve pedestrian and trail user visibility and reduce the number of cyclist/pedestrian-vehicle conflicts.

This design treatment is most applicable for local collector and residential streets or where the posted speed limit is 50 km/h or less. **Figure 4.34** illustrates a TAC recommended guideline for raised crosswalks.

Table 4.6 Minimum sight Distance for Mid-Block Crossing (Bike Path Crossing) TAC, GDGCR, 1999 (TAC – Table 3.4.7.1)

Width of Roadway - W (m)	Minimum Sight Distance (D) to Approaching Vehicle (m) Roadway Design Speed (km/h)			
	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

Note: Values for other roadway widths and/or design speeds may be derived from the formula i Figure 3.4.7.2.



Ramp Height Development
Crosswalk profile parallel to roadway surface.

Distance (m)	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875	1.000	1.125	1.250	1.375	1.500	1.625	1.750	1.875	2.000
Finished Height (mm)	0	1	3	7	12	18	25	32	40	48	55	62	68	73	77	79	80

All dimensions are in metres unless otherwise noted.

NOT TO SCALE

Figure 4.34 – Raised Crosswalk Design
Source: Canadian Guide to Neighbourhood Traffic Calming, TAC/CITE, 1998.

Raised crosswalks also allow pedestrians to cross streets at the same level as the sidewalk, eliminating the need for curb *ramps (see Curb Ramps Section 3.6.3).* This concept can also be applied to entire intersections as well. The raised portion of roadway in the intersection encourages motor vehicles to yield, reducing automobile speeds.

Raised Crosswalk
Source: Canadian Guide to Neighbourhood Traffic Calming, TAC (1998)

4.8.2 Mid-Block Curb Extensions

As with intersection curb extensions, mid-block curb extensions reduce the distance pedestrians must travel to cross a road and make the crossing more visible to motorists. They also have the secondary effect of slowing and calming traffic as the roadway temporarily narrows.

4.8.3 Pedestrian Refuge Islands

Pedestrian refuge islands may be used to protect pedestrians while crossing multi-lane roadways. The offset design forces pedestrians to stop and cross each direction of traffic separately. Raised medians can also act as a refuge for pedestrians crossing midblock. They could provide space for trees and other types of landscaping that can help to define the character of the area they serve. Pedestrian islands and raised medians are most useful on high-volume, high speed roads and should be designed to provide tactile cues for pedestrians with visual impairments to indicate the border between the pedestrian refuge area and the motorized vehicle roadway. The City of Toronto has developed a warrant for the installation of mid-block pedestrian refuge islands, which should be considered for use in the Region of York. Their warrant is 100-115 pedestrians per hour over an 8-hour period. **Figure 4.35** illustrates an example of a pedestrian refuge island.

Guideline:

4.32 It is recommended that the Region of York consider pedestrian refuge islands as an appropriate measure to accommodate a mid-block crossing on high volume and/or multi-lane roads.

Figure 4.35Pedestrian Refuge Island: Vaughan, ON

4.8.4 Mid-Block Signal Controlled Crosswalks

These crossings aid pedestrians in crossing busy roads mid-block by using signals to stop traffic. These are useful in areas that are distant from the nearest signalized intersection but have a high demand for pedestrian crossings.

With this treatment, standard traffic signals control vehicular traffic on the through-road, while pedestrian signals equipped with push buttons control the crossing pedestrian movement.

Unlike an RA-5 equipped crosswalk with pedestrian actuated flashing amber lights, these crossings are only partially pedestrian actuated, resulting in fewer disruptions to vehicular traffic.

Guideline:

4.33 It is recommended that the Region of York continue to use mid-lock signal controlled crosswalks and expand the program to other locations where appropriate.

4.9 Multi-Use Trail Treatments

4.9.1 Rails with Trails

There are some active rail lines in the Region of York which could also serve an AT function. These rail lines typically have a wide enough right of way to safely accommodate a multi-use trail in addition to existing rail operations. This can also work in reverse: should abandoned rail lines that currently host multi-use trails be needed in the future for rail operations, it is possible to reinstall the rail infrastructure without losing the use of the multi-use trail.

Trails may be considered on active or under-utilized rail corridors such as railways lines used by freight and passenger trains. Trails adjacent to rail corridors should also be physically separated from the cycling facility. This could be accomplished through the provision of a planted berm where sufficient right-of-way exists. In locations with constrained rights-of-way, a fence would be suitable to separate the two facilities.

An example of a trail adjacent to a rail corridor is illustrated in **Figure 4.36** and **Figure 4.37**.

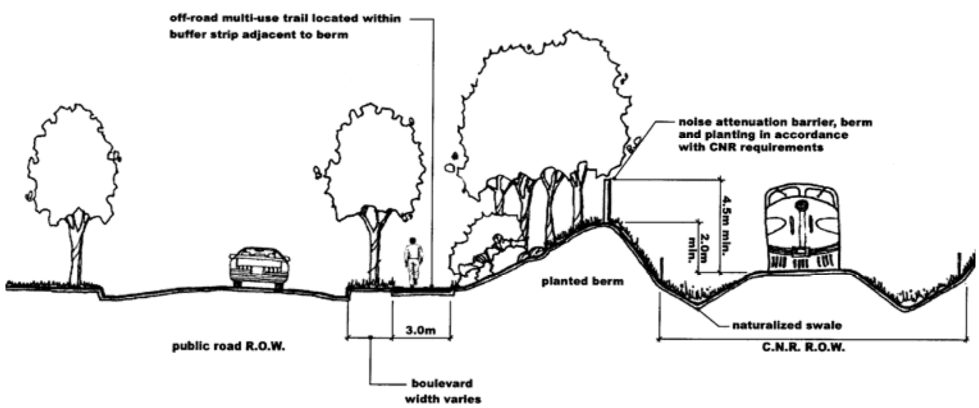


Figure 4-36 Typical cross-section of a cycling facility adjacent to a rail corridor separated by a planted berm.
Source: Stantec Consulting Ltd. (formerly ESG International) Public Open Space Plan, Town of Whitchurch, Stouffville, Functional Servicing Study, Southeast Quadrant OPA 101 Secondary Plan, May 2002

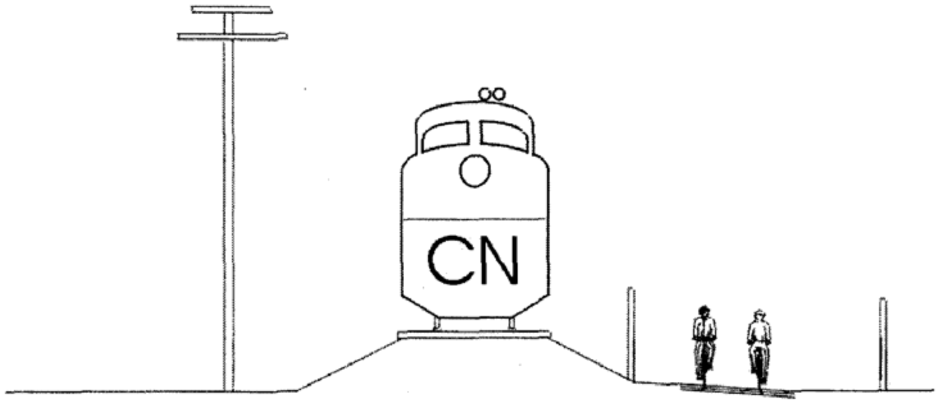


Figure 4-37 Typical cross-section of a cycling facility adjacent to a rail corridor separated by a fence.
Source: Rails with Trails Feasibility Study: An example from Kelowna, British Columbia. G.D. Hamilton Associates Consulting Limited, 2003.

Guidelines:

4.34 Railroads with wide enough rights-of-way can typically accommodate a multi-use trail.

4.35 Trails adjacent to active and/or under-utilized rail corridors should be separated from the rail line through the provision of a planted berm or fence.

4.9.2 Off-Road Barriers

Barrier protection may be required along a multi-use trail for a number of reasons: to protect the trail, the user or the natural environment. Most commonly, fence or railing type barriers are provided to protect users from dangerous situations or to discourage access to sensitive areas.

