4.6

PUBLIC REALM AND PLACEMAKING

Beyond providing safe pedestrian movement and access, sidewalk zones also serve as vital public spaces that contribute to the city's economic, social and environmental well-being. Various elements help create vibrant, attractive, safe, and green streets for people, including street furniture, lighting, cafés and marketing, curb and sidewalk extensions, wayfinding, green infrastructure, the sensitive placement of utilities, and year-round operations and maintenance. (Also see Chapter 7 on Green Infrastructure). These street elements are important components of placemaking, especially pedestrian amenities like benches and seating, which offer places for people to sit, rest, and socialize.

Sidewalks provide vital public space day and night.

c: tracer.ca. https://flic.kr/p/YYbkU

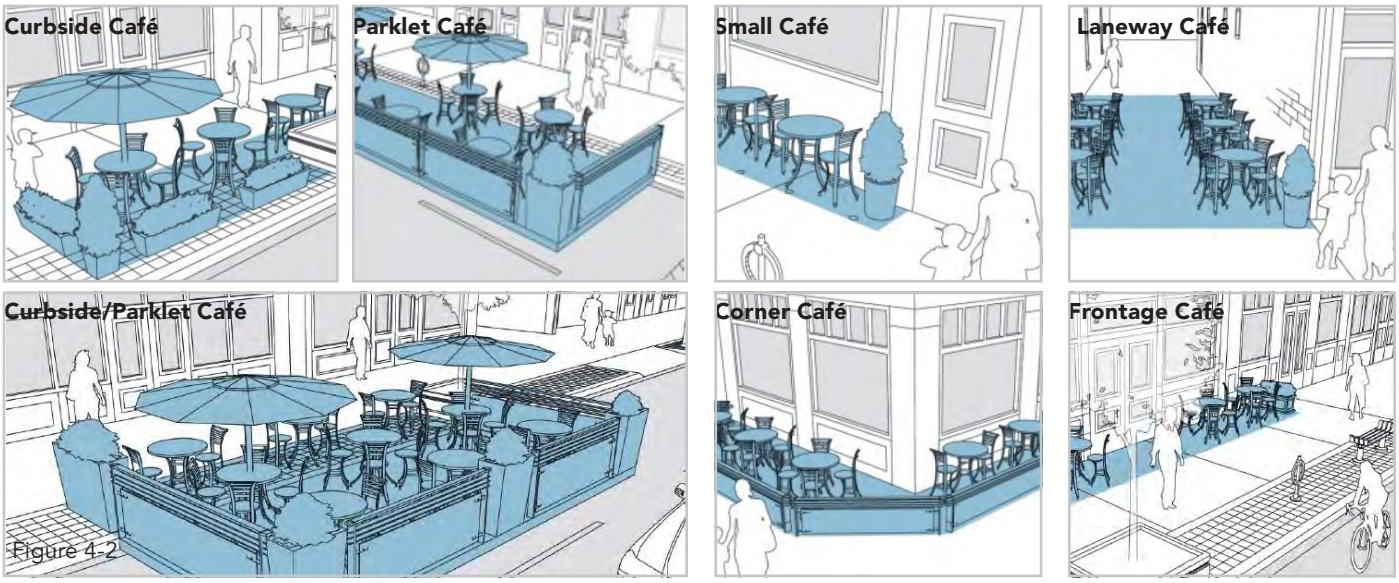

Figure 4.2

STREET FURNITURE

Street furniture includes street trees and planters, transit shelters, benches, bicycle parking, information and wayfinding signs, litter and recycling bins, multi-publication boxes, poster kiosks poles and boards, and automated public toilets. Ensure street furniture does not obstruct the pedestrian clearway, rather locate them in the Furnishing and Planting Zone or Edge Zone (for narrower elements), or on private property using building setbacks and easements.

LIGHTING

Street lighting supports safety, pedestrian activity, sense of place, and economic vitality. It includes roadway lighting and pedestrian-scale lighting. Pedestrian-scale lighting for sidewalks and crosswalks ensures that pedestrians are visible to motorists and illuminates potential tripping hazards. Where cycling facilities are located adjacent to the sidewalk, these benefits are also extended to cyclists.

CAFÉS AND MARKETING

An outdoor café is a seating area located on the sidewalk that is operated and maintained by an adjacent restaurant or café owner. Various types of sidewalk café configurations are shown in Figure 4.2.

Since pedestrians are given the highest priority in the Sidewalk Zone, outdoor cafés or marketing displays must not infringe on the pedestrian clearway. Greater clearways are required in busier pedestrian areas, so people do not spill onto the roadway and can comfortably access and enjoy café, marketing, and vending areas(see section 4.3 on the importance of the pedestrian clearway).

PUBLIC ART, CULTURE AND HERITAGE

These elements help to celebrate the culture, history, and sense of place that makes our communities unique. Public art, culture and heritage features enhance the sense of enjoyment and well-being of people using city streets. These elements can include street art, sculptures, plaques, painted traffic boxes, murals and heritage buildings, structures or sites.

ORNAMENTAL PLANTING

Decorative hanging baskets, planters for trees and landscaping, and other visually attractive initiatives by local businesses and communities help to improve the public realm and create a sense of place.

Placemaking on sidewalks may provide transition space between streets and destinations for people to gather, linger and socialize.

Wayfinding helps people orient themselves and navigate to their destinations.

An enhanced streetscape in Scarborough Centre.

CURB AND SIDEWALK EXTENSIONS

Curb and sidewalk extensions (a.k.a. bulb-outs or bump-outs) are extensions of the sidewalk area and/or landscaped boulevard that protrude past the normal curb alignment. They are used for safety, greening and placemaking purposes as they can help repurpose space in the roadway for other much-needed uses. Uses include stormwater management and greening, streetscaping, or multi-unit bicycle racks depending on context and ensuring clear sightlines. Consider curb and sidewalk extensions wherever there is a permanent parking lane and consider how to accommodate cyclists when introducing curb extensions.

PEDESTRIAN WAYFINDING

Wayfinding systems help people orient themselves in physical space and navigate from place to place. They also help people to identify landmarks, explore the city and discover new destinations. The wayfinding systems are further supported through signs, printed maps and mobile devices. Toronto's 360 Wayfinding Strategy has specific guidance for on-street pedestrian, TTC, parks and trails and cyclist wayfinding systems.

GREEN INFRASTRUCTURE

Green infrastructure refers to natural and human-made elements that provide ecological and hydrological functions. These environmental qualities contribute to the enjoyment, care and value of the City's streets and public spaces. Part of their social and economic benefits include supporting opportunities for recreation, leisure and green tourism. Green elements include street trees, plantings, bioswales, permeable materials, and active transportation facilities. (see Chapter 7 on Green Infrastructure)

4.7 UTILITIES, MAINTENANCE, AND OPERATIONS

Create a safe, attractive and functional public realm by coordinating early on with staff involved in utilities, maintenance, and operations. Various needs include considering the placement of utilities so that they can be accessed, upgraded and maintained, while also ensuring a safe, universally accessible pedestrian clearway and minimizing conflicts with street furnishings, trees and landscaping. Year-round maintenance and operations are important to consider upfront to enable city services to be provided, while coordinating with other complete streets needs.

PLACEMENT OF UTILITIES

Utilities play a vital role in the city's infrastructure system and in our daily lives. Above ground utilities include various electrical and telecommunications wires, fire hydrants, traffic signal controllers and lighting. Underground utilities include various electrical and telecommunications conduits, water infrastructure and natural gas mains. Coordinate the safe access, use and maintenance of utilities using a complete streets approach to ensure safe and efficient operation of city streets and the utilities. Important considerations include ways to reduce clutter above ground and minimize negative impacts of underground utility repair, modification and replacement where possible. Early street project coordination will maximize opportunities for well-designed sidewalks that minimize conflicts among utilities, street furnishings and landscaping.

YEAR-ROUND MAINTENANCE AND OPERATIONS

Access to the Furnishing and Planting Zone and/or Edge Zone is critical for on-going and seasonal city services like snow clearing and storage, and waste and recycling collection. Sidewalk planning and design must keep in mind the various needs – including sweeping, repairs, snow removal and storage, landscaping maintenance, and waste management

MORE INFORMATION

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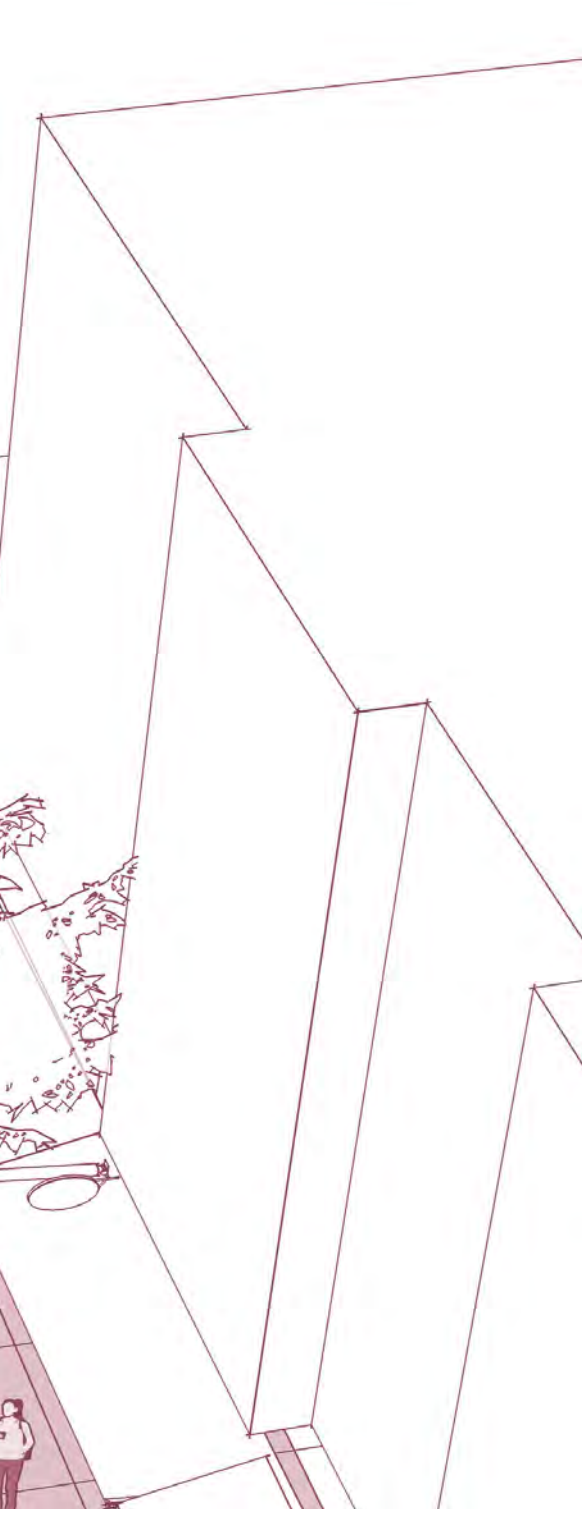
Cycling infrastructure provides choice in how people are able to move around the city. Cyclists are vulnerable road users and can be seriously injured in even minor collisions, so prioritizing the safety of cyclists by designing safe streets for cycling is critical. Streets that feel unsafe for cycling may also discourage people from choosing to ride. For many people, cycling close to fast moving motor vehicles is uncomfortable, but well-designed streets and cycling facilities can reduce conflicts for all road users and enhance real and perceived safety. It is critical to consider safe and comfortable cycling on all Toronto streets as part of the street design process. This includes mitigating exposure to potential conflict between cyclists and motor vehicles. Toronto's On-Street Bikeway Design Guidelines and Multi-Use Trail Design Guidelines provide detailed design guidance and should be used in the design of cycling facilities. When trips are shifted from driving to cycling, motor vehicle volumes decrease, which in turn reduces traffic congestion, as well as air and noise pollution. Streets with cycling infrastructure also have the potential to move more people, at a lower cost, and with improved public health outcomes.

5.0 STREET DESIGN FOR CYCLING

5.1 CYCLING DESIGN PRINCIPLES

For illustrative purposes - may include a mix of permanent/temporary materials.



1. Apply context–appropriate designs. Faster, busier streets create more risk for cyclists and will need greater separation and protection for cyclists. Quiet streets with low traffic volumes and low speeds may provide a comfortable cycling experience without a dedicated cycling facility.

2. Design for both present and future users. Cycling ridership numbers will grow if a cycling facility is provided on a street that was previously uncomfortable for cycling. Where cyclist volumes are growing, consider widening the cycling facilities.

3. Prioritize the most vulnerable road users. Vulnerable users can be seriously injured or killed in even minor collisions. Think of how to design facilities for all types of cyclists, as well as the protection of pedestrians of all ages and abilities. Protect pedestrians from cyclists by providing cycling facilities that are separated from sidewalks using design treatments that respond to both pedestrian and cycling speeds and volumes. Treatments range from buffers and physical delineators to visual contrast and tactile indicators.

4. Visible, intuitive cycling facilities. Clear delineation of the cycling path of travel and wayfinding can improve safety for all road users. Use pavement markings, signs, grade change between users and physical design, like buffers, to mitigate hazards, such as car doors opening, or pedestrians walking into bicycle paths.

5. Intersection safety and mixing zones. Continue bicycle lane markings through intersections and pedestrian crossing markings over cycling routes and clearly mark conflict areas. Consider providing visible, designated space for cyclists to wait and make turns. Avoid pedestrian and cyclist mixing zones, especially at intersections with high pedestrian volumes.

6. Supply adequate bicycle parking and Bike Share access. Support and encourage cycling through Toronto's bike sharing system - Bike Share Toronto, and a convenient and adequate supply of bicycle parking, including multi-unit corrals especially in mixed use, institutional, and commercial areas.

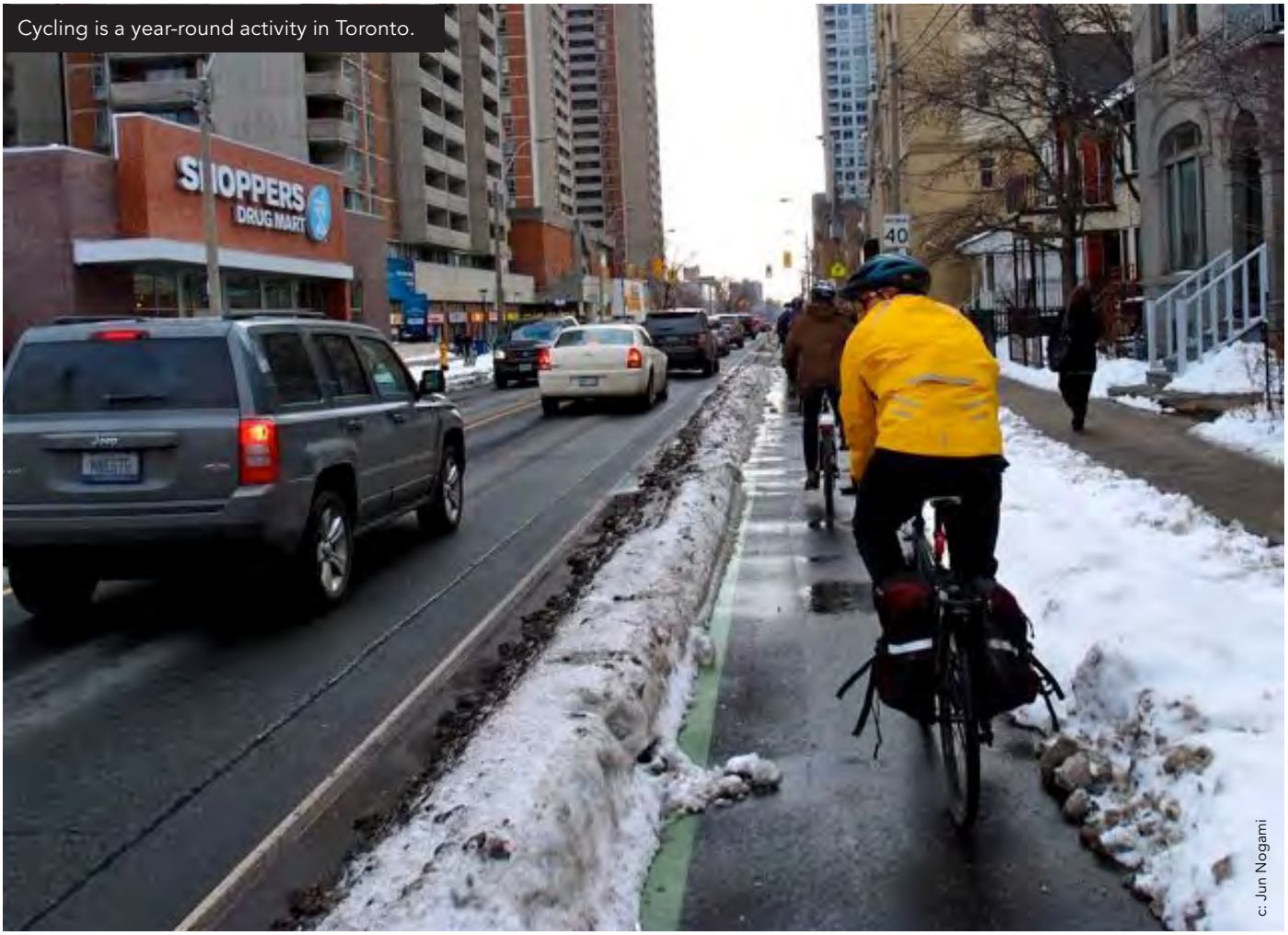
7. Design and maintain bike-friendly curbside conditions. Ensure catch basin covers are bike-friendly, and that debris, water and ice do not accumulate where people will be cycling.

8. Surface conditions. Provide smooth riding surfaces as much as possible by re-paving before adding cycling facilities, and regular maintenance, such as sweeping and snow ploughing. Provide pavement markings that guide cyclists safely across streetcar tracks.