To prevent access by unauthorized users such as motor vehicles, barriers should be installed at trail entrances. Barriers should be clearly marked and visible, otherwise they can become a hazard to trail users. Trailside signage alerting users of the upcoming barriers should be appropriately located to provide adequate time to slow down and/or stop as required.

Care should be taken to ensure that barriers do not make access difficult for those with disabilities or for inexperienced users wherever possible.

Suitable barriers associated with trails are bollards, gates, fences, and natural barriers.

Bollards should be located at trail access points where vehicle access must be restricted. Where it is required that maintenance or emergency vehicles have access to trails, a collapsible or knockdown bollard is a suitable alternative. In a natural situation, timber bollards are preferred; metal is suited to urban environments. Bollards should also have reflective surfaces facing a cyclist's direction for night time visibility.

Swinging gates can be used to prevent motorized vehicles (including ATV's) from accessing trails, but do not prevent many other activities unless locked. Gates should be easy to open and should be well marked, particularly for night time visibility.

Railings and fences are required to protect the user from a hazardous situation, and should be constructed to conform to local building codes. Timber or stone construction is best suited to natural situations while metal or a combination of wood, metal and in some situations stone may be more appropriate for urban and heavy use areas.

Landscaping treatments such as the strategic placement of stones, can provide a natural barrier that can successfully deter undesired access.

Guideline:

4.36 Barriers should be considered at off-road trail entrances to prevent access by unauthorized users such as motor vehicles, and to caution trail users that they are entering or exiting a trail environment.

4.37 Other barriers should be installed where appropriate.

4.38 Barriers should not restrict access to those with disabilities.

4.9.3 Trail Junctions

Trail junctions are an intersection of two or more trails and may a include multi-use trail in a road right-of-way. Junctions are ideal locations for rest stops and wayfinding signage. It is important that adequate sight lines be provided at trail junctions to avoid collisions between users. **Figure 4.38** illustrates an example of a trail junction.

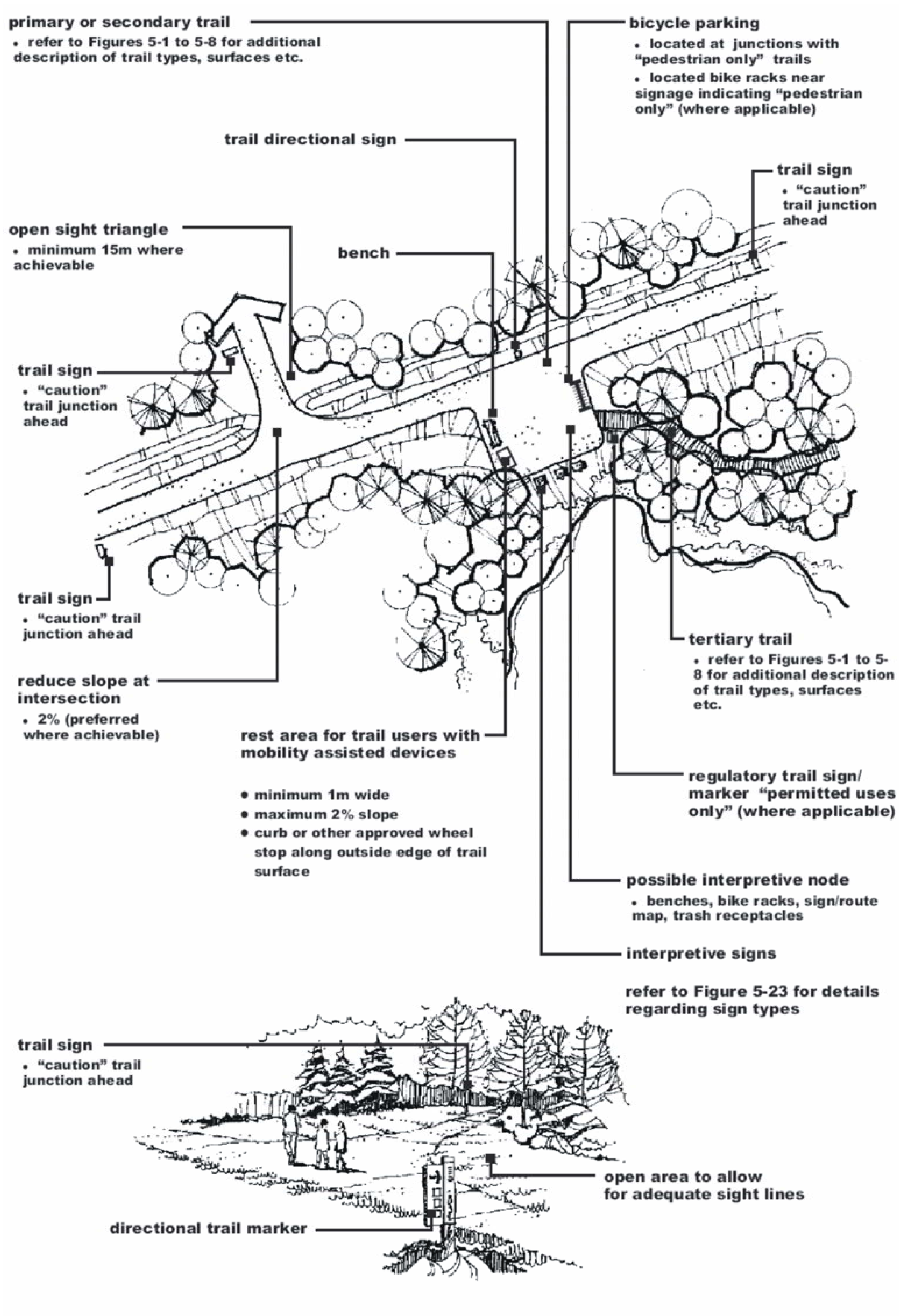
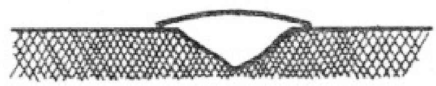


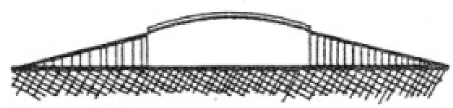
Figure 4.38 Example of a Trail Junction
Source: Guelph Trail Master Plan
Stantec Consulting and MMM Group Limited

4.9.4 Trail Bridges

There are typically two basic types of trail bridges, linear or ramped-type bridges. The approach paths of a flat or linear-type bridge do not ramp significantly. This type of bridge crosses over travel barriers such as waterways that are lower in elevation than the trail. The approach paths of a ramped-type bridge are sloped to gain elevation and cross barriers such as a railway that are at the same elevation or higher than the trail. These two bridge types are illustrated in **Figure 4.39.**



Linear Bridge



Ramped Bridge

Figure 4.39 Linear and Ramped Bridges

In general, a linear-type bridge is preferable because it is the simplest to build and has a flat runout, ensuring access for all trail users. Space limitations and increased bridge heights on ramped bridges may require ramp grades as steep as a maximum of 8 percent, which can cause excessive exit speeds. This is especially hazardous if the end of the bridge is located at an intersection.

In these situations, curved ramps should be used. Wherever possible, ramps should be elliptical or circular rather than being interrupted by 180 degree turns at landings. In addition, bridge approaches should not be located near intersections, both road/trail and trail/trial, or where visibility is limited.

Bridges should be 0.6 m wider (0.3 m wider on each side) than the trails they are serving, to provide adequate side clearance for the railings. They should also be wide enough and strong enough to support maintenance vehicles where required. An immovable bollard located at the centre of each approach can be used to prevent heavy vehicles from crossing a light duty bridge.

The bridge travel surface should be a non-slip material. Untreated wood or flat metal surfaces become slippery when wet or icy. Bridge slats made of self-weathering steel with raised dimples for traction have been used successfully. Open metal grating, on the other hand, is noisy and provides a less desirable riding surface for cyclists.

Bridges less than 3.6 metres wide should not be configured in a way that encourages two-way cycling traffic or encourages cyclists to ride on them or as part of a high use multi-use path. Warning signage and centre line bollards can be used to slow cyclists down and alert them to a constricted bridge crossing ahead. In some cases, it may be necessary to sign the bridge as a pedestrian only bridge and request that cyclists walk their bicycles.

Typically pre-fabricated bridges are recommended as a cost-effective solution, except when crossing very wide spans or 400 series highways. Key design considerations include:

- Surface type:
  - Applying stain grit to paint and using this to cover the wooden surface, adding a “rough” texture. This however wears down over time and must be re-applied;
  - Apply asphalt shingles or Tar and Stone to the wooden surface of the bridge to increase the traction and “grip” on the bridge;
  - Place an open webbed rubber track on top of the wooden surface to provide more traction;
  - Metal grate surfaces are effective also, but they tend to be more expensive and are not as desirable for in-line skaters and cyclists. Concrete surfaces are often used for major and more expensive crossing structures;
- Vertical railings should be located on the outside of the bridge structure to avoid damage by service and snow removal vehicles; and
- Cover plates should be used to cover expansion joints.

Guidelines:

4.39 Multi-use trail bridges should be designed with non-slip surfaces, have vertical railings attached to the outside of the structure and include cover plates over expansion joints.

4.9.5 Safety "Rub Rails" and Railing Height

Along off-road multi-use trails with railings, a "rub-rail" should be provided to prevent cyclist's handlebars from catching the vertical supports of the railing. **Figure 4.40** illustrates a "rub-rail". A rub-rail should be a minimum 20 cm strip of smooth surfacing along its length, placed at a height ranging between 0.90 m and 1.1 m.

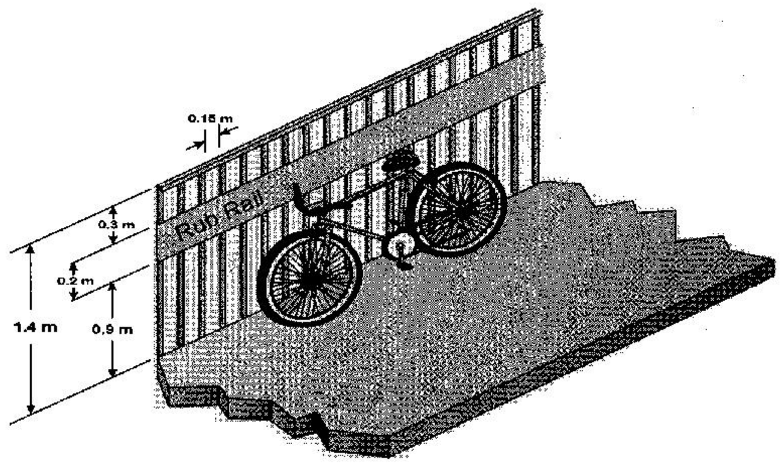


Figure 4.40 Safety Rub-Rail
Source: Figure 2.18, Bicycle Facility Design Guidelines, Appendix 1, City of Nanaimo, 2003

Guideline:

4.40 Safety "rub-rails" may be considered along bicycle trails with railings to prevent a cyclist's handlebar from catching the vertical supports of the railing.

4.10 Crime Prevention Through Environmental Design

Crime Prevention Through Environmental Design (CPTED) is a pro-active crime prevention strategy that is used by planners, architects, police services, security professionals and everyday users of space. CPTED is defined as:

"A proactive crime fighting technique in which the proper design and effective use of a building and its surroundings lead to a reduction in crime as well as an improvement in the quality of life for citizens of the community."[17]

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[17] Crime Prevention Through Environmental Design (CPTED), Presentation, Canadian Institute of Transportation Engineers (CITE), 2004

The four main underlying concepts of CPTED are as follows:

- Natural Access Control: Deters access to a target and creates a perception of risk to the offender;
- Natural Surveillance: The placement of physical features and/or activities and people that maximizes natural visibility or observation;
- Territorial Reinforcement: Defines clear borders of controlled space from public to semi-private to private, so that users of an area develop a sense of proprietorship over it; and
- Maintenance: Allows for the continued use of space for its intended purpose.

The concept of CPTED should be applied in the implementation of the York Region Pedestrian and Cycling Master Plan, especially in regards to off-road trail portions of the network and other areas that may be isolated or not heavily trafficked. It is important to design these facilities in such a way that a user would feel safe using a cycling facility and would not be deterred.

Recommended CPTED features that should be considered for the design of new AT facilities include the following:

- Properly located entrances, exits, fencing, landscaping and lighting should direct both foot and automobile traffic in ways that discourage crime;
- To deter criminals, landscaping and lighting should be placed in strategic locations that promote and maximize natural surveillance and the ability for others to "see what's going on." (e.g. from inside of a home or building, adjacent streets or from neighbours); and
- Physical barriers such as bushes, sheds, or shadows, make it difficult to observe activity therefore, these consideration should be given as to how these items are placed.

Guidelines:

4.41 The four main underlying principles of CPTED should always be considered when implementing the York Region Pedestrian and Cycling Master Plan:

- *Natural Access Control;*
- *Natural Surveillance;*
- *Territorial Reinforcement; and*
- *Maintenance.*

4.42 Properly located entrances, exits, fencing, landscaping and lighting should direct both foot and automobile traffic in ways that discourage crime.

4.11 Railway Crossings

Railway crossings can be challenging for all trail users. Therefore, extra caution should be applied to assure their safe operation. It is recommended that appropriate traffic control devices be installed at the intersections of railway tracks and network routes. These include:

- Pavement markings;
- Signage; and
- Lift gates.

The aforementioned traffic control devices should be designed and installed in accordance with the Bikeway Traffic Control Guidelines (TAC 1997) and the Manual of Uniform Traffic Control Devices for Canada (TAC 1998).

Careful consideration should be given to the design of at-grade crossings of railways. Furthermore, it is recommended that crossings be designed as close to right angles as possible. In many situations this may require widening of a network segment in advance of the crossing, thereby allowing cyclists, skateboarders, in-line skaters for example, to reduce their speed and position themselves for crossing at right angles.

Rubber track guards are also recommended to improve friction between bike tires and the pavement, and also to narrow the rail gaps. Clearly visible signage should also be displayed to forewarn pedestrians, including those using mobility devices, of an approaching railway crossing, and possible tripping hazards when walking or running over them. Pavement crossing surfaces should also be paved, and inspected regularly during road inspections for signs of deterioration around the tracks. Pavement deterioration adjacent to railway tracks can be a potential hazard, especially to those in wheelchairs since tires could get caught in the rails.

Figure 4.41 to Figure 4.44 illustrate recommended options for skewed railroad crossings. While these examples illustrate bicycle lanes, similar applications could be made using sidewalks or multi-use trails.