5.2

CONTEXT-SENSITIVE CYCLING FACILITIES

As part of the street design process, a key step is identifying whether the proposed project is part of the existing or planned Cycling Network or other area or corridor plans. The Cycling Network Plan aims to build and connect higher-order cycling routes across the city. A key benefit is to attract and accommodate a wide range of cyclists. While the Cycling Network Plan identifies key routes and their preferred cycling facility type, there is still opportunity to select and design context-sensitive cycling facilities for streets not yet in the plan.



Cycling is a year-round activity in Toronto.

c: Jun Nogami

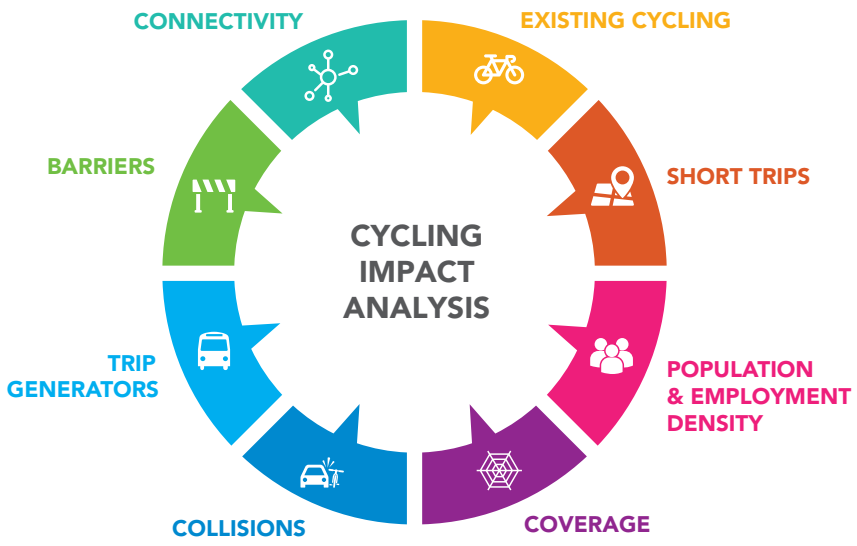


Figure 5-1: Considerations for Cycling Impact Analysis.
For more information on Toronto's cycling network, visit toronto.ca/cyclingnetwork

A good starting point for practitioners is to refer to the Ontario Traffic Manual (OTM) Book 18, which guides facility selection based on motor vehicle operating speed and average daily traffic volumes. In addition, it will be important to apply Toronto's On-Street Bikeway Design Guidelines to design for the context and local conditions. At the outset of a project, design teams should consider the:

- Presence of existing or planned Cycling Network Routes.
- Proximity and potential connections to the Cycling Network.
- Speed and volume of motor vehicles.
- Street's proximity to schools, seniors' homes, or similar institutions, as this may affect the types of users and the interaction with pedestrians of all ages and abilities.
- Existing and potential pedestrian volumes, as this may affect the suitability of sidewalk-level cycling facilities.
- Presence of transit and taxi stands.
- Presence of on-street parking (off-peak, lay-bys or lanes).

THE CYCLING NETWORK PLAN – A KEY NETWORK OVERLAY

Toronto's Ten Year Cycling Network Plan (2016) is the result of extensive feasibility analyses, together with public and stakeholder consultation. The following technical factors were combined to rate a route's cycling impact and feasibility:

- **Current and potential demand:** Number of existing and potential cycling trips. Number of short trips by motorists (less than 5km) with a high potential to shift to cycling. Areas where cycling volumes have high growth.
- **Population and employment density:** Greater density or new developments suggests more cycling trips.
- **Network coverage, connectivity, and barrier crossings:** The presence of gaps in the network or barriers (e.g. ravines, rail corridors) that a route could help overcome.
- **Trip generators and target demographics:** Assesses whether the cycling project would improve access to places many people would like to access, such as schools, universities, and transit stations. It also looks at how well the cycling project would meet the needs of target demographics such as women commuting, tourists, and children getting to school.
- **Safety:** Opportunities to improve cycling safety if the street in question is known to have a high number of collisions, or reported traffic safety issues.

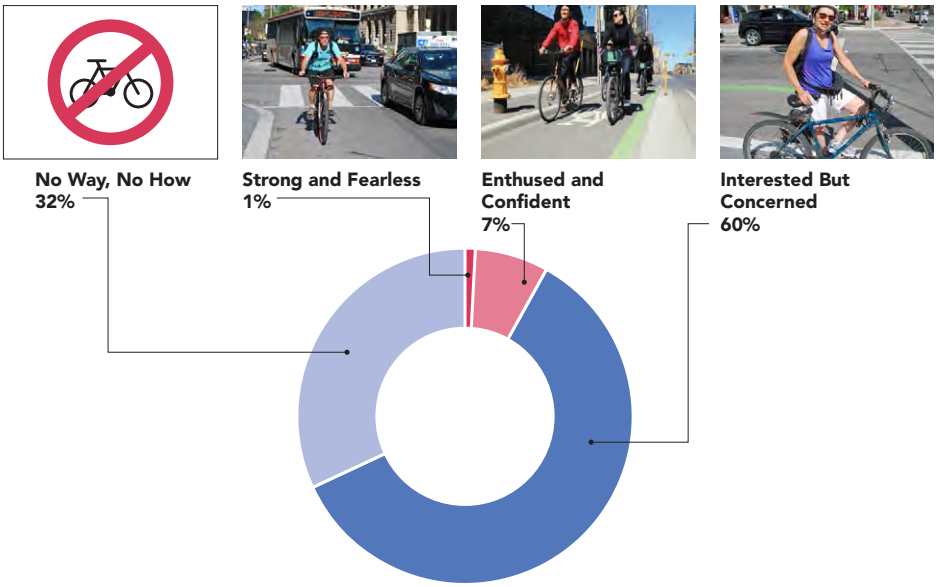
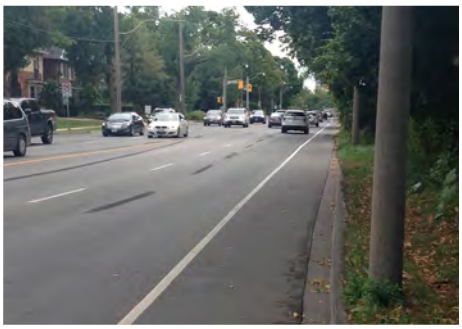


Figure 5-2: Designing for Cyclists of All Types.

source: Ontario Traffic Manual Book 18: Cycling Facilities (2013). Dill, Jennifer and McNeil, Nathan (2012). Four types of cyclists? Examining a typology to better understand bicycling behavior and potential. Geller, R. (2006) Four Types of Cyclists, Portland Bureau of Transportation.



"Urban edge lines" in Toronto provide safe riding space for cyclists.

BICYCLE FRIENDLY STREETS

Even in cases where there are no plans for cycling facilities, the City's bicycle friendly streets policies, as set out in the Toronto Bike Plan (2001), must be observed. These include wider curb lane widths, standards for the construction of bridges/ underpasses, provisions exempting bicycles from some traffic regulations and maintaining cycling access through traffic calming projects, catch basin cover standards, and bicycle detection at actuated signals. Toronto's Bicycle Friendly Street Policies are applicable to all street types.

KEY FACTORS – SPEED AND VOLUME OF MOTORIZED TRAFFIC

As mentioned above, the speed and volume of motorized traffic are key factors influencing the context-sensitive design of cycling facilities. Detailed guidance is provided in OTM Book 18. Figure 5.3 illustrates that higher speeds and higher volumes lead to higher risk to cyclists, thereby needing more separation (e.g., wider buffers) and protection (e.g., physical buffers) for safe and comfortable conditions for cyclists of all types (Figure 5.2).

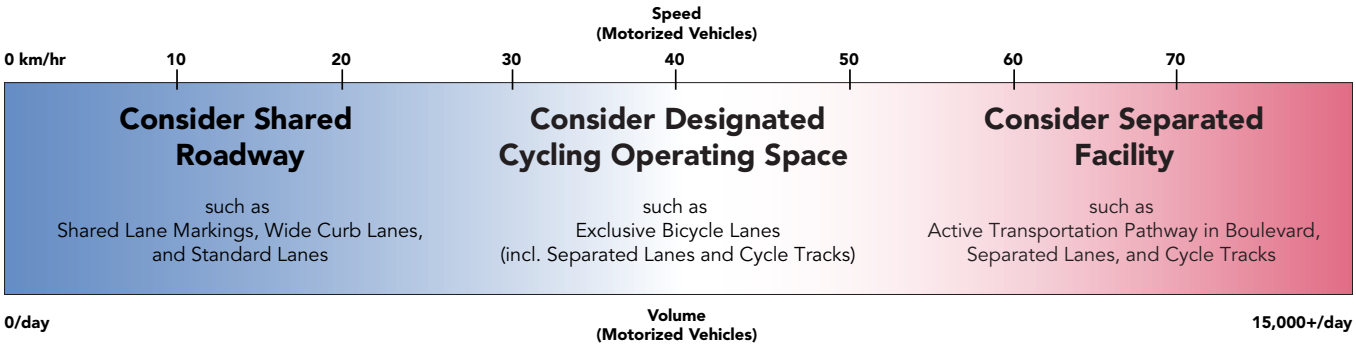


Figure 5-3: The Relationship of Traffic Speed and Volume to Types of Cycling Facilities.
Source: Adapted from OTM Book 18.

CYCLIST USER CHARACTERISTICS

In the street design process, it is critical to consider the characteristics and needs of existing and potential users. This includes cyclists of various ages, skill and comfort levels, as well as various trip purposes such as cycling for recreation, commuting to work or school, and other utilitarian purposes like shopping or visiting friends or making deliveries (e.g., cargo bikes). Important considerations include the typical user characteristics, as a starting point for thinking about the minimum space needed. The right amount of space is determined by examining typical cyclists' dimensions, space needed to maneuver, expected cyclist volumes, speed, road geometry, topography and the presence of other users and uses. A variety of factors influences the dimensions when designing cycling facilities. Figure 5.4, adapted from OTM Book 18, illustrates the minimum typical user characteristics for physical space and height.

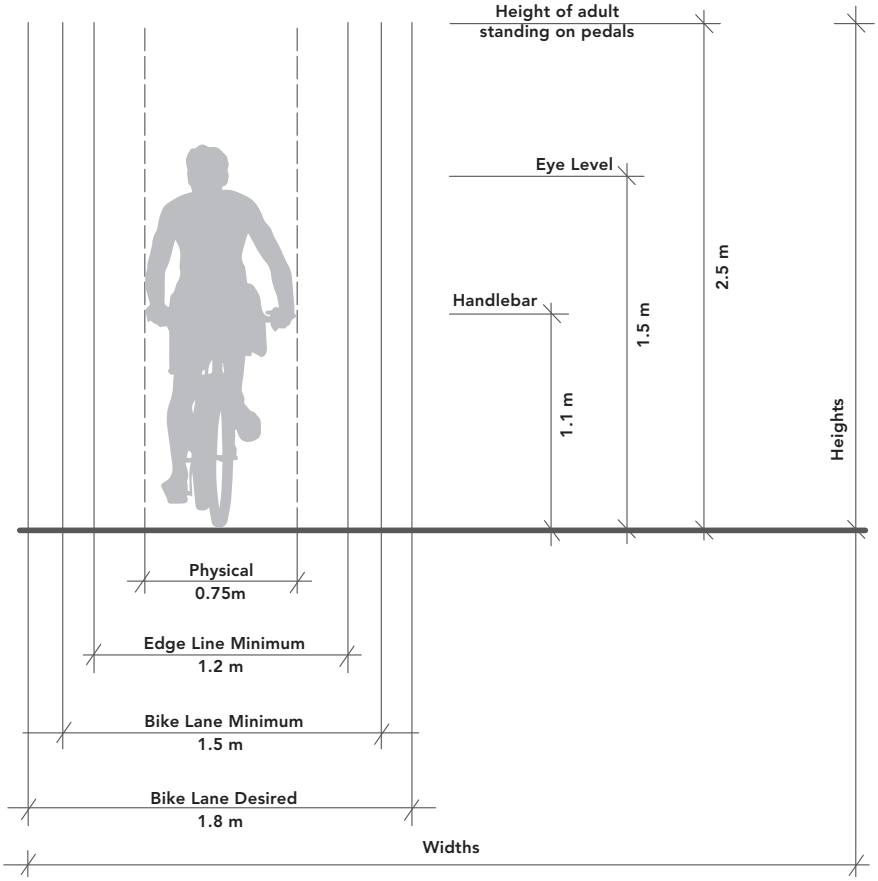
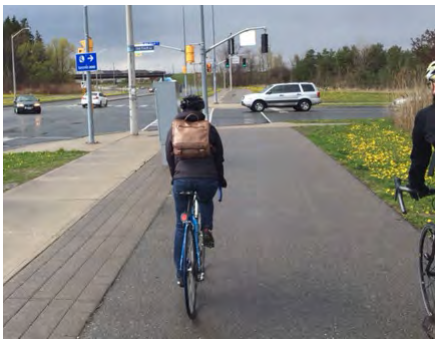


Figure 5-4: Cyclists Operating Space Requirements.
Source: Adapted from OTM Book 18.

5.3

KEY CYCLING ELEMENTS

Cycling facilities, bicycle parking, Bike Share Toronto, and wayfinding are key elements that should be considered for complete streets improvements. Intersection-related topics are covered in Chapter 9 on Intersections design. Cycling facilities can be subdivided into two categories: those on Fast, Busy Streets and those on Quiet Streets.



Cycling facilities can be between the sidewalk and the property line when there are no or few building frontages and when it connects with a multi-use trail such as this one in Scarborough.

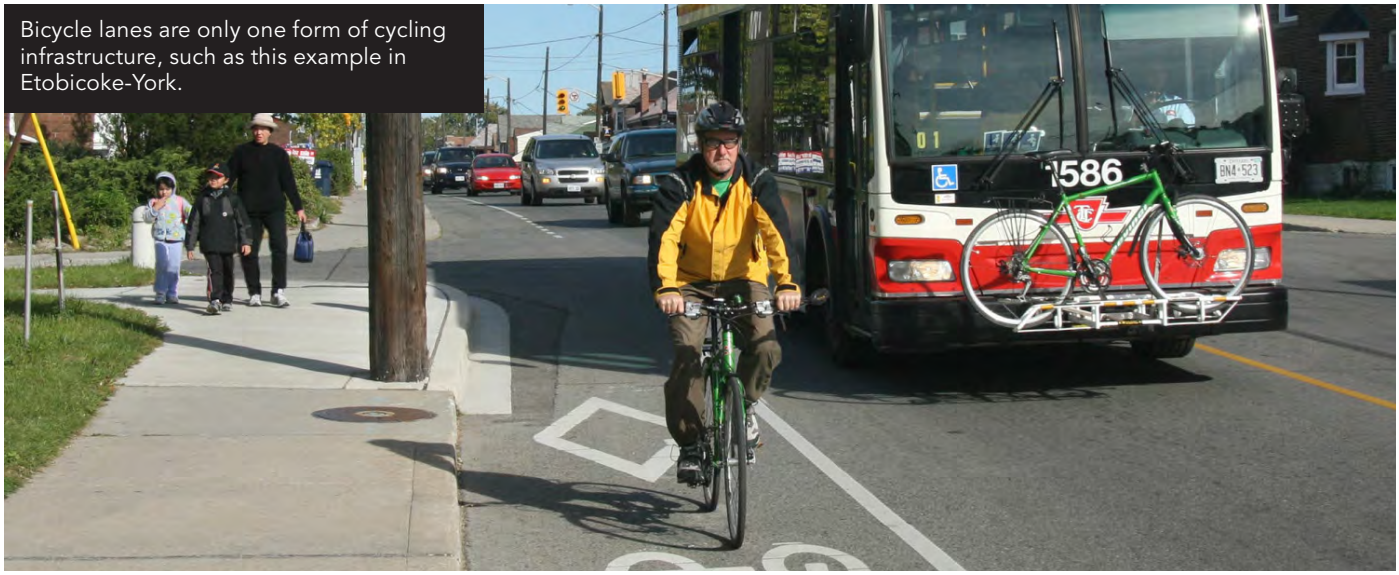
CYCLING FACILITIES ON FAST, BUSY STREETS

High motor vehicle speeds and volumes necessitate dedicated cycling facilities. Examples include painted and buffered bicycle lanes, cycle tracks (separated bicycle lanes with bollards, planters, or a row of parked cars between cyclists and moving traffic), and raised cycling facilities (e.g., curb protects cyclists from motorized vehicles, cycling facility in the boulevard, etc). In any of these cycling facilities, it is not lawful for motor vehicles to drive, stop, stand or park. Exceptions may be made for taxi pick-up and drop-off and Wheel Trans boarding.

CYCLING FACILITIES ON QUIET STREETS

Low motor vehicle volumes and travel speeds, may provide a comfortable cycling experience without a formal cycling facility. Some Quiet Streets that are part of the Cycling Network may have dedicated facilities, or a range of design features including traffic calming measures, shared lane pavement markings, and wayfinding. If the route is not a designated "Quiet Street" in the Cycling Network, consider ways to apply the City's Bicycle-Friendly policies. These include wider curb lane widths, standards for the construction of bridges/underpasses, provisions exempting bicycles from some traffic regulations and maintaining cycling access through traffic calming projects, catch basin cover standards, and bicycle detection at actuated signals.

Bicycle lanes are only one form of cycling infrastructure, such as this example in Etobicoke-York.



Bicycle Lanes

Buffered Bicycle Lanes

Cycle Tracks

Raised Cycling Facilities

Contraflow Bicycle Lanes

Routes - Wayfinding

Bicycle Friendly Streets

Bicycle parking may be seasonal or permanent depending on context and demand.

BICYCLE PARKING AND BIKE SHARE

Travel by bicycle requires an adequate and convenient supply of Bike Share Toronto bicycles and docking stations and bicycle parking on both private property and in the public right-of-way. Many types of bicycle parking exist from ring-and-post, to bicycle corrals and parking structures, such as secure bicycle stations or bicycle lockers. Bicycle parking in the right-of-way should be considered on every street type, except perhaps some Neighbourhood Residential Streets and Laneways. It is especially important on Main Streets and near destinations, such as in institutional, mixed-use, and commercial areas. Consider seasonal changes in demand for bicycle parking.