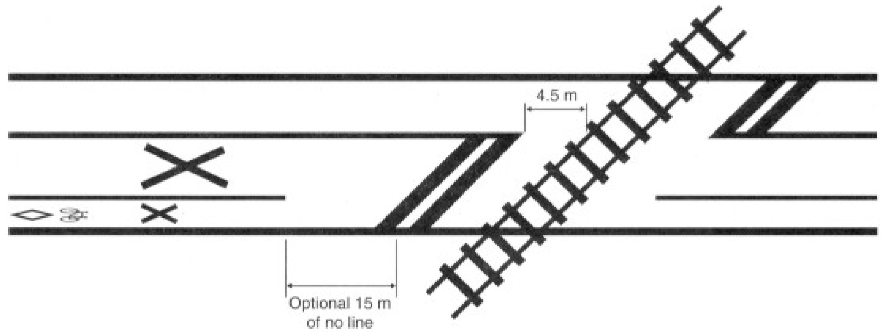

Figure 4.41 Skewed Railroad Crossing with Restricted Right-of-Way Width

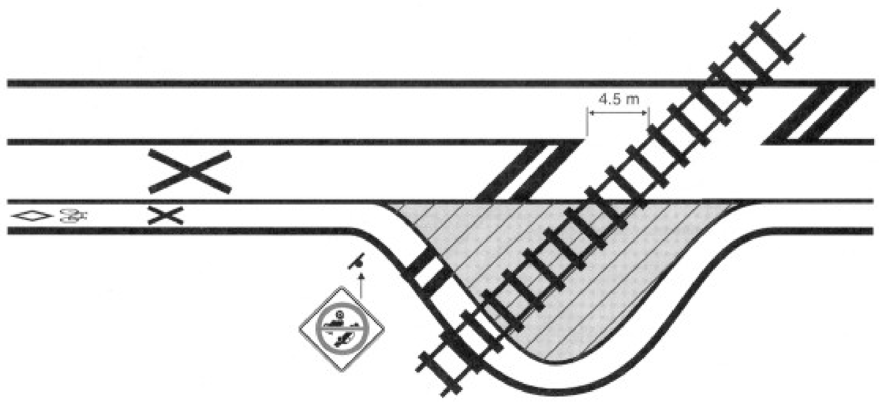

Figure 4.42 Skewed Railroad Crossing with Unrestricted Right-of-Way Width

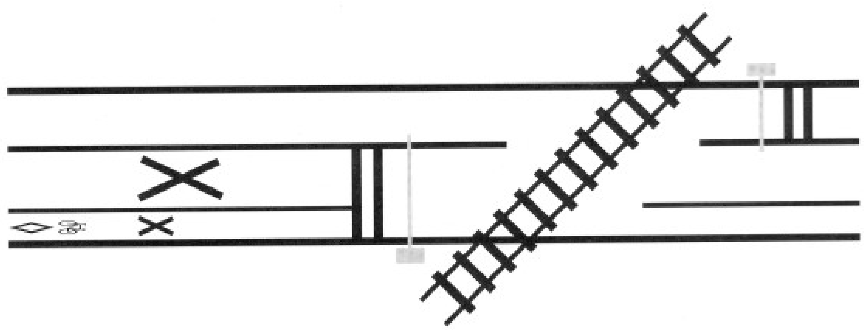

Figure 4.43 Skewed Railroad Crossing with Restricted Right-of-Way Width and Gate Control

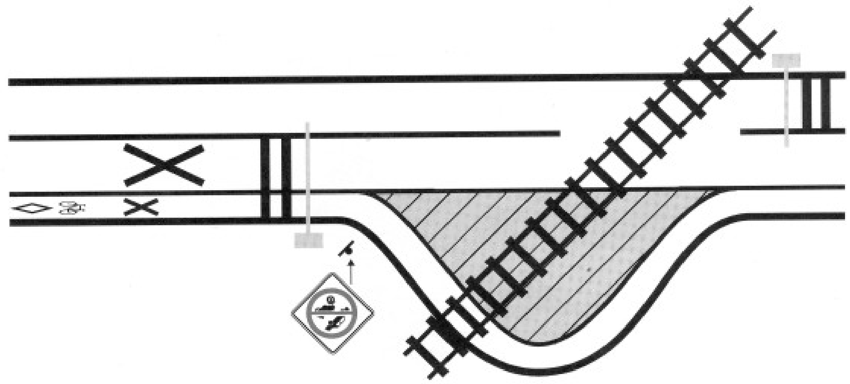

Figure 4.44 Skewed Railroad Crossing with Unrestricted Right-of-Way Width and Gate Control

4.12 Accommodating Pedestrians and Cyclists in Roundabouts

Roundabouts are gaining increased acceptance as an acceptable means of intersection control in North America. As a result, it is important to ensure that pedestrians and cyclists can be accommodated in roundabouts.

With respect to pedestrians, sidewalks should be provided along the outer edge of the entire roundabout. Crosswalks should be provided at all entry/exit legs of the roundabout. As with any crosswalk, a boulevard should be provided between the sidewalk and the roadway as per Ontario standards. Deflector islands should be utilized as pedestrian refuge islands and should be raised above the road level to offer protection to pedestrians. As with intersection crossings, ramps should be provided which are flush with the roadway to accommodate those people who use wheelchairs or other mobility aids. Refuge islands will make crossing the entry/exit legs easier for pedestrians as they will only have to concentrate on traffic moving in one direction at a time.

The inner island of the roundabout should be made difficult for pedestrians to cross in order to prevent pedestrians from crossing a roundabout at a location other than a crosswalk. This may be accomplished through landscaping or other appropriate measures.

With respect to cyclists, there are three options for bicycle access to a roundabout, depending on the configuration of the roundabout. For single lane roundabouts, no bicycle facilities are recommended for inclusion in the roundabout. If a bicycle lane is present on approach to the roundabout, it should be dashed for a minimum of 15 m (30 m to 45 m is preferable) and should end 30 m before the circulatory roadway. This line should then be tapered for 15 m to a point 15 m before the circulatory roadway, in order to provide cyclists the opportunity to merge into the motor vehicle lane.

To alert motorists to the presence of cyclists in the travel lane, and to inform cyclists where they should be on the road, a shared use lane marking should be applied at both entry and exit points for the roundabout. It should be located in the centre of the roadway.

In multi-lane roundabouts, cyclists may be directed onto a multi-use trail located along the outside of the circulatory roadway of the roundabout. This treatment is shown in **Figure 4.45**.

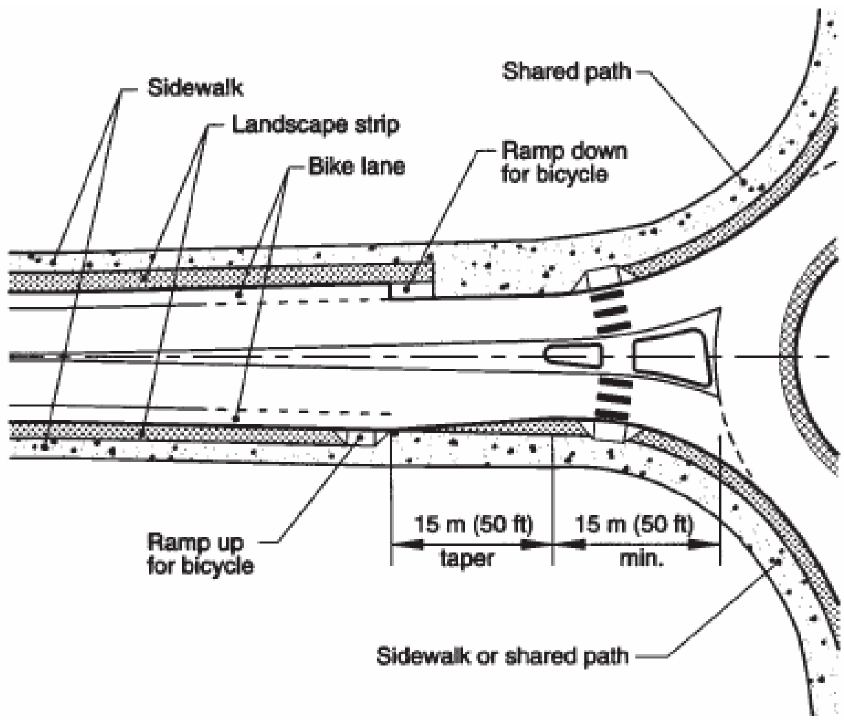

Figure 4.45 Bicycle Lane Terminating at a Roundabout
Source: U.S. Department of Transportation

If there is insufficient space available for a multi-use path, and only a sidewalk exists, cyclists will be required to use the roadway through the roundabout. In this case, shared use pavement markings should be applied to both travel lanes at the roundabout approach.

Guideline:

4.43 The needs of pedestrians and cyclists should be fully incorporated into any roundabout designs in the Region of York.

4.13 Transition Between Facility Types

The transition from one facility type to another should ensure the continuity of the route. Transitions between bike lanes to shared roadway or signed route facilities are typically straightforward, as a cyclists' trajectory along the right side of the road should remain unchanged. The same can be said for a transition between a crosswalk and a paved shoulder as the pedestrian is expected to continue on as far from the roadway as possible.

The role of a transition between facility types is more important between on-road and off-road facilities since users must transition between a route shared by motor vehicle traffic to a route that is not, or vice versa. In most cases, this would require a change in trajectory for a cyclist, whereas a pedestrian can simply follow crosswalks to change between facility types where an intersection is involved. As a result, the remainder of this section will focus primarily on cyclists. The trajectory change that may be experienced by a cyclist should be clearly indicated through the use of specific signing and/or pavement markings specific to that type of cycling facility. **Figure 4.46** illustrates an example of a transition between an off-road trail/multi-use trail and on-road bicycle lanes.