Bicycle parking, including the parked bicycles, must not obstruct the pedestrian clearway. Also consider the space needed to access bicycles while being locked or unlocked.

Bike Share Toronto requires unobstructed space within or adjacent to the right-of-way for its docking stations. Stations must be connected linearly and wired to a power source. To optimize station balance, Bike Share stations are installed along a 300m grid. The frequency of stations must be maintained to ensure connectivity and accessibility.

WAYFINDING

Bicycle wayfinding consists primarily of signs and pavement markings that are legible to cyclists while they are travelling. Directional signs focus on routes that are included in the Cycling Network. In addition to providing information to make travel simpler and more convenient, the main benefits of wayfinding include increased safety by facilitating decision making in advance of intersections rather than in intersections, and greater visibility of cycling as a viable travel mode.

MORE INFORMATION

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- City of Toronto. Toronto Bikeway Design Guidelines. Anticipated 2017.
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Bicycle wayfinding provides route and distance information to facilitate convenient travel.


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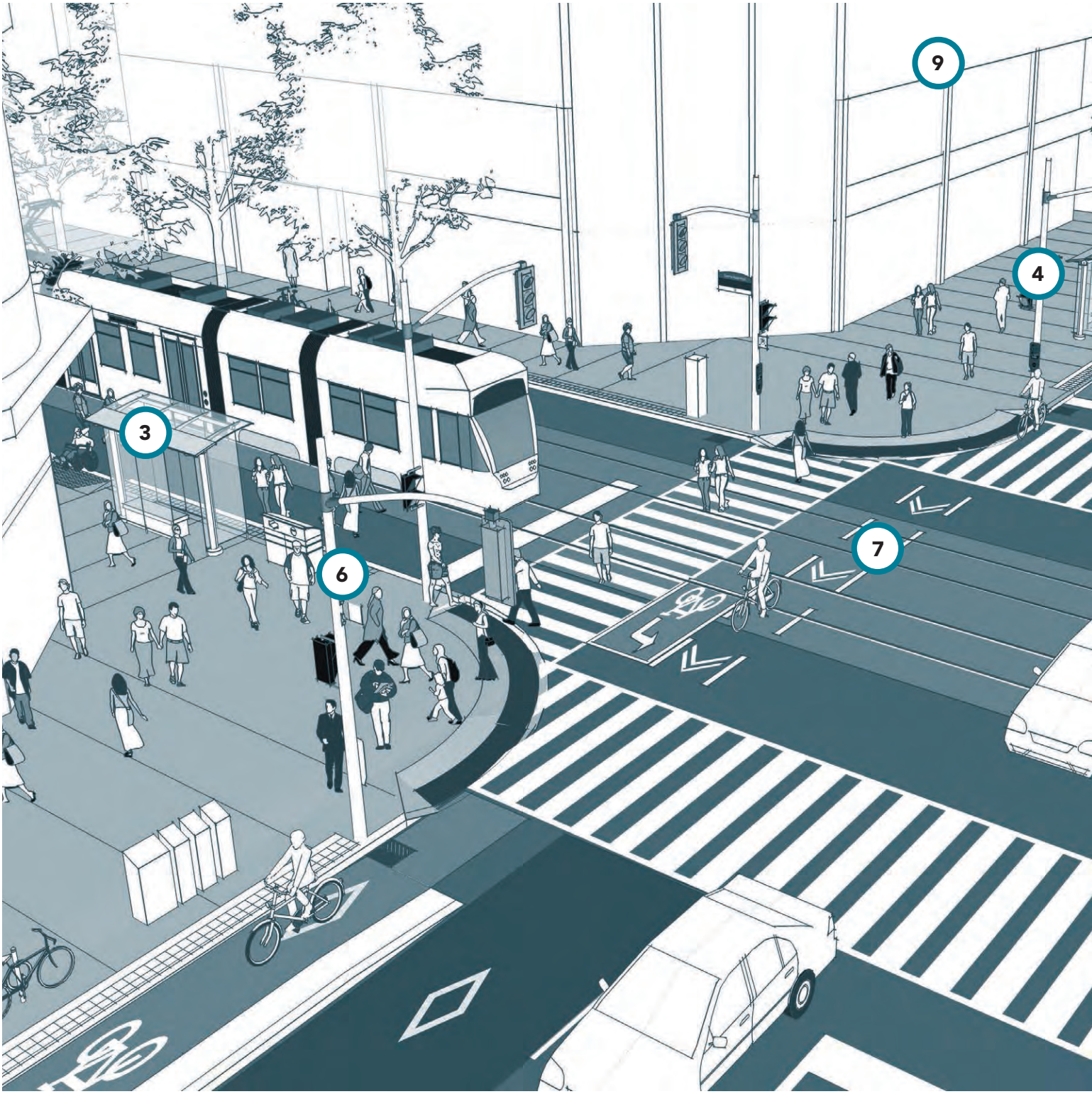
As the City of Toronto continues to grow, it becomes increasingly important to make public transit an attractive travel choice for more people. Buses, streetcars and light rail vehicles consume far less roadway space per passenger trip than a car, and can help relieve congestion, improve air quality and reduce greenhouse gas emissions. The Toronto Transit Commission (TTC) has over 7,400 km of on-street streetcar and bus routes carrying over 1.67 million people per weekday.

Transit on streets has the potential to move great numbers of people quickly to their destinations, making efficient use of very limited roadway space. This chapter outlines ways to support transit operations to make transit more convenient, faster and more reliable. The combination of various street elements outlined on following pages and signal strategies covered in Chapter 9 on Intersections aim to improve the quality of surface transit on our streets.

6.0 STREET DESIGN FOR TRANSIT

6.1 TRANSIT DESIGN PRINCIPLES



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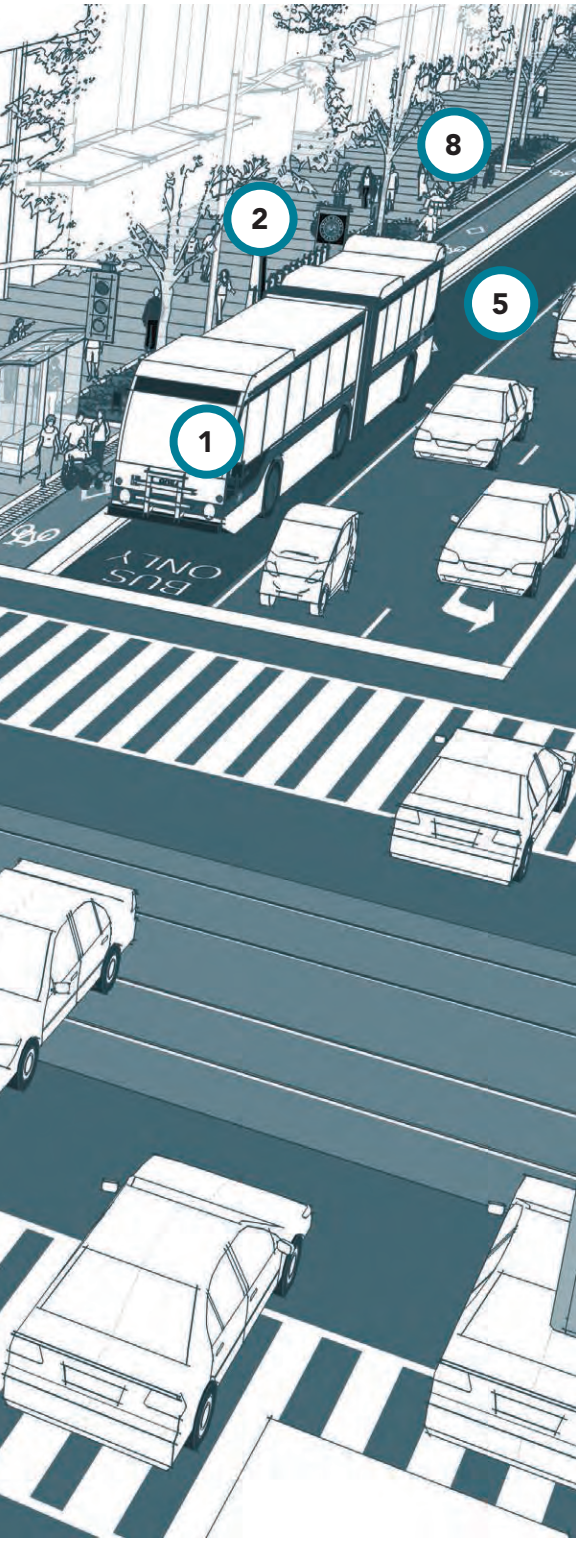


1. Enhance transit users' experience. Enhance the reliability, frequency and speed for transit by prioritizing space for transit and by implementing signal priority. Consider ways to improve convenience and comfort for users through amenities such as transit shelters, bus stop landing pads, streetcar platforms, street furniture, lighting, greening, public art and real-time travel and route information.

2. Make connections safe, convenient, and seamless. Facilitate ease of transfers among different transit routes, walking, cycling and other modes of transportation, such as sidewalks and crossings to transit stops, bicycle parking and Bike Share Toronto, and wayfinding information.

3. Visible, safe and convenient transit stops. Stops should be located at signalized intersections, or at controlled crossings (e.g. PXOs), as it allows for safe access to stops or when making route transfers. Locate stops near pedestrian generators.

4. Universally accessible transit stops and facilities. Design for all users, with universal accessibility, comfort and mobility of passengers in mind, such as accessible transit shelters that accomodate the pedestrian clearway, curb ramps for new LRT stops, tactile walking surface indicators on platforms and at stops delineating raised cycling facilities, and accessible pedestrian signals.

5. Curbside design to support transit efficiency. Where appropriate, queue-jump lanes provide opportunities for buses to move to the front of the queue, avoiding significant delays. At stops with adjacent on-street parking, transit platform bulb-outs can help people board or alight faster, and they make it easier for transit vehicles to pull back into traffic. Remove or relocate on-street parking away from a transit stop and supplement it with traffic signs to ensure the space is clear for transit vehicles all the time.

6. Traffic signal control strategies. Traffic signal progression or coordination aims to provide a wave of "green lights" on corridors with on-street transit. Transit signal priority is another method to enhance transit performance and keep transit on schedule. Time-based turn restrictions can help prevent significant delays to transit and other drivers on busy routes.

7. Transit streets are safe for walking and cycling. Create safe streets for people to walk and cycle and safe crossings – as they are most often the customers who use transit.

8. Transit streets are linear public spaces. Creating streets as places will enhance the attractiveness of transit and its ability to support the city's social, economic and environmental vitality. Repurpose underutilized space for parklets, plazas and cafés.

9. Design for growth. As Toronto continues to grow and develop, streets can be designed to retain current riders and attract new riders through the coordinated planning of transit expansion and new development.

6.2

KEY TRANSIT STREET ELEMENTS

Transit lanes, transit stop and intersection treatments are the three types of transit facilities that should be considered for complete street improvements. They may be considered on their own, but should be combined, while considering their benefits and impacts on all road users in the street design process. (For transit design considerations at intersections, such as Queue Jump Lanes, see Chapter 9 on Intersections.)

Surface transit may be in dedicated lanes (as above), or as part of the shared roadway (as below).

DEDICATED OR EXCLUSIVE TRANSIT LANES

They are marked for transit only using pavement markings, signs, and sometimes physical design.

Dedicated transit lanes are typically used to move the highest volume of passengers and to support the highest frequency of transit vehicles. Even when physically separated, these lanes may accommodate emergency vehicles and maintenance vehicles, with some exceptions.

RESERVED LANES OR SHARED TRANSIT LANES

Reserved lanes allow any combination of transit vehicles, taxis, high-occupancy vehicles (HOVs) and bicycles. Reserved lanes can allow for greater transit frequency and reliability on routes with high ridership and congestion. Shared-use lanes, where transit moves together with mixed traffic, are useful alternatives in many places where right-of-way space is limited. Transit service can be improved on shared-use lanes through geometric design, signal timing, time of day restrictions, as well as parking and turn restrictions. In all cases, lane widths need to be sufficient to serve transit vehicles and passengers.

The cycling facility is level with the sidewalk for accessible boarding on the streetcar on Roncesvalles Ave.

TRANSIT STOPS

The location and design of transit stops has direct implications for the comfort and convenience of transit passengers and other users. The selection of stop locations is generally guided by the safety and comfort of transit users, and minimizing transit delay. Key considerations for locating stops include spacing between stops, and stop location relative to intersections and land uses, including intensifying areas. The spacing between stops should be between 300m and 400m in most locations to balance access to transit with travel time for passengers, though this may vary based on context. Stops should generally be at intersections. Stops should be clear of clutter and unobstructed for boarding and alighting.

Signalized intersections are ideal locations to allow for safe pedestrian crossings, and the likelihood of route-transfers. Mid-block bus stops are recommended only near significant pedestrian generators, and where intersections are far away.

KEY CONSIDERATIONS FOR TRANSIT STOP DESIGN

- **Safety:** visibility, lighting, geometry, reducing conflicts.
- **Accessibility:** tactile walking surface indications, sign poles, curb cuts; full compliance with City Accessibility Guidelines and the Accessibility for Ontarians with Disabilities Act (AODA).
- **Comfort:** protection from weather, coordinated street furniture for waiting passengers, facilitating transfers with transit information.
- **Placemaking:** transit stops are gateways to streets and neighbourhoods; they should be legible and provide users with wayfinding information.
- **Integration with transit vehicle design:** the number, type and size of vehicles that will use the stop may affect the size of a stop and landing pads, where transit doors open.

TRANSIT PLATFORM BULB-OUTS

These are curb extensions that align the surface transit stop with the parking lane. This lets buses stop and board transit riders without having to leave and re-enter the travel lane. Transit platform bulb-outs help buses and streetcars move faster and more reliably by eliminating or reducing the amount of time lost with traffic interactions. They also ensure that the pedestrian clearway remains unobstructed by transit shelters and passengers waiting to board.

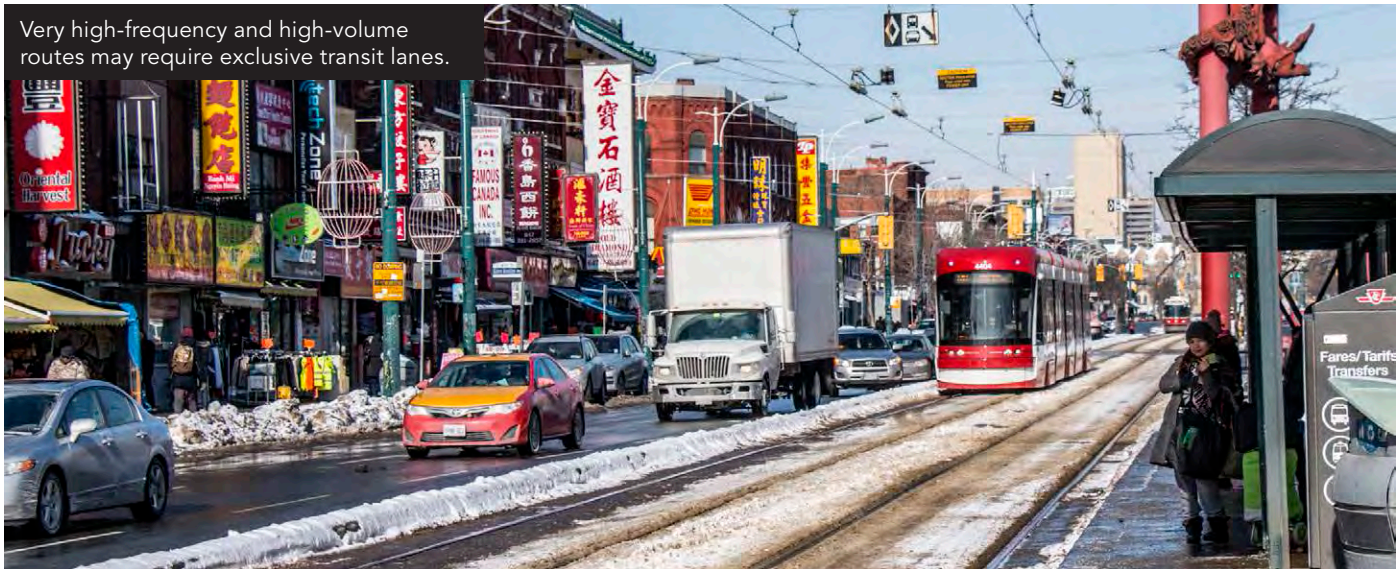
6.3

CONTEXT-SENSITIVE TRANSIT DESIGN

A street's land use and network context will inform the type of transit accommodation and priority, whether deciding on travel lanes, stop design or intersection treatments. In addition, location-specific information will help address issues such as transit user safety, comfort, visibility, boarding/disembarking, transfers among routes and modes, and coordination of transit with land developments.

GENERAL CONTEXT-SENSITIVE CONSIDERATIONS

- Official Plan rapid transit and surface transit priority routes (OP Maps 4 and 5)
- Existing and anticipated transit priority routes, ridership volumes and vehicle frequency
- Existing and anticipated transit ridership volumes on the route and nearby routes under consideration
- Location of current and proposed stops, including boarding and alighting volumes
- Other network priorities along the same route and location (e.g. cycling, goods movement)
- Existing and potential cycling and pedestrian volumes
- Transfers between transit routes and different modes (such as walking and cycling to take transit or passenger drop-off/pick-up)
- Total existing and planned street right-of-way widths (OP Map3)
- Direction of travel: one-way or two-way
- Number of through and turning vehicle lanes, and their usage throughout the day
- Speed and volume of motor vehicles, and traffic congestion management
- Collision data and safety issues
- Presence of on-street parking, driveways and other curbside uses
- Existing utility infrastructure
- Presence of trees and other greening functions
- New buildings and developments
- Demographics of existing and potential transit customers (e.g. school, college, university, seniors or tourists)



Very high-frequency and high-volume routes may require exclusive transit lanes.

- Access to destinations, especially special event venues, and transit rider-generating locations of all kinds

Very high-frequency and very high-volume services warrant unique considerations. For example, some high-volume stops will require accommodating many waiting passengers as well as people boarding and disembarking through wider sidewalks, or longer platforms and bus bays to accommodate more than one bus at a time. Where several thousand passengers per hour per direction is expected, unique and more extensive transit priority measures may be required, such as corridor-wide turn prohibitions, extended stopping prohibitions, or exclusive transit lanes. The implementation of dedicated transit lanes requires significant investment and planning, and is determined through comprehensive feasibility studies.

MORE INFORMATION

- "Accessibility for Ontarians with Disabilities Act, 2005, S.O. 2005, c. 11." e-Laws (Government of Ontario). Accessed October 24, 2016.
- City of Toronto. Accessibility Design Guidelines. 2004.
- City of Toronto. Criteria for Evaluating Request for Queue-Jump Lanes. Updates underway (in use internally).
- City of Toronto. Revised Transit Stop Guidelines. In development, anticipated 2017.
- Metrolinx. Mobility Hub Guidelines. 2011.
- Ministry of Transportation of Ontario. Transit-Supportive Guidelines. 2012.
- National Association of City Transportation Officials. Transit Street Design Guide. 2016.

Articulated buses are used on some of Toronto's busiest bus routes to accommodate high demand.

Yonge-Eglinton is one of Metrolinx's designated Mobility Hubs, where seamless mobility and placemaking are key goals.

Green infrastructure refers to natural and human-made elements that provide ecological and hydrological functions. In addition to these functions, green infrastructure contributes to making streets more pleasant, comfortable and sustainable. Components may include natural heritage features and systems, park lands, stormwater management systems, street trees, urban forests, natural channels, permeable surfaces, green roofs, and active and sustainable transportation modes.

Through the Toronto Green Standard, TransformTO, Wet Weather Flow Management Guidelines and Toronto's Strategic Forest Management Plan, the City of Toronto has established a wide range of environmental goals to address climate change, emissions, air quality, energy efficiency, stormwater quality and runoff, and the urban tree canopy. Green infrastructure is vital to achieving the City's environmental goals and is as integral to the City as other infrastructure.

7.0 STREET DESIGN FOR GREEN INFRASTRUCTURE

7.1 GREEN INFRASTRUCTURE DESIGN PRINCIPLES

For illustrative purposes.

1. Street trees and landscaping. Seek ways to incorporate and provide healthy growing conditions for trees and/or landscaping to improve air quality, mitigate urban heat-island effect, enhance ecosystem health, and contribute to community character. Select planting locations, spacing and design details (e.g., adequate soil volume, water and sun access) so that trees and landscaping will flourish. Trees can frame and define streets, calm traffic by visually narrowing the roadway, and add texture, shade and visual interest.

2. Stormwater management. Use a variety of "Low Impact Development" techniques to minimize stormwater load on Toronto's sewer system and improve water quality through natural filtration. Reduce stormwater runoff and potential flooding of streets and natural areas. Strategies include minimizing impervious surfaces, and promoting infiltration of rainwater and stormwater runoff.

3. Visibility and safety. Ensure adequate visibility is maintained, especially at street corners, traffic lights, traffic signs, transit stops and driveways. Where there is vegetation, ensure maintenance programs maintain appropriate sightlines. Clear sightlines are important to the safety of all road users.

4. Universal accessibility. Design to promote universal accessibility, such as through the selection of materials and elements, to accommodate people of all ages and abilities. Tree pits, openings and grates on the sidewalk are not considered part of the pedestrian clearway.

5. Operations and maintenance. Design for ease of maintenance, such as through passive irrigation, selecting context-sensitive native plant species and planning for safe access to maintain green infrastructure. Coordinate green infrastructure with utilities during design, construction and for the long term. Seek opportunities to partner with BIAs and other local stakeholders to assist with the design and maintenance of green elements.

6. Achieving multiple environmental objectives. Consider ways to combine environmental design, such as tree canopy expansion, stormwater retention, and microclimate moderation into single street features like roadside rain gardens.

7. Sustainable energy. Consider energy generation, use and management by selecting, designing and siting street elements such as solar lighting, parking machines, Bike Share Stations and street furniture to contribute to an energy efficient city.

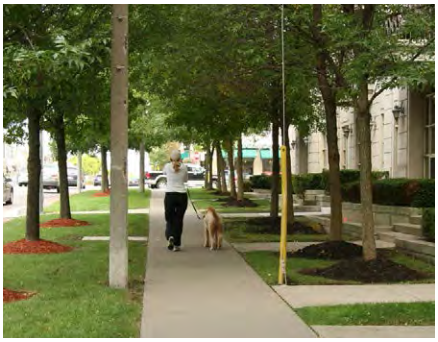
8. Sustainable transportation. Provide greener, healthier mobility choices so that more people walk, bicycle, take public transit and carpool. Reduce vehicular congestion, greenhouse gas emissions and air pollution.

7.2

CONTEXT-SENSITIVE GREEN STREETS

The Green Streets Technical Guidelines provide a full range of locations for green infrastructure, along with a selection tool to help identify the best green infrastructure elements for a given context. Green streets are designed with attention to the ecological and hydrological functions of the street, and in particular, to the at-source treatment of stormwater runoff.

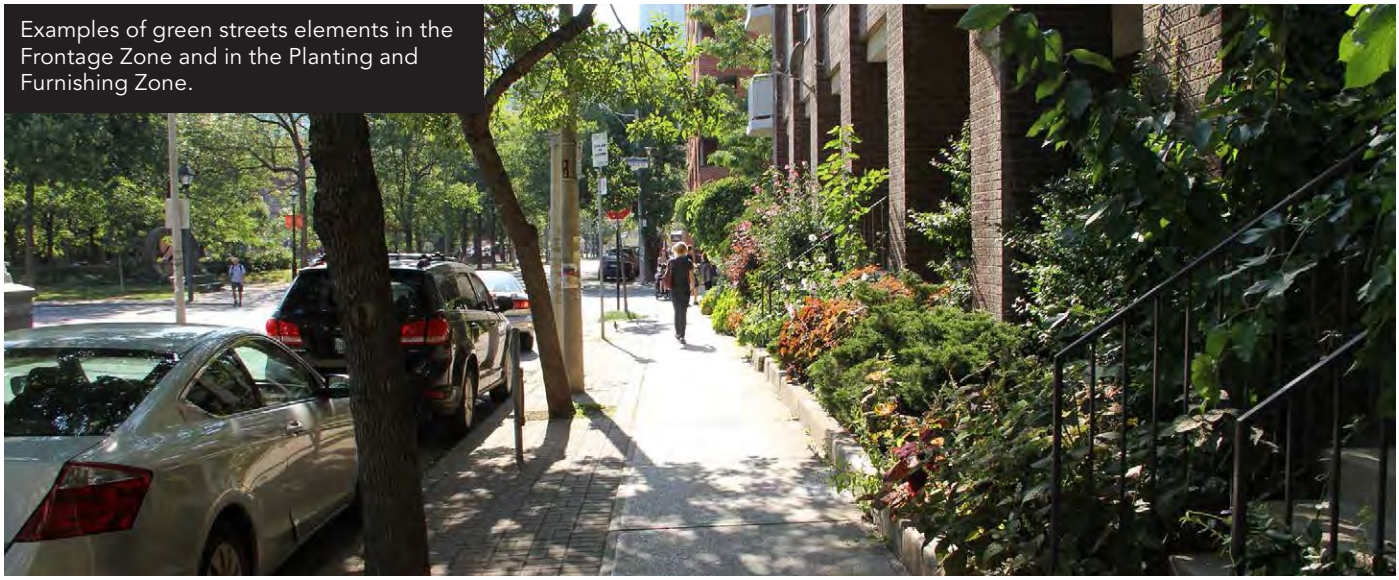
Green infrastructure may be provided in a variety of locations on a street.



Green streets employ green infrastructure solutions to support human health and well-being and to relieve urban pressures on ecological systems, air quality, energy efficiency and water resources. Street trees and other plantings can provide vital and comfortable microclimates for humans and habitats for urban wildlife and pollinator species. Low Impact Development (LID) facilities can be designed to replicate the functions of a natural drainage system by attenuating and infiltrating stormwater as close as possible to where it lands. A holistic approach can reduce or even eliminate the need for a conventional stormwater management system.

Street contexts with adequate space and limited conflicting demands are ideal locations for green infrastructure; however it is possible to incorporate green infrastructure in a variety of places within the public right-of-way:

- **Frontage Zone,** such as where buildings are set-back from the street and sidewalk.
- **Planting and Furnishing Zone,** typically between the pedestrian clearway and edge zone or curb, is an ideal location for green street elements as it provides a buffer between pedestrians and vehicles. This zone may also make use of street poles for hanging planters, trellises and solar panels as long as adequate visibility and safety are maintained.
- **Curbside** in the roadway is where greening can often be enhanced through curb extensions, bioswales, rain gardens, permeable paving on the curb extension or edge zone, cycling facilities or parking laybys and other green street elements.
- **Medians or raised islands** in the roadway can be good places to include trees and other landscaping, but require special attention to ensure visibility and safety for travelers and long-term maintenance.

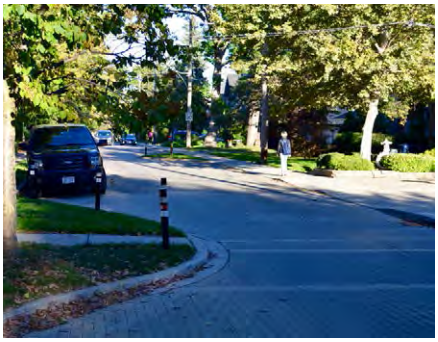


Examples of green streets elements in the Frontage Zone and in the Planting and Furnishing Zone.

The following contextual factors are considered when identifying streets (and locations on streets) for green street design:

- Street type – including components such as intensity of demand from other users and uses
- Available right-of-way width and building setbacks
- Site physiography (soil permeability, topography, depth to water table or bedrock, soil contamination)
- Surface water flow routes
- Sunlight
- Open space context – adjacent natural heritage systems, open space and parks
- Storm drainage infrastructure
- Underground transit infrastructure
- Utilities infrastructure (underground and overhead)
- Proximity to known flooding
- Urban forest cover
- Watershed context – erosion vulnerability
- The need and availability of operation and maintenance
- Curbside accommodations for goods movement, delivery and loading
- Sightlines and other safety considerations
- Setbacks from intersections and other street infrastructure

Some green street elements collect stormwater from sidewalks and roadways.



Green street elements are sometimes located curbside or combined with speed management components.

7.3

KEY GREEN STREET ELEMENTS

A wide variety of Green Street Elements are possible in Toronto to support the goals of sustainable street design. The Green Streets Technical Guidelines provide a comprehensive list of green infrastructure options and factors to select features that are appropriate for a given site context. Two of the most common options include street trees and landscaping, and Low Impact Development (LID) practices for stormwater management. These elements should be considered in the street design process.

South Station Street in Etobicoke-York is a City of Toronto green streets demonstration site. It features trees, landscaping and stormwater retention components.

Some larger sidewalks are candidates for a double row of trees, like this one on The Esplanade.

STREET TREES AND LANDSCAPING

Street trees and landscaping comprise a number of elements including groupings of trees, single trees, shrubs and perennial plants. Trees and planting materials are most commonly installed in open landscape at grade, in planters (that may double as seating) or in covered tree pits and may be installed in LID features such as stormwater tree pits/ trenches, bioswales and rain gardens. They have numerous benefits related to ecology, air quality, temperature moderation, safety, microclimate, land value, and human well-being. Toronto City Council has set a goal to reach 40% tree canopy cover over the next 40-50 years.

Street trees form a significant part of the City's urban forest, and are found on all types of streets. Consider enhanced planting conditions for street trees wherever noticeable deficiencies or gaps in the tree canopy are present. Special engineering solutions are required for trees in hard boulevard surfaces to provide adequate soil volumes and optimum growing conditions. Urban and drought tolerant plant materials and native plant species can facilitate ease of maintenance. Open planters, tree pits and above-ground planters are all possible elements to contain trees and landscaping on streets, but are not considered part of the pedestrian clearway.

Street trees and landscaping are ideally located where growing conditions are best, where people can enjoy them, and where they can be efficiently maintained. The two most common locations for tree plantings are within the Frontage Zone, and Planting and Furnishing Zone (see the Chapter 4 on Pedestrians for the various zones of the sidewalk and boulevard). See Section 7.2 for other locations in the street to include trees and landscaping.

To successfully incorporate plant material within a streetscape made of so many elements, it is essential that the design team consider planting conditions and street context as part of the street design process for projects. Coordination with utilities early in the design process is critical. Consideration should be given to minimizing conflicts between the layout of utilities and the planting plan at the time of construction and with future growth.

The City of Toronto's Tree Planting Solutions in Hard Boulevard Surfaces and Green Streets Technical Guidelines provide detailed design guidance, and should be consulted throughout the street design process.

This green street demonstration site features a rain garden as part of a new parkette, that was derived from excess roadway space at Fairford Ave. and Coxwell Ave. in East York.

TORONTO CITY COUNCIL ADOPTED AMENDMENTS TO TORONTO'S OFFICIAL PLAN TO INCLUDE IN ITS VISION:

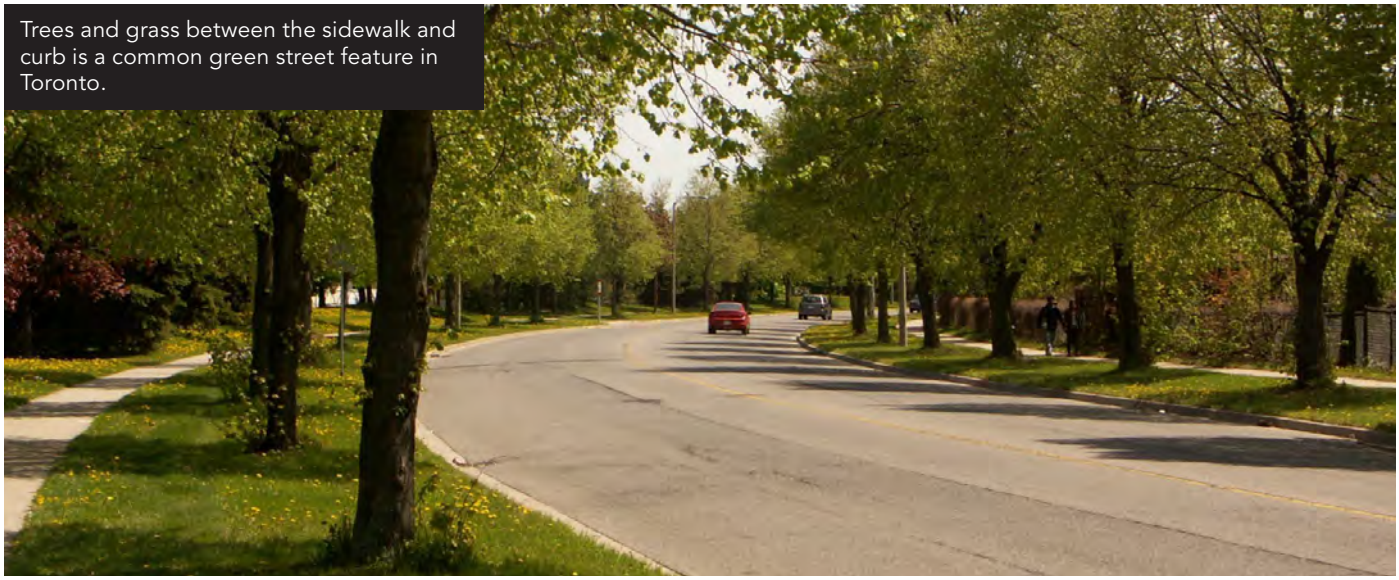
- a healthy natural environment, including clean air, soil, energy and water;
- infrastructure and socio-economic systems that are resilient to disruptions and climate change; and,
- a connected system of natural features and ecological functions that support biodiversity and contribute to civic life.

GREEN STORMWATER MANAGEMENT INFRASTRUCTURE

Streets form a vital part of Toronto's stormwater management infrastructure. A Green Street in Toronto is a right-of-way that through a variety of design and operational treatments, manages stormwater at-source and achieves the broad objectives of the Toronto Green Standard (2014). Green Streets are designed with a particular focus on capturing rainfall, and treating runoff at the source. This approach is at the core of "Low Impact Development". The City of Toronto's Green Street Technical Guidelines (2016) are intended as the primary source for technical direction on green stormwater management.

Green infrastructure designed to capture rainwater is an emerging and important part of Toronto's streets. It can help minimize stormwater load on the City's sewer system, which has come under increasing pressure with the frequency and severity of storms.

Green Streets can help to reduce runoff volumes and manage stormwater runoff quality. This may lead to other benefits such as reduced operating infrastructure costs, enhanced water quality and water balance in Toronto's streams, rivers and Lake Ontario. Among the many health and environmental benefits, green streets can also provide a more aesthetically pleasing street and contribute to placemaking.



Trees and grass between the sidewalk and curb is a common green street feature in Toronto.

An attempt should be made in the street design process to assess ways to incorporate green infrastructure in appropriate parts of the right-of-way. Design options should weigh the benefits to other users, the water cycle and the overall ecosystem.

Furthermore, it is important to recognize that maintenance is required to ensure plants can thrive and infrastructure can maintain its functionality. Maintenance processes and owners are required to be clearly identified and agreed upon as part of the design process when assessing the viability of design options. Maintenance responsibility should be clear and agreed upon before moving onto the detailed design phase.