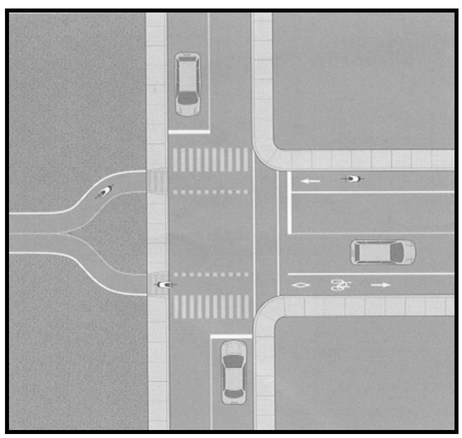

Figure 4.46 Transition between Off-Road Trail and On-Road Bicycle Lanes.

Source: Technical Handbook of Bikeway Design 2nd Edition, Velo Quebec, 2003.

In a situation where there is a single crosswalk, the small dashed markings shown in Figure 4.45, known as "elephant's feet", may also be applied on both sides of the crosswalk to provide a cycling area adjacent to the crosswalk, preventing cyclists from having to dismount to cross the road. In this case, the minimum width for the elephant's feet markings is 1.2 m and the recommended width is 1.5 m to 1.8 m.

Signing such as that shown in the **Figure 4.47** should be installed to warn cyclists to watch for turning motorists and to remind cyclists to yield to pedestrians.

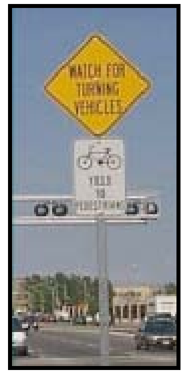

Figure 4.47 Cyclist Warning Sign

Guidelines:

4.44 Transitions between different facility types are especially important between on-road cycling facilities and off-road cycling facilities or multi-use trails, as they typically require a change in the cyclist's trajectory and/or a transition between routes shared with motor-vehicle traffic to routes that are not, or vice versa.

4.45 Appropriate signing and/or pavement markings should be installed to direct cyclists to the new cycling facility type.

Chapter 5.0 Bicycle Parking

5.1 Bicycle Parking Facilities

The provision of bicycle parking facilities is essential for encouraging more bicycle use in the Region of York. The lack of adequate parking supply or type can deter many from considering using their bicycle as a basic mode of transportation.

This Chapter lists guidelines on the basic elements of a bicycle parking rack, site and location that the Region of York should refer to when installing new bicycle parking facilities.

5.2 Bicycle Racks

Bicycle racks are made up of the following four main components:

- The rack element;
- The rack;
- The rack area; and
- The rack area site.

These four components are described in greater detail in the following sections.

5.2.1 Bicycle Rack Element

The bicycle rack element is the portion of a bike rack that supports the bicycle. Bicycle rack elements can be joined on any common base or arranged in a regular array and fastened to a common mounting surface. The racks may be used to accommodate a varying number of bicycles securely in a particular location. Various types of available bicycle rack designs include the "Ribbon" rack, the "Ring" rack, the "Ring and Post" rack and the "Swerve" rack. **Figures 5.1 and 5.2** illustrated these rack designs.

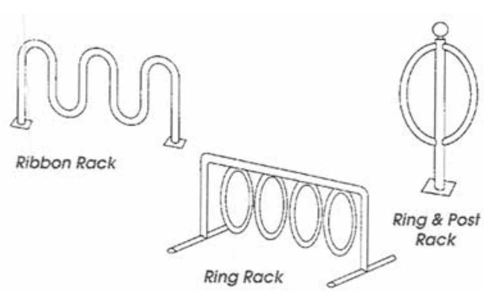

Figure 5.1 Various Bicycle Rack Designs

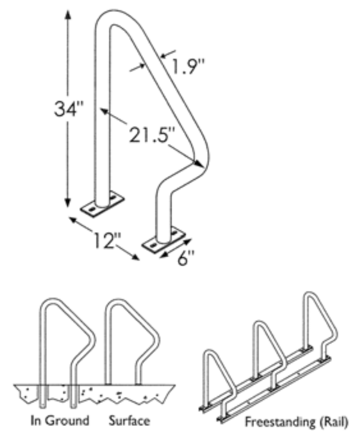

Figure 5.2 Swerve Rack Design

The rack element should:

- Support the bicycle upright by its frame in two places;
- Prevent the wheel of the bicycle from tipping over;
- Enable the frame and one or both wheels to be secured;
- Support bicycles without a diamond-shaped frame with a horizontal top tube;
- Allow front-in parking: a U-lock should be able to lock the front wheel and the down tube of an upright bicycle; and
- Allow back-in parking: a U-lock should be able to lock the rear wheel and seat tube of the bicycle.

Bicycle racks should not only allow for a secure lock between the bicycle and the rack, but should also provide support for the bicycle frame itself. The rack element should also be designed to resist being cut or detached by common hand tools such as bolt and pipe cutters, wrenches and pry bars which can be concealed in backpacks.

5.2.2 Bicycle Rack

Bicycle racks should consist of a grouping of the rack elements either by attaching them to a single frame or allowing them to remain as single elements mounted in close proximity to one another. Racks, whether as single units or grouped together, should be securely fastened to a mounting surface to prevent the theft of a bicycle attached to a rack. Another alternative is to create a bicycle rack that is so large that it cannot be easily lifted or moved from its position with bicycles attached. **Figure 5.3** illustrates a bicycle rack made up of three rack elements.

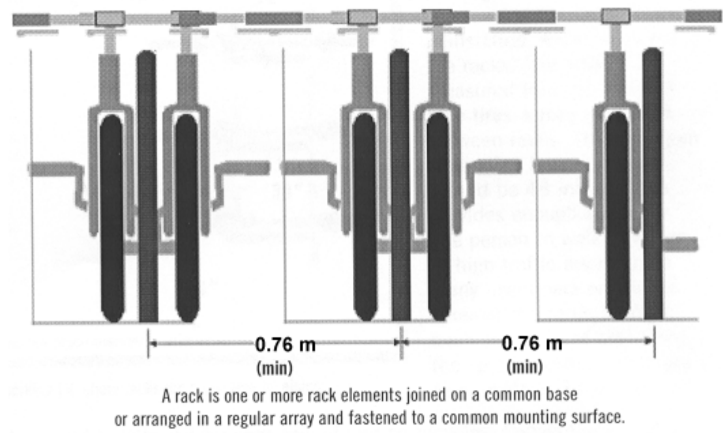

Figure 5.3 Bicycle Rack
Revised Figure from Bicycle Parking Guidelines: The association of Pedestrian and Bicycle Professionals [apbp], www.apbp.org

Easy and independent bike access should be provided to the bicycle rack. Inverted "U" rack elements should be mounted in a row and placed on 750 mm (approximately 30") centres to allow enough room for two bicycles to be secured to each rack element. Bicycle racks should be arranged in a way so that is quick, easy and convenient for a cyclist to lock and unlock their bicycle to or from a rack.

5.2.3 Bicycle Rack Area

The rack area is essentially the "bicycle parking lot" and refers to the area where more than one bicycle rack is installed. Bicycle racks are separated by aisles, much like a typical motor vehicle parking lot. The recommended minimum width between aisles should be 1.2 m to provide enough space for one person to walk with one bicycle. Aisle widths of 1.8 m are recommended in high traffic areas where many users may retrieve their bicycle at the same time, such as after a school class. A 1.8 m depth should be provided for each row of parked bicycles since conventional bicycles are just less than 1.8 m long and can be accommodated in that space.

Large bicycle rack areas with a high turnover rate of arriving and departing cyclists should have more than one entrance to help facilitate user flow. If possible, the rack area should be sheltered to protect the bicycles from the elements by placing awnings and overhangs above the rack area.

5.2.4 Bicycle Rack Area Site

Bicycle racks should be placed as close as possible to the entrance that it serves, but not in a location where they would inhibit pedestrian flow in and out of the building. Rack areas should be no more than 15 m from an entrance, and should be clearly visible along a major building approach line. Bicycle rack areas that are hard to find or that are located far from a building entrance are generally perceived as vulnerable to vandalism and will generally not be used by cyclists. To encourage use of a bicycle rack by cyclists, the rack site should be clearly visible and well lit.

Multiple buildings in an area should not be served by one distant bike rack. Rather, smaller bike racks should be placed in a convenient location at each building, but not in a manner that would obstruct utility access openings, garbage disposal bins, doorways or other building access points.

Bicycle racks can be placed on concrete, asphalt or brick surfaces. Bicycle racks should be securely fastened to the surface to prevent shifting or removal. If they cannot be fastened to the surface, then they should be large and heavy enough so that they cannot be easily moved.

Bicycle racks placed on grass surfaces cannot be secured to the ground, therefore they should also be heavy enough so that they cannot be moved. To avoid excessive bicycle riding on the grass, bicycle racks should only be placed on grass surfaces located within close proximity to a paved cycling route, such as on off-road multi-use trail, or an on-road route. Bicycle racks on grass surfaces should be considered temporary, and every effort should be made to relocate them to a permanent, hard surface area or a concrete pad can be paved in an approved area to accommodate bicycle parking.

Bicycle racks should not be placed within the following areas:

- Bus loading areas;
- Goods delivery zones;
- Taxi zones;
- Emergency vehicle zones;
- Hotel loading zones;
- Within 4.0 m of a fire hydrant;
- Within 2.5 m of a driveway or access lane; and
- Within 10.0 m of an intersection.

Guidelines:

5.1 Bicycle racks should be designed to provide lateral support to the parked bicycle and should be made from materials that can resist being cut by common hand tools such as bolt and pipe cutters, wrenches and pry bars.

5.2 Racks, whether as single units or grouped together, should be securely fastened to a mounting surface to prevent the theft of a bicycle attached to a rack.

5.3 Bicycle racks should be placed adjacent to the entrance that it serves without inhibiting pedestrian flow in and out of the building. Rack areas should be no more than 15 m from an entrance and should be clearly visible along a major building approach line.

Chapter 6.0 Network Amenities

The provision of network amenities is a key and sometimes overlooked element of pedestrian and cycling network design. Developing and maintaining a comprehensive network of on-road and off-road pedestrian and cycling facilities does not automatically mean people will use the network. The network has to be promoted, users need to feel comfortable and safe in using it, and they should have access to adequate trip-end facilities at strategic locations.

This section outlines many of the amenities that should be considered during the design and implementation of the Pedestrian and Cycling network.

6.1 Bicycle Friendly Catchbasin Covers

Catchbasin grates and utility covers are potential obstructions to cyclists, as well as in-line skaters. Therefore, bicycle-safe grates should be used, and grates and covers should be located in a manner which will minimize severe and/or frequent manoeuvring by the cyclist. When new curbed roadways are constructed or rehabilitated, curb face inlets should be considered to minimize the number of potential obstructions. Catchbasin grates and utility covers should be placed or adjusted to be flush with the adjacent pavement surface.

Catchbasin grates with slots parallel to the roadway, or a gap between the frame and the grate, can trap the front wheel of a bicycle, causing loss of steering control. If the slot spacing is wide enough, narrow bicycle wheels can drop into the grates. Conflicts with grates may result in serious damage to the bicycle wheel and frame as well as injury to the cyclist.

These grates should be replaced with bicycle-safe, hydraulically efficient versions. All on-road cycling facilities in urban areas with curb, gutter and storm drains should be made bicycle friendly through the provision of bicycle friendly catchbasin covers.

The Region of Niagara has recently adopted a new standard for catchbasin covers that is bicycle friendly.

All arterial roads in the Region of York should adopt a standard similar to the one used in the Region of Niagara and develop a standard catchbasin cover.

Guideline:

6.1 The Region of York should ensure that all catchbasin covers are bicycle friendly. Catchbasin covers on proposed bicycle routes should receive priority for adjustment.

6.2 Rest and Staging Areas

Rest areas should be provided along routes at areas where users tend to stop, such as interpretative stations, lookouts, restaurants, museums and other attractions / services, are logical locations for rest areas. Ideally, there should be a rest area every five kilometres on a recreational trail or at major intersections and gathering places near on-road facilities or along sidewalks and boulevard trails. Typical furnishings to be considered include benches or tables, washrooms, drinking fountains, trash cans, information signing complete with mapping, plus bicycle parking facilities. Additional services may include an air pump, shelter and telephones.

Staging areas should be incorporated into key gateways and park areas. This will provide for access to the trail system. Potential amenities at staging areas may also include picnic facilities and automobile parking for recreational users and “Park and Bike” commuters. Should parking at a rest or staging area be necessary, the number of parking spaces required should be determined on a site-specific basis, and should account for factors such as supply and demand of automobile parking elsewhere throughout the network.

Guideline:

6.2 Rest and staging areas should be provided at strategic locations such as gathering points, attractions and destinations, as well as other locations where cyclists and pedestrians are expected to stop. The Region of York and its partners, including the private sector, should work together to identify and implement rest and staging areas, where possible.

6.3 Gateways and Trailheads

Gateways and trailheads are a key character enhancing element of a pedestrian system and cycling network and a hierarchy is suggested for them. It is suggested that a hierarchy be established that represents region-wide and local level contexts.

Regional Gateways

These features are intended to "set the tone" for the system. They introduce the Region of York as a community oriented place and are intended to create a sense of welcome, arrival and safety. They are recognized by their usually appealing plaza design. They are also an opportunity to establish trail use conventions, introduce sites of historic and cultural significance and introduce themes that reflect the character of different areas in the Region. This is especially important in a region as large and diverse as the Region of York.

It is also important to offer people amenities such as benches, trash receptacles and information / directional kiosks.

Local Gateways

Local gateways primarily reaffirm region-wide conventions and introduce locally significant themes. They are often paired with information and way-finding signs. They will become a recognizable feature in the landscape and are important to both tourists and local residents. These sites should become an integral part of the marketing initiative and should be identified on regional maps.

Guidelines:

6.3 It is suggested that a hierarchy of Regional and Local Gateways be established that represents region-wide and local level contexts.

6.4 Gateways should become a recognizable feature in York Region's landscape to both tourists and residents alike.

6.5 Gateways should become an integral part of the marketing initiative and should be identified on the bicycle and other maps.

6.4 Transit Connections

6.4.1 Cycling and Transit

Providing defined access to/from the bus stop is also important. Sidewalks should be provided to connect bus stops with intersections, or other land uses. Consideration should also be given to safe pedestrian crossings, especially when a bus stop is located at a mid-block location. Bus shelters and other amenities should be provided at the bus stops, where appropriate. They can be placed either in front of the sidewalk, or behind the sidewalk. Care must also be taken to ensure that these amenities do not pose hazards to pedestrians, nor obstructions for sight lines for vehicular traffic.

York Region Transit has specific guideline documents that outline their requirements (Technical Guidelines for Transit Facilities, Stops and Accessories, January, 2005 and York Region Transit Drawings and Specifications, November, 2005).

Transit stops, particularly bus stops should be designed in a way that provides safe, convenient, and comfortable place for people to wait. Desirable features at bus stops also include waste-recycling receptacles, seating, lighting and bike racks. The Viva Bus Rapid Transit system currently in operation serves as an excellent example of ideal bus-stop design. Although, realistically, it is not expected that every bus stop in the Region of York will be as elaborate as Viva stops, some of the features used in the Viva system can be applied to local YRT routes.

Bus stop locations should also be fully accessible to pedestrians in wheelchairs and should have hard surface connections to sidewalks where landscape buffers exist, without blocking pedestrian travel along the sidewalk.[1]

Improving the cycling-transit link is an important part of making cycling a part of daily life in the Region of York. Linking cycling with York Region Transit and Viva services will overcome barriers such as lengthy trips, personal security concerns and riding at night or in poor weather. This link also enables cyclists to reach more distant areas across the Region, and increases transit ridership on weekends and holidays.

Bike racks on buses is one example of a cycling-transit link. It allows cyclists to ride their bike to a transit stop or station, attach it to a bus-mounted bike rack, travel to their stop, disembark and continue on their bicycle to their final destination.