MORE INFORMATION:

- City of Toronto. Design Guidelines for 'Greening' Surface Parking Lots. 2013. (includes adjacent sidewalk zone)
- City of Toronto. Green Streets Technical Guidelines. Anticipated 2017.
- City of Toronto. Sustaining & Expanding the Urban Forest: Toronto's Strategic Forest Management Plan, 2012-2022. 2013.
- City of Toronto. Toronto Street Trees: Guide to Standard Planting Options. 2010.
- City of Toronto. Tree Planting Solutions in Hard Boulevard Surfaces: Best Practices Manual. 2013.
- City of Toronto. Urban Design Streetscape Manual. 2010.
- Ministry of Municipal Affairs and Housing of Ontario. Provincial Policy Statement Under the Planning Act. 2014. (includes direction on green infrastructure)
- Toronto Cancer Prevention Coalition. Shade Guidelines. 2010.
- "Toronto Green Standard – Developing Toronto – City Planning." City of Toronto. Accessed October 13, 2016.
- Transportation Association of Canada. Canadian Guide for Greener Roads. 2015.

Before tree planting on Holbrooke Ave. in Etobicoke.

After tree planting.

The design of streets has become more complex over time, especially given the rapid growth of the city.

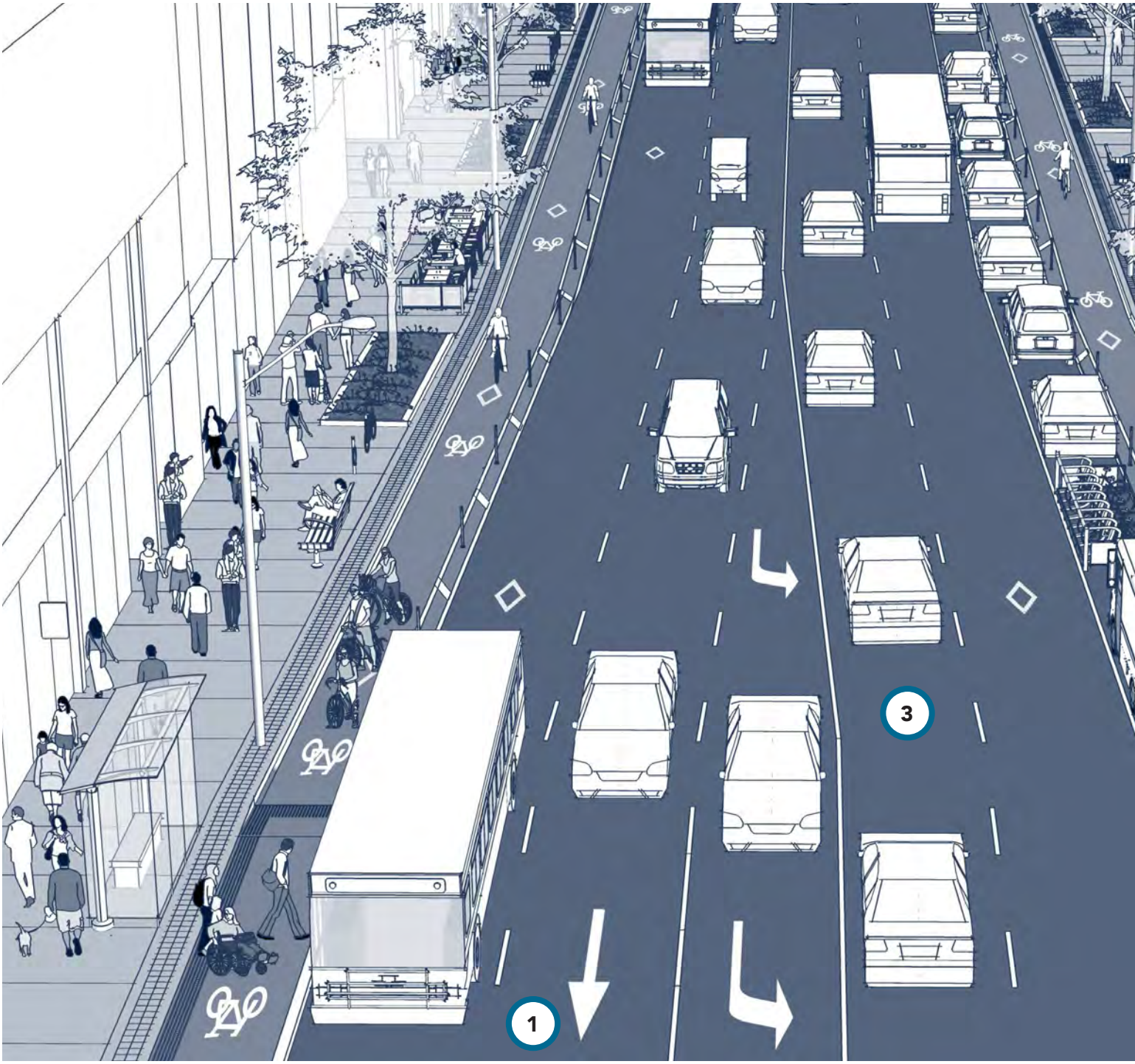
As shown in Chapter 1, the roadway is not just about moving motorized vehicles – its design affects the space adjacent to the roadway, as well as multi-modal access and mobility, public health, economic vitality, environmental sustainability and quality of life.

The roadway (the space between the curbs) needs to serve various modes of travel and their access in an environmentally, socially and economically sustainable manner. Roadway design should provide conditions that foster reliable travel and safety for all road users, particularly for the most vulnerable.

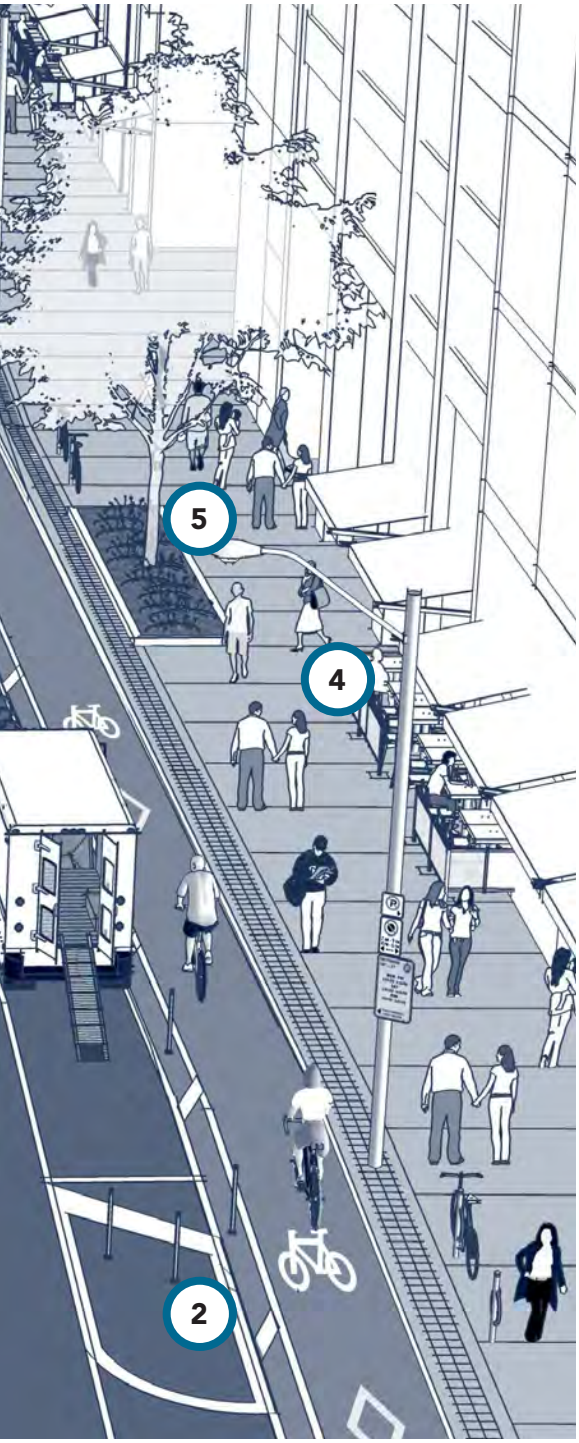
This chapter focuses on designing mid-block portions of roadways. Intersections are dealt with in Chapter 9. Topics related to pedestrians, cycling, transit and green infrastructure are discussed in Chapters 4 to 7.

8.0 STREET DESIGN FOR ROADWAYS

8.1 ROADWAY DESIGN PRINCIPLES



For illustrative purposes - may include a mix of permanent/temporary materials.



1. Multi-modal transportation. Give reliable, convenient and attractive mobility choices to people and support more efficient, active and healthier forms of travel (by foot, bicycle, transit) to reduce vehicular congestion. Provide emergency access and operations. Support goods movement and delivery by different modes. Identify and support existing and planned priority networks for each mode.

2. Safety. Fully consider road users who are particularly vulnerable in a crash or in interactions with other road users, such as pedestrians (especially children, older adults and persons with disabilities) and cyclists. Seek ways to reduce their exposure to risk (e.g., rightsize travel lanes, repurpose underused road space and separate pedestrians from cyclists). Provide visible, clear and predictable travel paths for all road users.

3. Context-sensitive target speed and reliable travel. Create a safer environment for everyone by using design to facilitate the intended speed of travel for drivers based on the street's context. Safer speeds and driver behaviours result in fewer incidents on the roadway that can cause delays and vehicular congestion, which negatively impact emergency access and goods movement. Coordinated signals, along with target speed, can help improve consistency in travel times. Peak-hour restrictions for stopping, parking and turn movements can improve travel times along key routes. This helps to manage demand and road capacity during peak travel times.

4. Placemaking. Consider existing and planned land uses, urban form, and the different uses of the street (e.g., social and economic activities) when making decisions about competing demands for space on the street. Seek ways to provide space, for example, through building setbacks and/or repurposing underused roadway space for streetscaping, street trees, street furniture, café or marketing areas, parklets, bicycle parking, pedestrian lighting, snow storage and removal, etc.

5. Greening and stormwater management. Limit the area of impervious materials. Seek ways to integrate street trees, landscape features, as well as water retention and treatment strategies and snow storage. Promote non-motorized modes to reduce greenhouse gas emissions and air and noise pollution. Use materials that contribute to sustainability, life-cycle performance and reduce the urban heat island effect. See Chapter 7 on Green Infrastructure for design guidance.

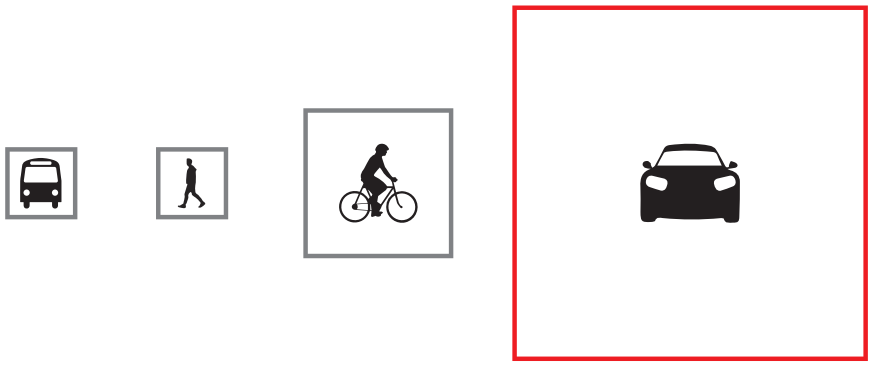
8.2 DESIGN FOR A MULTI-MODAL TRANSPORTATION SYSTEM

In a growing city like Toronto, limited street space is in high demand. Streets become more efficient when the focus is on moving people and goods rather than just moving vehicles.

Transit vehicles carry far more passengers than private automobiles and should be given priority wherever practicable to reduce vehicular congestion. Fewer single occupant motor vehicles will help free up space for other purposes, such as urban goods movement or placemaking. Design streets to encourage and support higher volume and more space efficient modes like walking, cycling and public transit, whenever possible.

An example of the efficient use of space to increase person capacity is the improvement to the Richmond-Adelaide corridor - converting a travel lane to a protected bicycle lane led to an increase to overall person capacity. Evaluations of such projects are important to monitor person capacity, traffic operation and impacts on emergency response.

Figure 8-1: Toronto Version of the famous Munster, Germany graphic illustrating space requirements between autos and transit.



transit
1m²/second

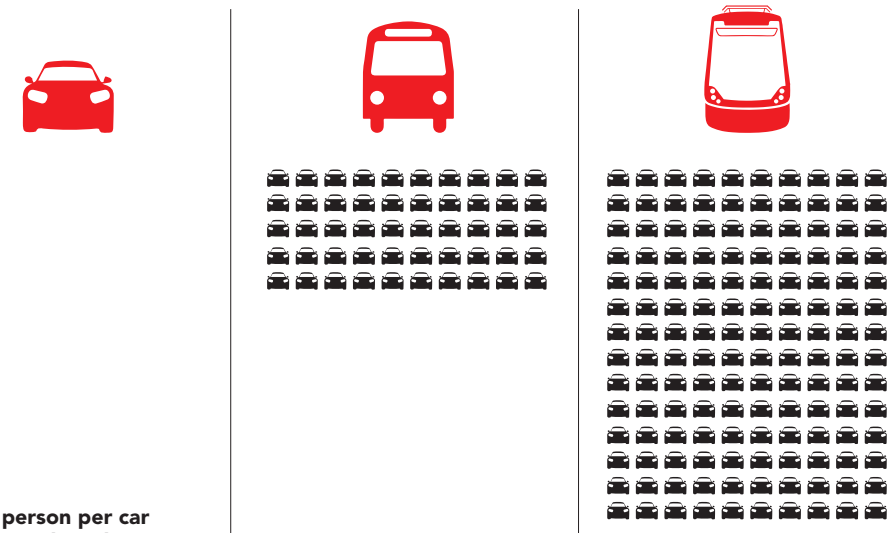
walking
1m²/second

cycling
4m²/second

single occupant automobile
19m²/second

Figure 8-2: Road space required per passenger for various travel modes. Street space requirements increase with vehicle speeds, as faster vehicles require more "shy distance" between them and other objects. Space requirements also decline with more space efficient modes like walking, cycling and taking transit. An automobile on an urban arterial requires about 20 times as much space as a pedestrian or transit passenger, and five times as much as a cyclist.

source: Adapted from Litman, T. August 2015. "Evaluating Complete Streets". Assumes typical dimension and travel speeds of walking (5km/h), cycling (15km/h), transit (25km/h) and auto (30km/h), with bus transit occupancy at 60% or 30 passengers and 1.2 passengers per automobile.



1 person per car (typical single occupant vehicle)

50 people per bus

130 riders per new streetcar

Figure 8-3: Mode Priority and Capacity. For longer trips, transit can move far more people and with greater efficiency than single occupant motor vehicles.

source: Metrolinx, TTC

8.3 DESIGN FOR SAFETY OF VULNERABLE USERS

Vulnerable users such as pedestrians, especially children, the older adults and people with disabilities are the priority. Pedestrians are more vulnerable to serious injury or death in motor vehicle collisions, as well as in interactions with cyclists given the differential in mass, speed and momentum. Pedestrians and cyclists are at greater risk of injury and mortality during a collision than motor vehicle occupants. Reducing speed is a critical aspect to improve safety for the most vulnerable.

Pedestrians are the most vulnerable road users.

Cyclists are also vulnerable road users and have a high risk of injury and mortality during a collision with motor vehicles.

Street design teams shall consider the safety of vulnerable users throughout every stage of the street project delivery process and design strategies that take into account street context such as:

- Lowering speeds to reduce severe injuries and deaths in the event of a crash.
- Rightsizing travel lanes to meet target speeds for the street's context.
- Prioritizing the safety of pedestrians, who are the most vulnerable of road users, especially children, older adults and persons with disabilities (e.g. mobility, vision, cognitive, and balance issues). Assess risks for the most vulnerable users, ensure dedicated space and reduce exposure to faster modes that may harm or injure pedestrians.
- Shortening crossing distances and exposure of vulnerable users to vehicles in the roadway.
- Increasing and ensuring the visibility of pedestrians and cyclists to drivers.
- Curb extensions and rightsizing intersection corners to address turning speeds.
- Separation between different users, and greater separation with increasing speeds.
- Bicycle facilities designed according to context and to make cyclists more visible to turning motor vehicles.
- Placement and design of elements to reduce the opportunity for crime and fear of crime, such as the principles in the Safer City Guidelines and Crime Prevention Through Environmental Design (CPTED).

Figure 8-4: Mass of Various Street Users. The severity of a crash increases as the mass and/or the speed increases. The lighter of the two objects will always sustain the more severe injuries or damage.

source: Adapted from NACTO Urban Street Design Guide.

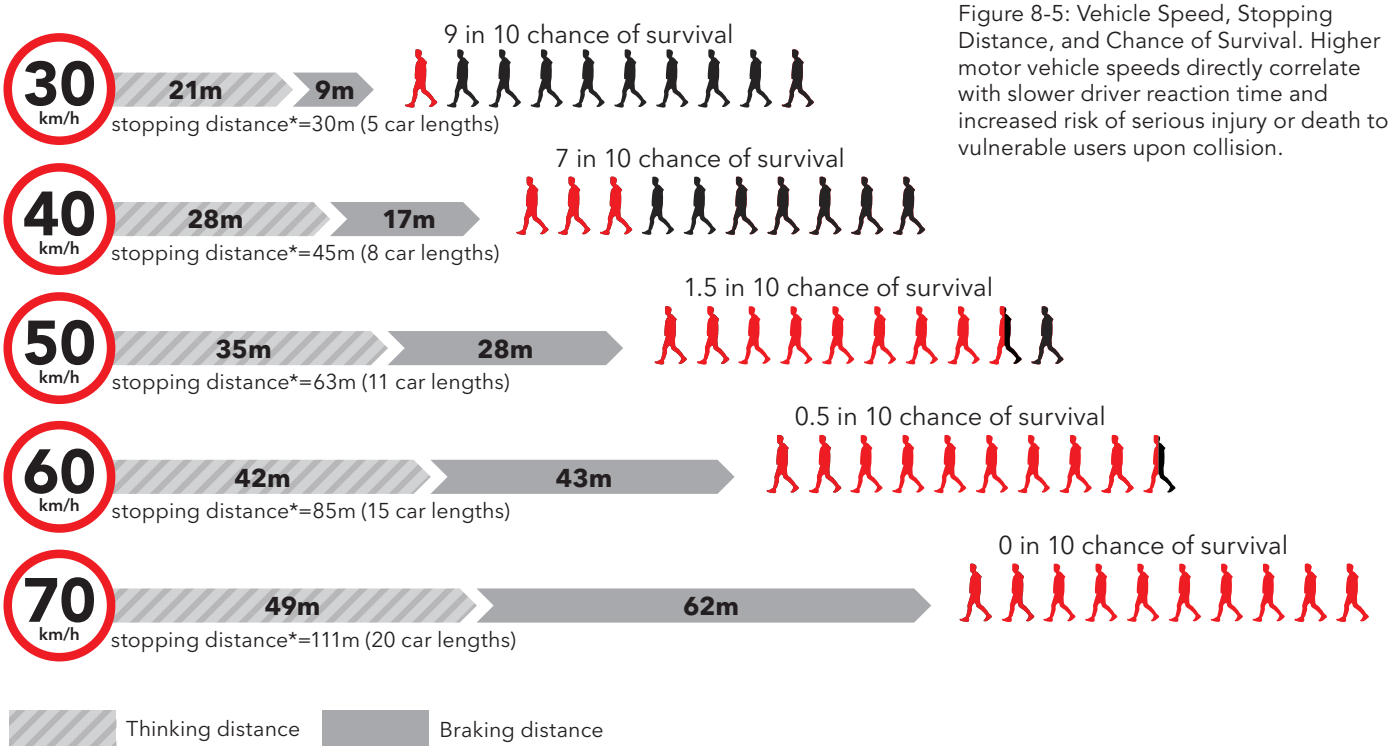


Figure 8-5: Vehicle Speed, Stopping Distance, and Chance of Survival. Higher motor vehicle speeds directly correlate with slower driver reaction time and increased risk of serious injury or death to vulnerable users upon collision.

*Stopping distances during wet conditions. Single car length=5.6m. Based on a 2.5s reaction time, representing 90th percentile of drivers.

source: Adapted from World Health Organization, 2008. Speed management: a road safety manual for decision-makers and practitioners.
Transportation Association of Canada, 2011. Geometric Design Guide for Canadian Roads Part 1. 1.2.5.2 - 1.2.5.4.

8.4

DESIGN USING A TARGET SPEED FOR THE STREET CONTEXT

The speed at which vehicles are travelling is a central factor in the ability to avoid collisions and the severity of crashes should they occur. Target speed is the intended speed of travel for drivers based on the street's context.

Reduced corner radii help to slow turning traffic.

Mid-block curb extensions help reduce vehicle speeds.

Lower speeds increase a driver's field of view and decrease their stopping distance. For example, safe speeds around schools or busy pedestrian areas will need to be lower than on wide streets with large setbacks or land uses that do not generate many trips.

Street design is always more effective in shaping behaviour than posted speed limits. Incorporate context sensitive design feature when redesigning streets to achieve the intended target (posted) speed for the context. More consistent travel speeds support reliable and smooth traffic flows for all road users, and can help reduce incidences on roadways which cause delays and traffic congestion.

Examples of mid-block design measures to achieve target speed based on street context include:

- Rightsizing lane widths mid-block and rightsizing turning radii.
- Mid-block curb extensions to rightsize roadway (e.g., pinch points to reduce vehicular speeds).
- On-street bicycle or motor vehicle parking.
- Trees and other vertical elements ("cause visual friction").
- Presence of pedestrians and cyclists, and facilities that support them.
- Signals synchronized to target (posted) speed.

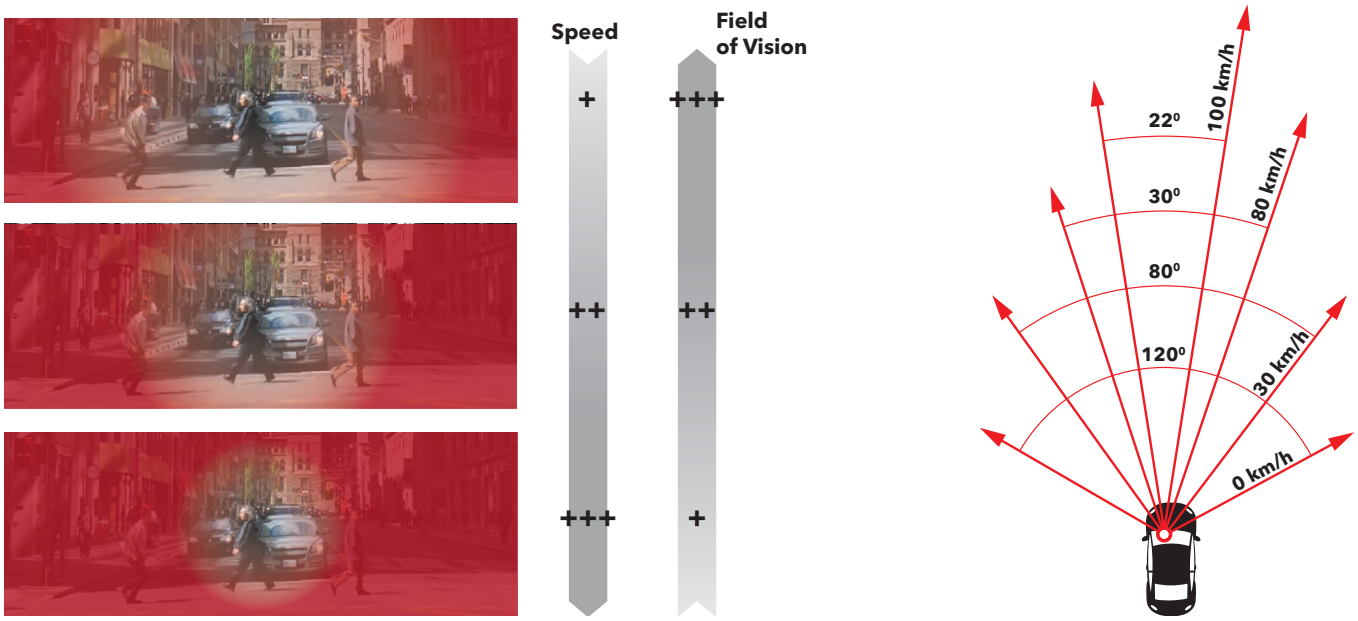


Figure 8-6: Speed and Field of Vision
Speed is especially lethal to vulnerable users like people walking or riding a bicycle. The risk of severe injury increases as a driver's field of vision narrows and misses potential hazards. Field of vision is the area a person sees when their eyes are fixed in one position.

source: base image: mark.watmough flickr: cc.2.0; Federal Motor Carrier Safety Administration; DTAH

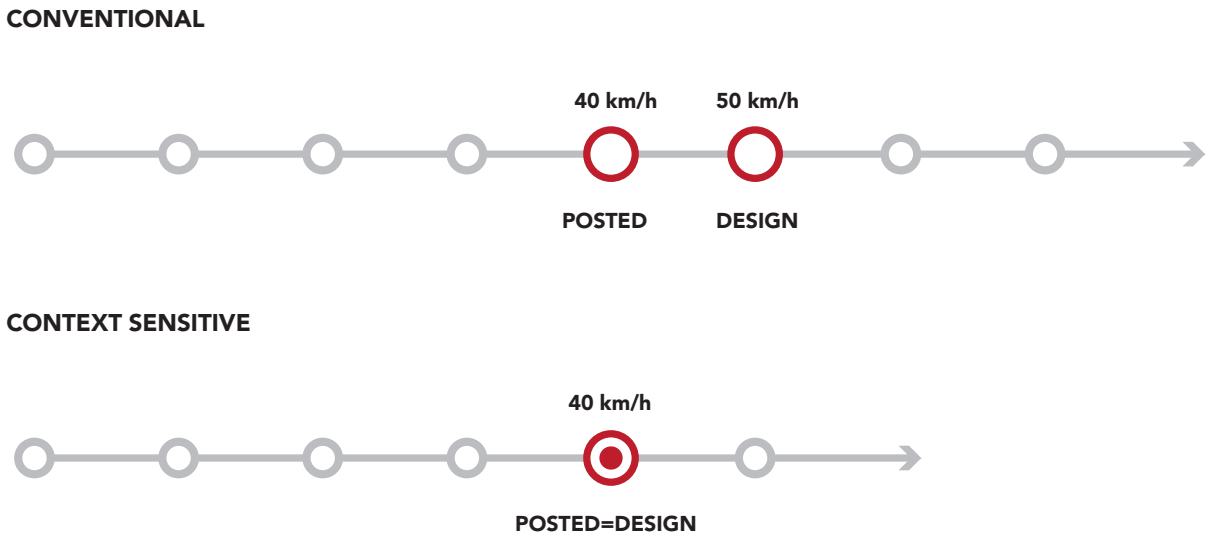


Figure 8-7: Target Speed
Conventional street design considers a posted maximum speed as lower than the design speed. Context-sensitive design promotes that the street includes elements so that both are the same, so that drivers are not comfortable exceeding the intended posted speed.

source: NACTO ; ITE; FHWA; DTAH

8.5

DESIGN TO SUPPORT PLACEMAKING AND STREET CONTEXT

Placemaking is the act of creating public spaces that contribute to the location's unique character. It often involves diverse tactics such as streetscape improvements and event programming to attract social and economic activities to an area like a Main Street. When redesigning Toronto streets, respond to the existing and planned context— taking into account the land uses, buildings, front yard setbacks, activities on the street, and public spaces adjacent to the street itself.

Roadways contribute to placemaking when their design responds to an area's unique social and cultural importance.

Some underutilized roadways in Toronto have been repurposed to meet an area's placemaking, mobility and safety objectives.

c: Courtesy of Waterfront Toronto

Traditional roadway design focused on a "centreline-out" approach where the basis of street design began from the center of the roadway, meeting the vehicle needs first without an understanding of the context that the street exists within. A best practice for transportation engineering is to take a more holistic approach – one that looks at the whole street from building face to building face. Taking a holistic view of streets means applying a "building in" perspective that first looks at the adjacent land uses and users of the street, and then the curb to curb portion of the street. Street context informs the priority functions and uses of the street, as well as details such as choice and quality of materials, need for furnishings, user amenities and greening schemes.

Local context becomes a critical input. Context can range from industrial employment areas to mixed use areas to residential. Street context will inform the priority functions and uses of the street, as well as details such as choice and quality of materials, need for placemaking and furnishings and user amenities, and greening schemes.

Street projects will account for placemaking and context by:

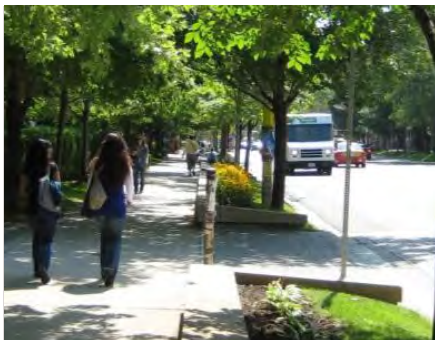
- Assessing the street from a holistic perspective (building face to building face), taking into account the adjacent land uses, ground floor uses and setbacks of a street together with designing the roadway or curb-to-curb portion of the street.
- Using information in Chapter 2 on Street Types and data inputs such as maps and overlays to identify and understand a project area's context (both existing and planned land uses and priority networks, e.g., for transit, cycling and goods movement).
- Using consultation and engagement, as outlined in Chapter 3 on the steps to designing streets to obtain input on a project's street context.
- Developing a full profile of the street's current and future context, uses and various users of the street and developing a priority for space allocation for the street.
- Seeking ways to enhance and support the unique character, e.g., social and cultural aspects of the location of a street, such as designing public spaces for lingering and respite, not just movement. For example, curb extensions on side streets enable seating and plantings to enhance local character. Street furniture, pedestrian scale lighting and public art will also contribute to the identity of a street.
- Looking at strategies that include use of building setbacks and/or repurposing underutilized roadway space for placemaking objectives for a street's context.

8.6

RIGHTSIZING & REPURPOSING ROADWAYS AS COMPLETE STREETS

On many streets, a key objective is to observe what space is not being used effectively and to rightsize and repurpose the space to achieve complete streets goals.

Curb extensions provide space for green infrastructure and street furniture.



St. George Street lanes were repurposed to widen sidewalks, add green infrastructure, and improve safety for all.

Rightsizing and repurposing roadway space essentially involves the following approach:

- Observing and thinking critically about the required space needed by various road users to enable safe mobility and access (see Chapters 4 to 9 on each component related to pedestrians, cycling, transit, green infrastructure, roadways and intersections).
- Ensuring that excess space is not provided for any one mode to the detriment of the safety of other modes and/or street project objectives such as safety and target speed, active and sustainable transportation options, placemaking, greening or universal design and accessibility.
- Gathering all of the relevant background information on a street's context and evaluating design options against the complete streets goals and street project objectives developed through the street design process outlined in Chapter 3.
- Developing and evaluating street design options, and finalizing the reallocation of space in the roadway.

Rightsizing and repurposing roadway space involves redesigning the physical space and using geometric design to improve safety conditions for everyone using the street. Design techniques include:

- Curb extensions mid-block or at intersections.
- Chicanes (or road narrowings) such as using on-street parking, or curb extensions, that alternate on a street.
- Reconfiguring four lanes into three, with the shared turn lane as the middle lane.
- Reviewing for adequate corner radii for truck routes or transit vehicles.
- Rightsizing vehicular lanes and repurposing space to on-street parking and/or bicycle lanes and/or widened sidewalks and boulevards.
- Rightsizing pavement and repurposing space to add or widen a sidewalk and/or boulevard where there is none to provide for safe space for pedestrians and universal accessibility.
- Repurpose or redesign sidewalks and boulevards to ensure that the pedestrian clearway is not cluttered or obstructed, such as by moving a

transit shelter to the back of a sidewalk onto private property through an easement or providing outdoor café patio seating using a parklet.

Potential co-benefits of rightsizing and repurposing roadway space include opportunities for landscaping and stormwater management if the features enable greening or the use of permeable surfaces. All of the above and previously described design techniques will also take into consideration the accommodation of emergency vehicles and year-round operations and maintenance. By increasing perceptions and experiences of safety and repurposing space to other uses such as placemaking, more people may walk and cycle in the neighbourhood or frequent local businesses to support local economic development.

Repurposed roadway space to improve cycling facilities on Sherbourne Street.

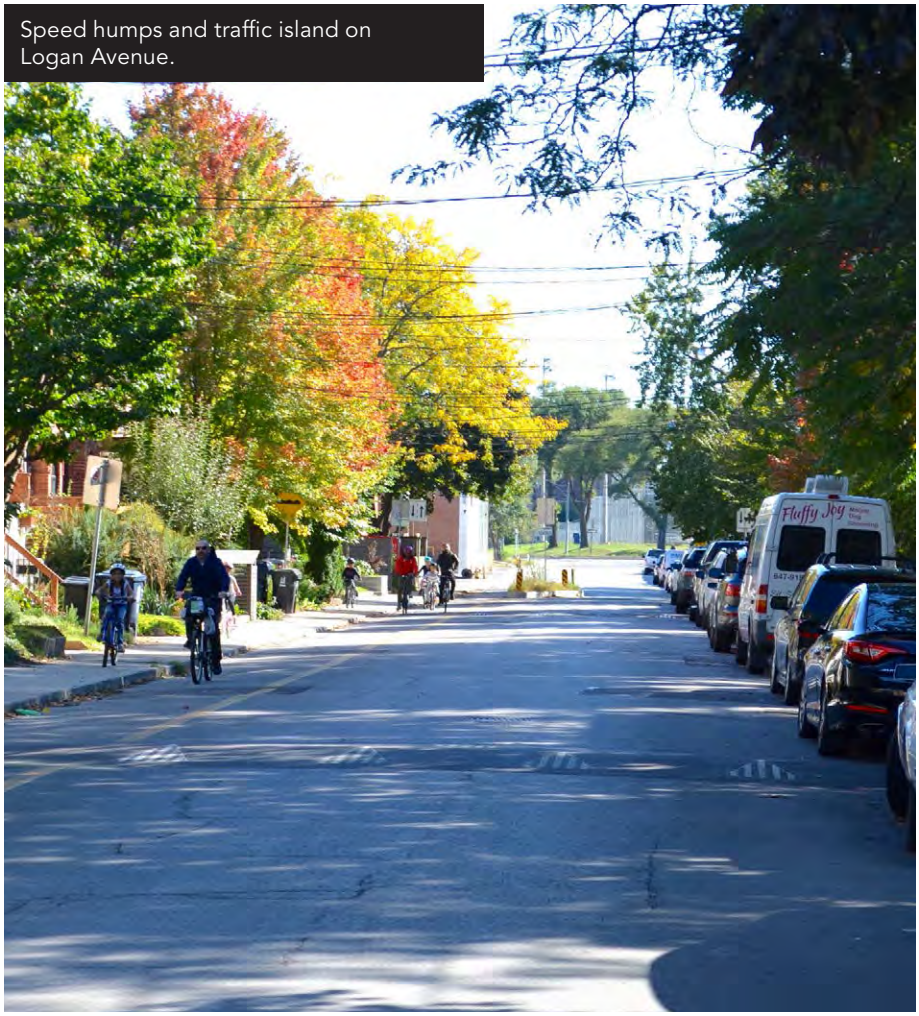
8.7

TRAFFIC CALMING

In Toronto, traffic calming measures, such as speed bumps or diverters may only be used on local and collector roads. The City's Traffic Calming Policy (2010) defines traffic calming measures as well as the criteria and process for applying them to streets. The purpose of traffic calming devices is to alter drivers' behaviour and to improve road safety. The need for these devices is often an indication that the street is not well-designed to achieve its desired target speed for vehicles. The better approach is to seek opportunities through street redesign projects to rightsize and repurpose street space to achieve complete streets objectives. When implementing traffic calming, treatments intended to curtail motor vehicles should exempt cyclists, not be located on transit routes and should accommodate emergency vehicles and winter maintenance requirements.