The cycling-transit link can also make access to transit less expensive. In suburban neighbourhoods, population densities are often too low to offer transit service within the typical walking distance of 500 metres of every commuter. Within the last 20 years, many transit agencies built expansive motor vehicle park-and-ride lots or centralized depots as an alternative to costly feeder bus service. Many of these facilities are within easy cycling distance, provide opportunities to increase cycling and transit ridership and reduce taxpayer costs, traffic congestion and air pollution.

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[1] Pedestrian Facilities User Guide – Providing Safety and Mobility; U.S. Department of Transportation, Federal Highway Administration March 2002.

Bike Racks on Buses – Seattle, Washington

6.4.2 Linking Terminals to Pedestrian Facilities

In order to encourage people to walk to transit terminals, it is imperative that pedestrian access to terminals be both safe and convenient. Terminals should always be directly connected to sidewalk systems, and where possible, multi-use trail systems.

Where terminals are located near major trip destinations, such as malls, the terminals should ensure a direct and convenient connection to that destination. It is preferable if the terminal can be located adjacent to the destination rather than on the other side of a parking lot.

Guideline:

6.6 Transit terminals should feature safe and convenient pedestrian access, including direct links to sidewalks and major destinations.

6.5 Trip End Facilities for Commuters

Installation of showers and lockers at workplaces and educational institutions help to promote the use of the network for utilitarian purposes. Lockers can be used to store personal belongings such as cycling accessories and a change of clothing. Businesses or institutions with employees who commute by bicycle, in-line skating, or other modes should be encouraged to offer these facilities.

Consideration should be given to promoting and / or implementing trip-end facilities as part of efforts to apply a region-wide transportation demand management (TDM) strategy.

Guidelines:

6.7 The Region of York and its partners should provide trip-end facilities for employees and visitors at all public buildings where feasible, and the private sector should be encouraged to do the same.

6.8 Consideration should be given to promoting and / or implementing trip-end facilities as part of efforts to apply a region-wide transportation demand management (TDM) strategy.

Chapter 7.0 Route and System Signing

7.1 Types of Signage

Signs along the Pedestrian and Cycling Network should communicate various kinds of information to the user. Recommended signage has been organized according to the following six functions:

- Bicycle Route and Pedestrian System Designation signs;
- Way-Finding signs;
- Regulatory signs;
- Warning signs;
- Information signs; and
- Interpretative signs.

While all elements of the bicycle network and most elements of the off-road trail network should be signed, it is not feasible to sign every part of the pedestrian system. Therefore, only the primary (spine) system and key secondary (community) system links should be signed.

Bicycle Route and Pedestrian System Designation signs should be used to "brand" or identify routes that constitute the network. This type of sign may be designed in various sizes depending on its intended application. Designation signs may be mounted alone or with other signs at logical, highly visible locations on both on and off-road network route segments. The bicycle route sign, shown in **Figure 7.1**, is already in use in the Region of York. The National Capital Commission (NCC) has been very successful at "branding" the Ottawa Area's Capital Pathway network through its signing system. An example of an NCC pathway sign is shown in **Figure 7.2**.

IB-23
450 mm x 450 mm

Figure 7.1 Bicycle Route Marker Sign
Source: TAC Bikeway Traffic Control Guidelines, 1998

Figure 7.2 NCC Branding Sign

Way-Finding signs may include the network logo or "brand" and communicate other information to users such as directional arrows and distances in kilometres to major attractions and settlement areas. Way-finding signs should be mounted on standard sign poles and be located on all legs of an intersection or off-road trail junction, as well as at gateways.

Regulatory signs are intended to control particular aspects of travel and use along the road or off-road network. Signing restricting or requiring specific behaviour is not legally enforceable unless it is associated with a provincial law or municipal by-law. Where applicable, it is recommended that authorities discreetly include the by-law number on signs to reinforce their regulatory function. **Figure 7.3** illustrates a reserved bicycle lane sign and a bicycle lane ends sign which are currently used in the Region of York.

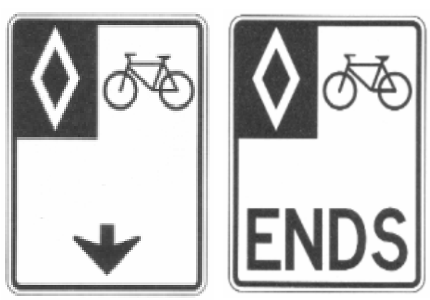

Figure 7.3 Reserved Bicycle Lane and Reserved Bicycle Lane Ends Signs
Source: TAC Bikeway Traffic Control Guidelines, 1998

Warning signs are used to highlight bicycle route conditions that may pose a potential safety or convenience concern to network users. Examples are steep slopes, share the road, railway crossings and pavement changes. These signs are diamond in shape, with a black legend on a yellow background. These signs are more applicable to cycling routes and multi-use trails than pedestrian systems. **Figure 7.4** illustrates examples of warning signs.

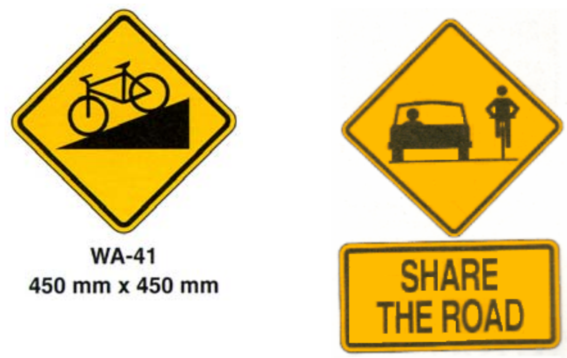

Figure 7.4 Examples of Warning Signs
Source: TAC Bikeway Traffic Control Guidelines, 1998

Information signs provide general information about the use and identity of the network, as well as adjacent features. Signs can communicate a single point of information on a standard sign, or a number of points on a large format signboard. Signs at trailheads, access points and gateways may communicate a range of information, including maps. The preferred (as opposed to the regulated) use of the system is communicated through "use symbols" where the separation of trail users has been accommodated.

Interpretative signs provide specific information about points of ecological, historical, cultural and general interest, as well as current land uses along the network. They represent a broad range of possible sign formats and applications, depending on the interpretative program and complexity of information to be communicated.

Currently in the Region of York, many designated bicycle routes are not signed as such. In many locations with signage, the types of signage are inconsistent. In order for a particular segment to be designated as a bicycle route, it should be signed as such to create safe and user-friendly routes. There may also be legal liability issue if a route is designated as a bike route, but is not signed.

In order to maximize the ease of understanding, signage for pedestrian and cycling network should be consistent.

7.2 Signage Formats

Signs associated with the Pedestrian and Cycling Network should be economical, adaptable, durable and identifiable. To accomplish these objectives while unifying the design and graphic image of the network, recommended signing can be organized according to the following three formats:

- Standard signs;
- Large signboards; and
- Special applications.

The following descriptions introduce the three formats.

Standard signs are aluminium plate blanks with a reflective sheeting surface. The dimensional size of standard signs varies. Recommended signage is generally the same size as typical roadway signs for on-road sections of the network. For off-road sections, where the travel speed of the typical trail user is slower, standard signs are slightly smaller. Simple shapes, bold graphics and concise text typify the sign message. Standard signs are mounted on or immediately adjacent to the pedestrian or cycling facility on existing posts wherever possible, or on new posts as required.

Large signboards are composite structures generally constructed with a wood or metal frame and a replaceable, updateable message area. Large signboards are associated with trailheads, access points and gateways. The specific format for primary and secondary trailhead signs have been recommended. Large signboards are mounted near the pedestrian or cycling facility, but never immediately adjacent to the travel surface.

Special applications include pavement markings (lines and symbols on the trail surface), as well as unique signage formats associated with information and interpretative signs. Typically interpretative signs and features are mounted away from the travel surface of the trail, allowing users to pull off to appreciate the sign.

Guidelines:

7.1 The Region of York should develop a formal logo for the Cycling Network.

7.2 The Region of York should develop and implement a formal on and off-road signing plan to support the existing and proposed Pedestrian and Cycling Network.

7.3 The Region of York should ensure that all designated bicycle routes are properly signed.

7.4 All signage should be consistent throughout the Region.

Chapter 8.0 Maintenance

The maintenance costs and liabilities involved with the installation of a public Pedestrian System and Cycling Network must be acknowledged. Poor quality roadways and other infrastructure can present a major risk to users. Effective route and system design can decrease maintenance costs and deter liability risks.