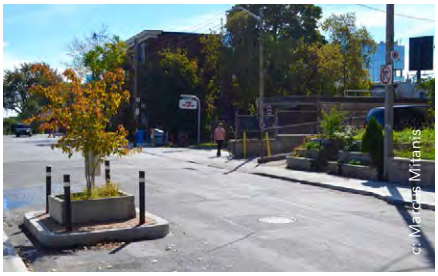
Traffic calming on Armadale Avenue in Etobicoke using a raised concrete island.

Speed humps on Falstaff Avenue in Etobicoke.



Speed humps and traffic island on Logan Avenue.

Treatments curtailing motor vehicles should exempt cyclists.

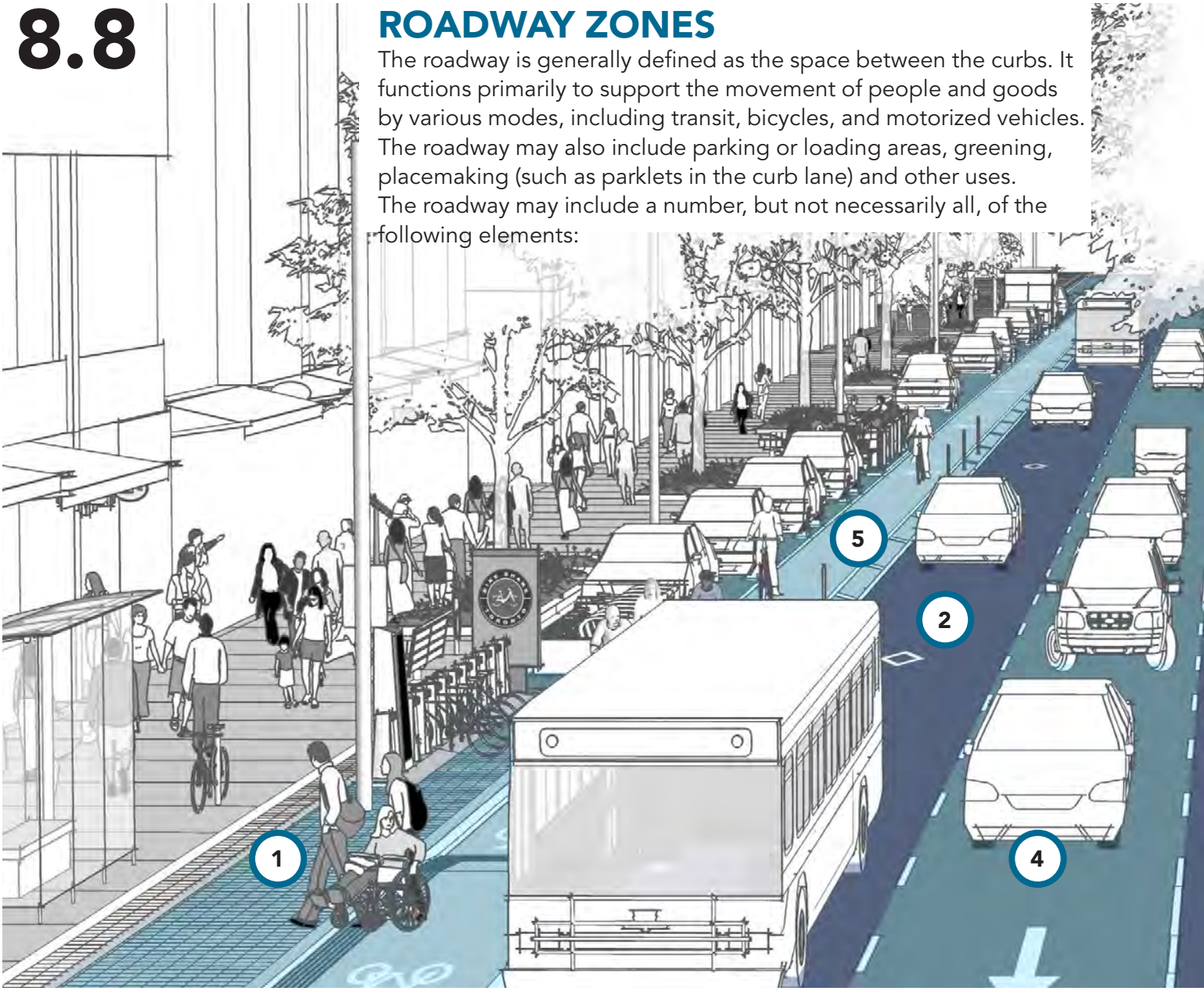


Traffic island on Armadale Avenue.

8.8

ROADWAY ZONES

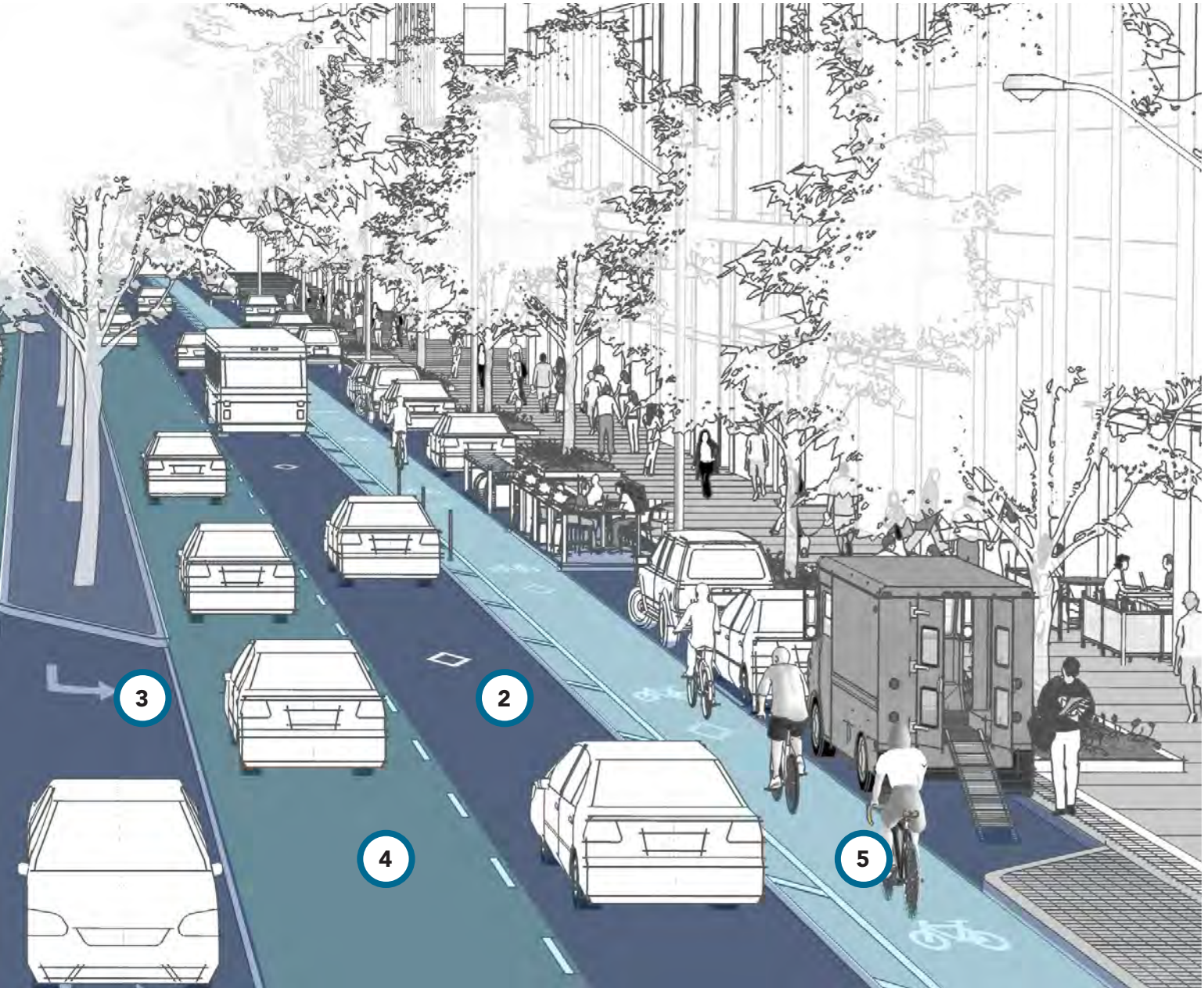
The roadway is generally defined as the space between the curbs. It functions primarily to support the movement of people and goods by various modes, including transit, bicycles, and motorized vehicles. The roadway may also include parking or loading areas, greening, placemaking (such as parklets in the curb lane) and other uses. The roadway may include a number, but not necessarily all, of the following elements:



For illustrative purposes.

1. Curbside Space. The area next to the curb is the space that is often in high demand by diverse and competing uses, such as cycling facilities, public transit (boarding/disembarking), accessible parking, parking/pick up/drop-off, delivery vehicles, driveways, access to buildings, on-street parking of various types, parklets or curb extensions, waste/recycling collection and snow storage.

2. Transit Lanes. These lanes, if present, could share a centre or curb lane with other vehicles (for example High Occupancy Vehicle Lanes) or act as fully dedicated transit only lanes or facilities. The width of these lanes will need to accommodate transit vehicles (buses, streetcar, or light rail transit). See Chapter 6 on Transit for design guidance.



3. Turn Lanes and/or Medians. If present, painted or built medians in the centre of the roadway may provide for a number of different uses including lane separation, Left Turning Lanes, Pedestrian Crossing Islands, and space for streetscape elements on wider medians such as planting, public art and public space (e.g. University Avenue).

4. Vehicle Lanes. These lanes serve vehicular movement, including thru and turning movements. The width of the lanes depends on many factors and is informed by street context and priority network requirements such as transit routes or routes with high truck volumes.

5. Cycling Infrastructure. Depending on the street's context (including vehicular speeds and volumes), there may be cycling facilities in the roadway that are demarcated by pavement or physical separation from moving motor vehicles. Depending on the context, these cycling facilities may be located curbside, or separated from the curb by a row of on-street parking. See Chapter 5 on Cycling for design guidance.

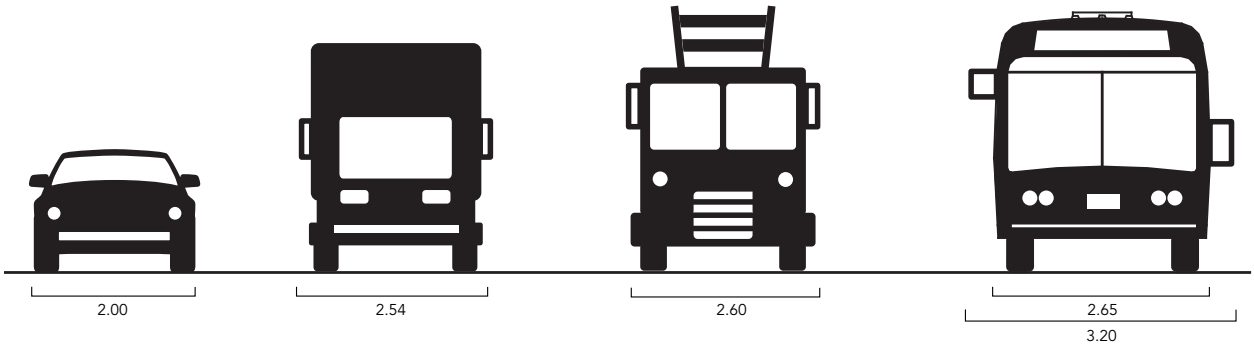


Figure 8-8: Drawing of Typical Road User Dimensions for four different types of vehicles: cars, delivery trucks, fire trucks and TTC buses.

Context is a key factor in the City's approach to vehicle lane widths.

Signal retiming is an important part of the City's Congestion Management Plan.

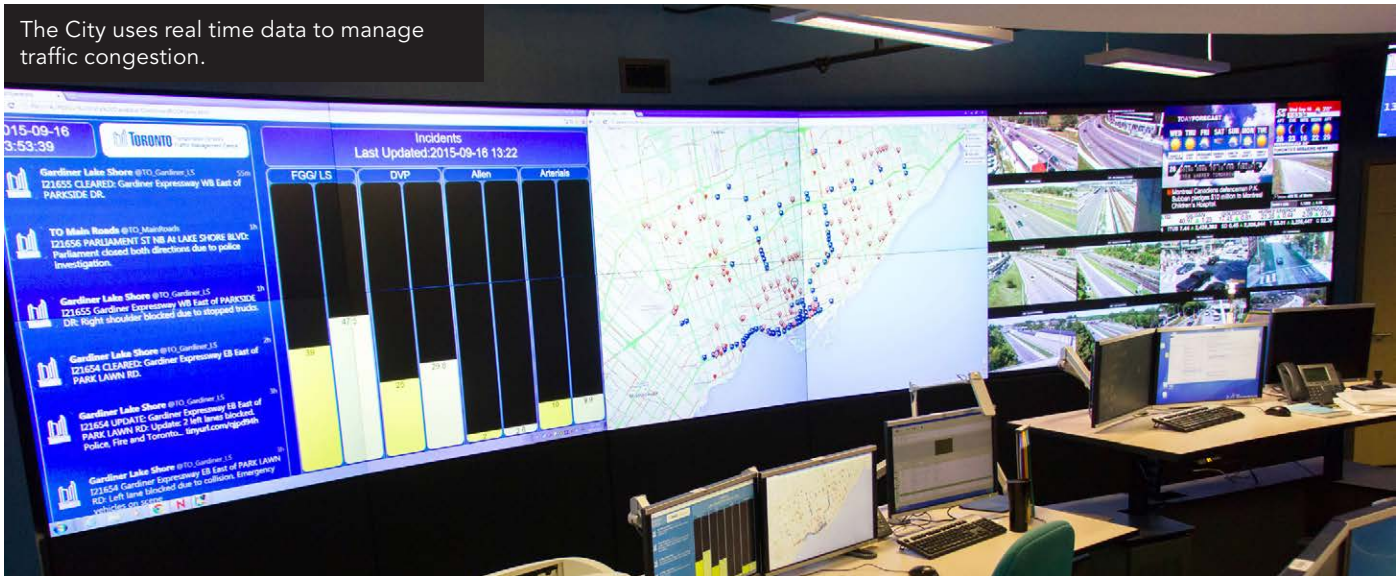
VEHICLE LANES

Vehicle lanes are typically striped to delineate the path of travel for vehicles along a street. They serve the movement of people and goods by various modes. The City of Toronto's Lane Width Guidelines provide guidance on selecting the context-appropriate lane widths in order to improve safety, consider all road users, and balance roadway space for other competing uses.

Travel lane widths can range from 3.0m to 3.5m depending on context and constraints, including land uses; presence of pedestrians, cyclists, and transit; truck volumes; emergency services; posted speed; on-street parking; etc.. Curb lane widths depend on whether there are cycling facilities – if there are not dedicated cycling facilities, the curb lane width should still be designed to enable a car to safely pass a cyclist on the roadway.

HIGH OCCUPANCY VEHICLE (HOV) LANES

Lanes marked with signs and markings to indicate which vehicles are permitted to travel in the lanes. HOV lanes are intended to provide travel time incentives to people who carpool, use public transit or ride taxis, motorcycles or bicycles, so that limited space on city streets is optimized by moving more people in HOV lanes as well as reducing emissions and air pollution. HOV lanes are accompanied by hours of operation (typically during morning and afternoon peak travel times) and occupancy requirements that consider efficiency and use of the lanes. The City's Congestion Management Plan includes reviewing HOV lane locations and ways to improve their use and benefits.



The City uses real time data to manage traffic congestion.

CONGESTION MANAGEMENT

The City of Toronto's Congestion Management Plan 2014-2018 sets out numerous activities to manage traffic congestion to benefit travellers, businesses and the environment. These include traffic management on arterial roads (e.g., Main Streets, Mixed Use Connectors, etc.) and using different technologies (e.g., intelligent transportation systems, upgrading the city's signal system) and partnerships to improve efficiency and coordination on the City's transportation network.

EMERGENCY SERVICES AND OPERATIONS

Roadway design must consider the space and operational needs of first responders such as fire, paramedics and police. Fire trucks are the largest emergency response vehicles and need accommodation in the design of roadways. They must have adequate space in the roadway to access structures and fire routes; deploy apparatus, equipment, and personnel safely and efficiently; and provide passable (drivable) space to ensure effective, timely and safe emergency response. For example, in some instances, the transitway may be used as a route for first responders.

One of the potential benefits of the complete streets approach is to improve safety of all road users and to reduce the incidence and severity of crashes to which paramedics, police and fire must respond. Collaborative and innovative efforts exist among city departments to address response times, including system planning for dispatch locations, use of real-time data for traffic congestion, navigation technologies, signal operations and street design considerations.

Space efficient modes help to reduce motor vehicle congestion.

Designs must consider the space and operational needs of fire services and paramedics.

Taxi stands are one of the many potential curbside uses. Curbside space will vary based on context, and may be flexible by time of day, season, or location on the block.

On-street parking in a lay-by.

Seasonal bike parking corral.

CURBSIDE SPACE

The area next to the curb is in high demand for many different uses including access and movement. The uses will vary widely depending on street context and span transit lanes; on-street parking for bicycles, motorcycles, and automobiles; loading/unloading for goods; pick up and drop off including accessible boarding and disembarking; taxi stands, food trucks; parking for film, music and tourism; and collection and storage of snow and solid waste/recycling. It can also be used for an extension of the sidewalk and boulevard zone, for example for parklets. Depending on street context, it can also be space that is used for mobility options for dedicated cycling facilities, transit lanes and stops or high occupancy vehicle lanes. This space can also be treated in a flexible manner through regulation (time of day restrictions for parking) and/or street design (e.g. curb extensions, parklets or laybys).

Since there are many demands from many users for the limited space in this zone, curbside design and management often involves making collaborative trade-offs. It begins with an understanding of the competing demands for its use and the overall context, including the use and design of the whole street such as the adjacent buildings and public spaces.