Diligence is required when managing any asset. The pedestrian systems and cycling network and their amenities should be inspected on a regular basis as a minimum through an annual audit including structures such as bridges and culverts. These inspections will identify hazardous conditions as well as issues related to maintenance, repairs and events of vandalism.

In the spring, summer and fall months, priority consideration should be given to debris removal on arterial roads with bicycle route facilities and sidewalks. Trails should be inspected each spring prior to the anticipated peak season when high use is expected.

The following sections describe more detailed maintenance procedures for on-road and off-road networks that the Region of York (and off-road partners) should consider for maintaining existing and future facilities.

8.1 Maintenance Issues Affecting On and Off-Road Routes

Trash Clean-Up and Grass Cutting

Trashcans should be emptied on a weekly basis. This maintenance can occur in conjunction with the grass cutting. The grass should typically be cut down to approximately two inches on either side of a trail or in boulevard spaces adjacent to sidewalks.

Vegetation

Vegetation should be routinely cut back since overgrown shrubs and low-hanging branches can obscure signs and pose a hazard to users. Adequate clearance and sight distances should be maintained at driveways and intersections so that users are visible to motorists. Installing root barriers during trail and sidewalk construction may assist in preventing premature break-up of the surfaces. Maintenance of vegetation originating on private property should be required through other Region of York by-laws.

Surface Maintenance

Asphalt trails are most suitable for intense high traffic multi-use areas. Asphalt has a life span of approximately eight to 15 years and requires a base of properly compacted granular 'A'. Asphalt trails must be cross-sloped at a minimum of two percent to allow for drainage. Asphalt should be used on all slopes greater than 10% to prevent erosion. Drainage swales are also required next to asphalt trails. Inspection of asphalt trails should be undertaken once per year, especially for potholes and cracks in the spring. This is particularly true given the extreme freeze thaw cycles that the York Region experiences.

Litter Removal

Perhaps one of the most difficult tasks in maintenance is collecting the increasing amount of litter in open spaces and along road sides. While the task of litter collection is primarily a municipal responsibility, in recent years it has become common practice to encourage citizens' groups to assist in litter control and vegetation management.

Leaf Removal

Piles of wet leaves present a serious obstacle to users when encountered on trails, sidewalks or in roadway gutters. It is difficult for cyclists to stop on leaves, and falls can occur. Pedestrians and those requiring mobility aides may also have a difficult time maintaining their footing on slippery leaf covered surfaces. Leaves can also hide potholes, debris and drainage inlets. It is recommended that excessive fallen leaves be removed from the travelled portion of the pedestrian and cycling facility as soon as possible to prevent accidents. Leaf removal is especially important in older sections of the Region of York due to the full tree canopies that are prevalent on many streets.

Sign Maintenance

Sign markers and other facility signing should also be properly maintained throughout the year as frequently as other regulatory signs in the Region of York.

Liability:

Through the implementation of an asset replacement program, the risk of liability can be significantly reduced if the Region of York provides adequate resources and co-ordinated programs for good network design, construction, monitoring, maintenance and repairs.

A well-constructed network that is free of potholes, ruts and obstructions allows the user to travel safely. Regular inspection and repair will keep the surface in a smooth and level condition.

Signing, as a warning mechanism, could also reduce liability concerns. Signing throughout the network should be designed to warn the off-road users of road crossings, steep grades and low clearance underpasses. The ultimate goal for limiting liability is to provide a safe system through effective design, construction, monitoring and maintenance techniques.

An annual review and inspection of on-road facilities and off-road trails that comprise part of the cycling network should occur after a major weather event. Staff representing the jurisdiction or property owner through which a route or system passes should be cognizant of potential hazards such as broken tree limbs and damaged signs. Trail erosion is a result of high water and the undermining of off-road trail structures. Extra care should be taken with respect to ensuring sight lines are not compromised. Acts of vandalism should be addressed as soon as possible. Ensuring the system is safe and litter free will help promote its use to residents and visitors.

Off-road trails should be swept once a year, following winter and prior to special events. Trails that are not maintained in the winter should be signed accordingly and spring sweeping should be a major priority for these facilities. Trails that are intended to be challenging and that would be compromised by sweeping should be exempt from this policy.

Guidelines:

8.1 When possible, especially in the spring, summer and fall months, priority consideration should be given to debris removal on arterial roads with cycling facilities and sidewalks.

8.2 Off-road trails should be swept at least once a year following winter and / or prior to special events except those that are designed to be challenging and would be compromised by sweeping.

8.3 The maintenance of pedestrian and cycling facilities should be based on the Region of York's road, sidewalks and trails maintenance standards.

8.4 In the spring, summer and fall months a program of litter, debris and leaf removal for facilities should be implemented.

8.5 Other maintenance guidelines set out in this report should be adopted by the Region of York as the basis for a maintenance regime for on and off-road network maintenance in the Region.

8.2 Snow Clearing

Currently, we understand the priority of snow clearance in the Region of York is as follows:

Class 1 – First Priority

- Arterial roads;
- Roads that serve as connectors/collectors between areas and routes;
- Roads that serve as emergency routes to hospitals and fire equipment;
- Roads that serve as snow routes in major hilly terrain during weather situations; and
- Roads that serve major bus routes.

Class 2 – Second Priority

- Roads with medium to low volume of traffic including residential and rural routes.

Pedestrian and cyclists are active year round, though their numbers are typically reduced during winter months (more so cyclists than pedestrians). Nevertheless, measures should be taken to ensure that active transportation in the winter can remain a realistic transportation alternative, especially as the network is expanded.

The Region of York should continue its practice of clearing roads of snow as soon as possible after a snowfall. As the network is expanded, roads with designated on-road cycling facilities or signed-only cycling routes that are part of the network should receive priority for snow clearing and removal with priority given to roads that have been designated as the "spine" or "community" tier of the network. This means that paved shoulders or bike lanes on these roads should be cleared of snow to accommodate cyclists. Similarly, segments of the pedestrian system that form the "spine" and "community" systems should receive snow clearance to accommodate pedestrians.

During the winter months, snow and ice should be regularly removed from the network with a priority placed on the primary routes and systems of the network. Liability is limited when ice is eliminated due to good drainage design and efficient snow removal schedules.

Other Surface Types

The Region of York will regulate the maintenance of the other surfaces, mirroring the priorities given to adjacent routes unless specified differently for a particular activity. Items within this classification include:

- Sidewalks;
- Bus stops;
- Walkways and overhead crosswalks;
- Parking lots;
- Handicap parking; and
- Private roads and lanes provided winter maintenance under agreement.

Since bus stops and sidewalks are considered to be a lower tier in terms of snow removal, it can be quite difficult for pedestrians to access public transit or to use walking or cycling for their travelling needs. If it were easier for people to do this after a snowfall, they may be less likely to use a car to reach their destinations, reducing the amount of traffic on the road network after a snowfall and making it easier to clear the snow. Hence, the Region of York should ensure that bus stops and connections to bus stops are given a higher snow-clearance priority.

Following the end of winter, the use of pedestrian or cycling facilities can be delayed due to accumulated piles of snow that may still be present in locations where the sun does not reach until later in the season. Should a small section of the network be blocked by snow and debris accumulation, it could affect an entire area. Several weeks of system use could be added to the year with one well-timed snow and debris cleaning per year.

Although it may not be feasible or necessary to clear all multi-use trails in the winter, consideration should be given to clearing trails that provide key connections or links to "spine" segments of the network.

Guidelines:

8.6 In the winter months, on and off-road systems that serve as part of the primary cycling network should receive priority for snow clearing and removal.

8.7 The Region of York should ensure that bus stops and sidewalks, particularly those that connect to bus stops, receive a higher priority during snow clearing efforts.

8.8 Consideration should be given to clearing trails during the winter that provide key connections or links to "spine" segments of the network.

Chapter 9.0 Primary References

The following are recommended as the primary references for planning and design of on and off-road cycling and pedestrian facilities in the Region of York:

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- Transportation Association of Canada (TAC), Canadian Guide to Neighborhood Traffic Calming (1998);
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