PARKING

Parking serves an important need for motorists, persons with disabilities and cyclists as well as for the film, music and tourism industries, accessing destinations and can be supplied off-street (e.g., parking lots or garages) and on-street (e.g., temporary, pick up/drop off spots, metered or permitted parking).

Medians help to manage access and provide space for green infrastructure. It is critical to consider impacts on emergency access, maintenance access and costs.

Landscaped mid-block curb extensions.

Traffic island with seating for transit users and new tree plantings.

CURB EXTENSIONS (MID-BLOCK)

A curb extension is where the curb extends out and expands the sidewalk beyond the typical curb alignment. Curb extensions should be considered where on-street parking exists, as the extensions can be on either side of the on-street parking and provide street space for features such as benches, trees and plantings (for stormwater management), surface transit stops, and multi-unit bicycle racks to increase parking. Curb extensions also provide an unobstructed location for fire hydrants that do not have the risk of access being blocked by illegally parked cars. When street elements are installed in curb extensions, it is important to plan and design to maintain sightlines for safety.

PEDESTRIAN CROSSOVERS, MID-BLOCK CROSSWALKS, AND PEDESTRIAN REFUGE ISLANDS

These are discussed in Chapter 4 on Pedestrians.

MEDIANS OR RAISED ISLANDS

Medians or raised islands separate lanes or directions of traffic within the roadway using pavement markings or raised concrete islands. Medians may be applied for different reasons – they can be used to manage or restrict access, provide space for turn lanes (and turning vehicles), facilitate pedestrian crossings, placemaking and provide space for greening. Their application and dimensions depend on many considerations. Since medians typically require a wider right-of-way, the practitioner needs to weigh the benefits of a median against using the space to support other uses and facilities (e.g., curb extensions, cycling facilities, sidewalk and boulevard widening for pedestrians and streetscaping). In addition, medians or raised islands can impact emergency vehicles accessing properties and intersecting side streets, which should be considered in design options.

The design and installation of "soil cells", the underground system to help trees grow, must be coordinated with the location and access of any underground utilities.

Street lighting supports road safety and personal security.

LIGHTING

Street lighting is directed towards roadways and also sidewalks, and is critical at intersections and crosswalks. Lighting supports road safety for all users and enables road users to see each other. Streets with higher intensity of use, such as Civic Streets and Main Streets, will have higher illumination levels than lower intensity streets, such as Park Streets and Residential Streets, which receive lower illumination levels.

UTILITIES AND THE ROADWAY ZONE

Utilities in the roadway can be found at the surface (e.g., catch basins) and below ground (e.g., pipes, ducts, conduits and chambers for water, wastewater, stormwater, electric, telecommunication, and gas). Proactive planning and coordination among various city partners, external organizations and developers will help identify opportunities to site utility elements where they will support design objectives and operational expectations. It is essential to address utility design and engage utility companies early in the street design process.

MORE INFORMATION

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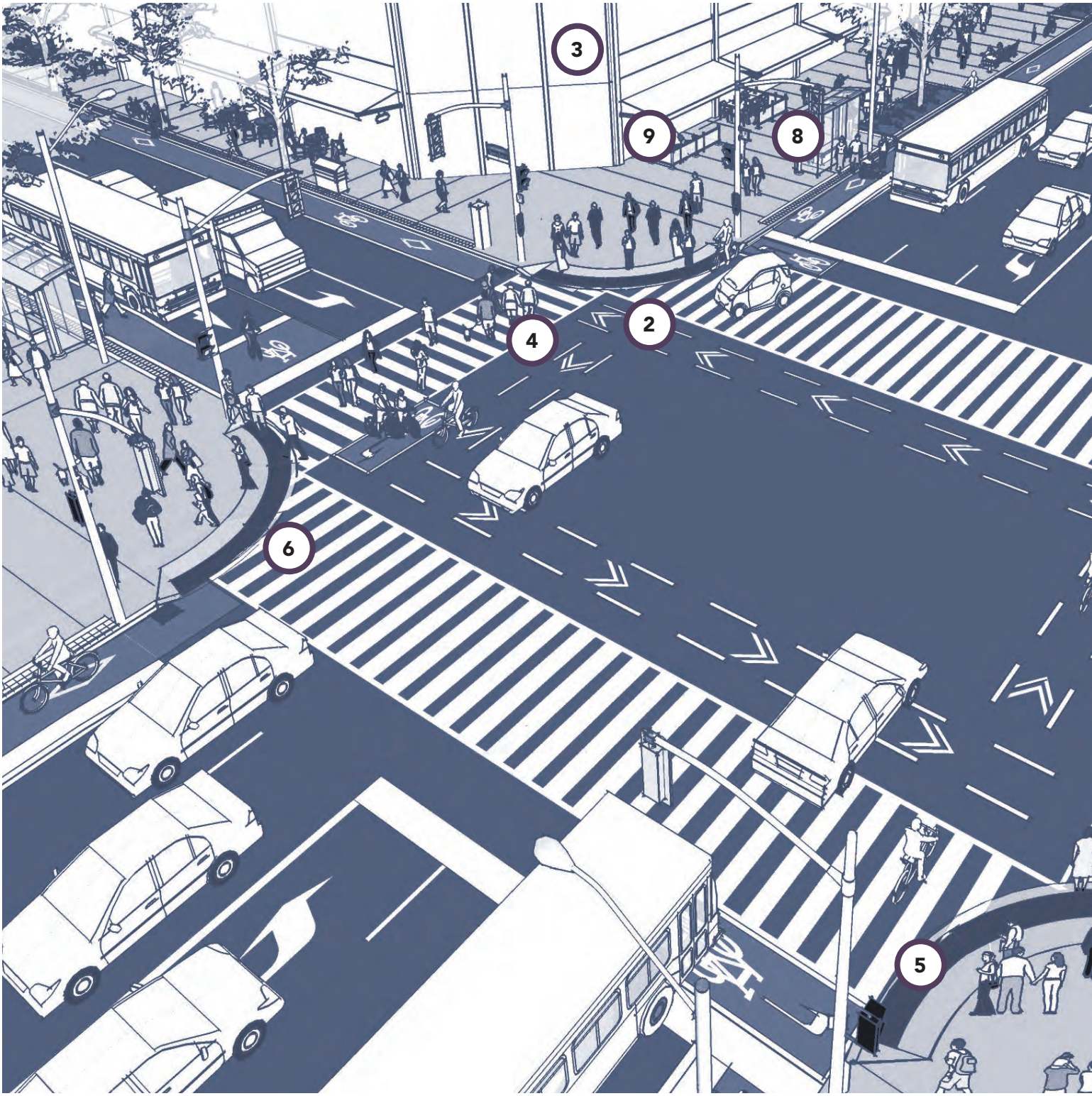
- Toronto Hydro. Design and Construction Guidelines for Street Lighting. Anticipated 2017


obn
OUTDOOR BROADCAST NETWORK
SEARS
Eaton Centre
SEARS
DOWNTOWN

Intersections are where streets meet – these locations generate a lot of interaction and potential conflict among all modes. The principles outlined in this section enable the design of intersections to function well for everyone, to create an environment that is safe and predictable. A key starting point is to understand the primary needs of each modal user. Some street elements that improve the conditions for one mode may reduce the comfort or convenience of another, but these should never supersede the need for safety of all road users, especially of the most vulnerable. Street context will inform intersection design, including the physical space and budget constraints. The street design process will ensure full consideration of the needs of various users and help to weigh the benefits and drawbacks of different intersection features.

9.0 STREET DESIGN FOR INTERSECTIONS

9.1 INTERSECTION DESIGN PRINCIPLES



For illustrative purposes.

1. Safety first: Intersections are where the most points of conflict occur between different street users. The design of intersections should first ensure safe crossing for the most vulnerable users.

2. Predictability: Provide clear guidance for all users on where crossing movements are expected and the correct path of permitted movements. Simplify complex intersections where possible.

3. Visibility: Ensure unobstructed sightlines among road users at intersections. Locate crosswalks close to the intersection to improve the visibility of pedestrians to drivers. Reduce physical barriers and visual clutter.

4. Multi-modal: Select traffic controls based on equitable consideration of all street users, the street's context and role in the network. Analyze capacity from a multi-modal perspective, focusing on movement of people, rather than vehicles.

5. Accessibility: Incorporate accessible design at intersections, such as tactile walking surface indicators, curb ramps or depressed curbs, accessible pedestrian signals, walk speeds at crossings for all ages and abilities, and access to transit stops, etc.

6. Compact design and shorter crossings: Compact intersections tend to lower motor vehicle operating speeds and enable more eye contact, which increases safety. They also minimize pedestrian crossing distances and exposure to risk for vulnerable road users. They can also shorten signal cycle lengths which benefits all modes by reducing delay and improving convenience.

7. Active transportation: Observe and anticipate pedestrian and cyclist desire lines to inform design based on street context. For example, provide depressed curb ramps and wider crosswalks in locations with higher pedestrian volumes, and bike boxes where needed to enhance safety for cyclists making turns.

8. Transit: Incorporate transit stops at intersections to allow for convenient transfers for transit users. Consider transit priority measures based on street context.

9. Placemaking: Depending on street context and width, repurpose space to enhance quality of life with greening, street furniture, or public art gateways, especially to define the entrance to unique neighbourhoods.

10. Maintenance and operations: Intersections should function well for all users all year, e.g. design to prevent ponding at ramps and snow from blocking access to pedestrian push buttons.

11. Manage stormwater: Incorporate green street elements depending on street context and width, such as on curb extension to reduce stormwater runoff and recharge ground water, improve air quality and beautify.

9.2 KEY NEEDS AND PERSPECTIVES OF EACH ROAD USER

The principles outlined in this chapter enable the design of intersections to function well for everyone, to create an environment that is safe and predictable. A key starting point is to understand the primary needs of each modal user. Keep in mind that some street elements that improve the conditions for one mode may reduce the comfort or convenience of another, but these should never supersede the need for safety of all road users, especially the most vulnerable.

PEDESTRIANS

- Lower motor vehicle speeds, by rightsizing vehicle lanes and curb radii, and traffic calming on local or side streets such as installing curb extensions or raised intersections.
- Reduced exposure to risk and conflicts, with clear sightlines and visibility, shorter crossing distances, adequate pedestrian space on corners, and adequate crossing time.
- Accessibility and universal design for all, with curb ramps or depressed curbs (for people using assistive devices or people with shopping carts or strollers), tactile walking surface indicators (for persons with low or no vision), accessible pedestrian signals, dedicated space (away from mixing with cyclists and vehicles), sufficient walk time for all ages and abilities, and adequate sidewalk and crosswalk widths given pedestrian volumes and the street context.
- Adequate signalized crossing opportunities.
- Desire lines inform crossings, so that crosswalks align with the path of travel.
- Placemaking considerations, based on street context, such as buildings that front on the street or have transparent storefronts (for "eyes on the street"), transit shelters and benches.

CYCLISTS

- Lower motor vehicle speeds, by rightsizing vehicle lanes and turning radii, and traffic calming on local or side streets such as installing curb extensions or raised intersections.
- Reduced exposure to risk and conflicts, with clear sightlines, shorter crossing distances, and dedicated space, separation and signal design for cyclists that are context sensitive.
- Guidance for safe streetcar track crossings, by providing markings at safe angles.
- Wayfinding on cycling routes and how to stay on the network and navigate routes, especially at complex intersections.
- Maintenance and materials to have pavement quality that reduces vibrations for cyclists.
- Nearby bicycle parking and Bike Share stations to support cycling options for people, especially at transfer points like transit or major destinations.

TRANSIT USERS

- Good pedestrian and cycling connections (see the previous sections), with sidewalks, transit shelters benches, nearby bicycle parking, and Bike Share stations, wayfinding, cycling route information, and regular maintenance (e.g., snow removal).
- Reduced exposure risk and conflict, such as curb extensions at bus stops, transit-only lanes and far-side bus stops.
- Accessibility for all with context-specific stop spacing, platforms, bus pads and sidewalk ramps with tactile walking surface indicators, and well-lit transit stops and adequate pedestrian clearway widths.

Pedestrians crossing a busy intersection in North York.

- Reliable and improved travel times and schedules, with context-specific measures such as frequent headways, signal priority, queue jump lanes, and seamless connection to other transit.
- Placemaking considerations, based on street context, such as buildings that front on the street or have transparent storefronts (for "eyes on the street"), safe, comfortable waiting areas and transit-supportive developments.

MOTORISTS (e.g. TRANSIT, CARS AND TRUCKS)

- Reduced conflicts and severity of crashes, with clear sight lines and visibility, dedicated space for all modes, and predictability of expected movements (e.g. using pavement markings, signage and signals/traffic controls).
- Safe turning options, with context-specific measures such as phase-separated turning movements, placement of advanced stop bars, and clearly marked turn lanes.
- Well-maintained intersections such as good pavement quality, pruned vegetation, and adequate levels of lighting.
- Wayfinding, with large visible street name signs and other wayfinding information to help people navigate the city, e.g. to locate reliable parking options.
- Reliable and improved travel times, using coordinated signal timing, responsive vehicle detection and signals, real-time information, traffic regulations and congestion reduction by shifting more trips to walking, cycling and transit.

Cycling facility is at sidewalk level for accessible boarding on transit at the intersection.

Cycling infrastructure in Toronto that promotes multi-modal mobility and safety.

9.3 ACCESSIBILITY AND UNIVERSAL DESIGN OF INTERSECTIONS

Intersection design is an important component of providing accessible and barrier-free environments for everyone. The following are some examples of accessible and universal design strategies to provide access, predictability, safety and convenience for people of all ages and abilities at intersections.

Depressed curbs smooth the transition from sidewalks to roadways.

Tactile Walking Surface Indicators are detectable underfoot and used as a warning for people with low or no vision.

CURB RAMPS OR DEPRESSED CURBS

To eliminate the need to step down from a curb to the roadway to cross at intersections, design intersections with adequately wide and properly designed curb ramps and depressed curbs at intersections. A curb ramp or depressed curb is needed for people with physical disabilities or even people using shopping carts or strollers. A fully depressed curb has the benefit of removing trip hazards (e.g., the section of curb between crosswalks), especially with high volumes of pedestrians. Curb ramps can also be found at transit stops, such as for the Light Rail Transit stops.

TACTILE WALKING SURFACE INDICATORS (TWSIs)

These are the flat-topped bumps detectable under foot that are used as warning or attention indicators for persons with low or no vision. TWSIs help warn someone with low or no vision that they are approaching a hazard such as moving traffic or the edge of a transit platform.

ACCESSIBLE PEDESTRIAN SIGNALS (APS)

These have an audible locator tone and also a walk indicator tone to indicate to persons with low or no vision when it is safe to cross the roadway and in which direction. APS may be activated automatically, or by push-button that has a tactile arrow aligning with the direction of crossing. This button vibrates when the pedestrian can cross for persons who are deafblind.

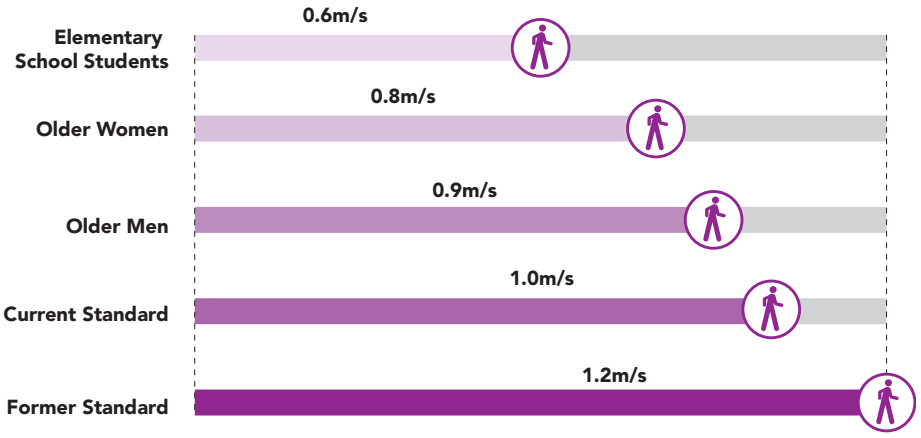


Figure 9-1: Not all pedestrians are able to cross the street at the same pace. Signal timing should consider context and most likely users.

c. L. Asher, M. Aresu, E. Falaschetti, J. Mindell (2012). Most older pedestrians are unable to cross the road in time: a cross-sectional study. Age and Ageing, Oxford Press; L. J. H. Schulze (2006). Evaluation of cross-walk timing and the application of a standard crossing light timing formula, International Ergonomics Association

WALK SPEEDS AT CROSSINGS CONSIDERING ALL AGES AND ABILITIES

Typical walk speeds when crossing the street are 1.0 to 1.2 metres per second (m/s), but this walking speed could exclude one-third of older pedestrians and 90 per cent of pedestrians using an assistive device such as a walker or cane. Where there are higher pedestrian volumes and the expectation of pedestrians with disabilities based on demographics and land use context, the walk speed for traffic signals should be in the range of 0.8m/s to 1.0m/s to enable safe crossings for people of all ages and abilities.

DEDICATED PEDESTRIAN SPACE (AWAY FROM MIXING WITH CYCLISTS AND MOTOR VEHICLES)

The hierarchy of vulnerable users has pedestrians at the top, because they are unprotected when encountering faster-moving road users such as cyclists, motorcyclists and drivers. At intersections and mid-block locations, it is important to provide dedicated space for pedestrians, and separation from cyclists and motor vehicles, whether on the sidewalk, at transit stops, and at intersections – on street corners and crosswalks.

ADEQUATE SIDEWALK AND CROSSWALK WIDTHS FOR THE STREET CONTEXT

Safe, passable space is needed to accommodate persons using assistive devices and the context-specific pedestrian volumes at intersections. Sidewalk and crosswalk widths should be commensurate with the intensity of pedestrian activity and volumes at intersections, to minimize crowded conditions, and potential conflicts among modes.