



Ontario Traffic Council

Multi-Modal Level of Service Guidelines

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The 2021 Multi-modal Level of Service guidelines (MMLOS guidelines) are an Ontario Traffic Council (OTC) reference manual containing the methodology for the evaluation of the level of service provided by streets and intersections to travellers using all modes of travel. The guidelines allow transportation professionals to make design and operational decisions for streets and intersections that align with municipal goals and network strategies.

The OTC MMLOS guidelines methodology is applicable to facilities operated by single, upper, and lower-tier municipalities across Ontario. The guidelines can be adopted by municipalities in their entirety or to act as a foundation for municipalities to generate or update their own MMLOS analysis methodology. The MMLOS guidelines are consistent with the intent of the Ontario Highway Traffic Act and reflect the current best practices in the Province of Ontario.

The methodology and recommendations of the MMLOS guidelines are intended to provide guidance over a broad range of situations encountered in practice. However, no manual can or should cover all contingencies or all cases encountered in the field. Therefore, field experience and knowledge of application are essential in deciding what to do in the absence of specific direction from the guidelines, and in overriding any recommendations in these guidelines.

The recommendations produced through the application of the MMLOS methodology contained in this document should be used with judicious care and proper consideration of the prevailing circumstances. The transportation practitioner's fundamental responsibility is to exercise good judgment in technical matters that are in the best interests of the public. The MMLOS guidelines are intended to assist in making those judgments, but they do not replace good judgment. Nor do they preclude context-specific design solutions that run counter to, or are not covered by, these guidelines, so long as the design judgement satisfies the test of good engineering judgment and is supported by provincial or local multi-modal transportation policy.

Every effort should be made to clearly document any departures from the guidelines in cases where the guidelines might not be met for sound reasons. This promotes transparency and accountability in the decision-making process where established processes are not followed in their entirety. The use of any of the recommendations or applications discussed in the MMLOS guidelines should be considered in conjunction with the contents of other industry-accepted standards, level of service (LOS) evaluation tools and related transportation policy, as appropriate.

The MMLOS guidelines do **not** replace detailed design guidance, but act as a supplement in the planning, functional design and operating phases. The detailed design process should be driven by municipal design standards and other industry-accepted standards produced by organizations like the OTC, the Transportation Association of Canada (TAC), the Ontario Ministry of Transportation (MTO) and the National Association of City Transportation Officials (NACTO).

The guidelines were developed following a review of national and international best practices in MMLOS analysis. OTC acknowledges that as the application of MMLOS guidelines will evolve over time, regular updates of these guidelines will be completed to ensure that this document reflects the best practices of the time.

Acknowledgments

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Project Team Members	Technical Committee (cont'd)
Shawn Doyle - Dillon Consulting Limited Mariam Bello - Dillon Consulting Limited (Formerly) Auja Ominski - Dillon Consulting Limited Matthew Ma - Dillon Consulting Limited Adam Lanigan - Dillon Consulting Limited (Formerly) Alice Bessol - Dillon Consulting Limited Justin Goulding - Mobycon Lennart Nout - Mobycon Angela van der Kloof - Mobycon	Joe Rocca - City of Greater Sudbury Jacqueline Hunter - City of Mississauga Patrick McMahon - City of Ottawa Robert Grimwood - City of Ottawa Jennifer Armstrong - City of Ottawa Eric Chan - City of Toronto Christopher Tam - City of Vaughan Selma Hubjer - City of Vaughan Maged Elmadhoon - Niagara Region Sulaf Alkarawi - Niagara Region Sabbir Saiyed - Peel Region Doug Robertson - Region of Durham Kornel Mucsi - Region of Waterloo Carolina Cautillo - Town of Innisfil John Kazilis - York Region Vi Bui - York Region
Technical Committee	
Geoff Wilkinson - Ontario Traffic Council (OTC) Andria Oliveira - City of Brampton Kaylan Edgcumbe - City of Burlington Jennifer Juste - City of Guelph Mike Field - City of Hamilton Steve Molloy - City of Hamilton Garfield Dales - City of London Sarah Grady - City of London	

1.0 Introduction

The Ontario Traffic Council (OTC) created these guidelines as a “made in Ontario” methodology to assess the performance of all travel modes on Ontario streets and to guide any required trade-offs between different users within a constrained right-of-way (ROW).



In this Chapter:

1. *What is MMLOS?*
2. *Definition of Modes*
3. *OTC Approach to MMLOS*
4. *Limits of OTC MMLOS Guidelines*
5. *Document Terminology*
6. *Legislative Authority*
7. *Best Practices Considered*
8. *How to Use This Document*





1.1 What is MMLOS?

Multi-modal Level of Service (MMLOS) analysis is a methodology for analyzing the level of service experienced by users of different modes along street segments and at intersections. MMLOS builds upon the traditional transportation engineering concept of level of service (LOS) used by municipalities, which is a way to evaluate an intersection's performance from the perspective of motorists.

Since traditional LOS evaluations focus on vehicle delay and congestion (through metrics like intersection delay and volume-to-capacity or v/c ratios), they classify intersections that enable efficient and convenient conditions for drivers as *well performing* and intersections that are congested as *poorly performing*. But this approach does not take into consideration how any other users experience the intersection or if the efficient movement of vehicles is even aligned with the intent of that intersection within a municipality's larger planning context.

As a result, the traditional LOS leads to design decisions that consistently prioritize the car above all other modes of travel. In response, an MMLOS approach offers municipalities a tool to evaluate and build streets that enable and encourage travel by modes other than the car.

1.2 Definition of Modes

The MMLOS Guidelines considers level of service for five modes:

- Pedestrians-includes assisted mobility
- Bicycles-includes micromobility and bike sharing
- Transit-includes surface LRT and trams
- Trucks-includes delivery service vehicles
- Cars-includes ride sharing and car sharing.



1.3 Ontario Traffic Council Approach to MMLOS

The OTC MMLOS guidelines establish the methodology for evaluating the level of service for all modes of travel on street segments and at intersections. The MMLOS guidelines assist in identifying design or operational elements that can be modified to improve user experience for different modes of travel to align with municipal goals and network strategies. The guidelines accomplish this through two broad steps:

1

Setting Targets

This step helps municipalities establish context sensitive performance targets for each mode along a variety of corridor types that align with their policy goals. These targets will later inform design and operational reviews.

2

Measuring Performance

This step provides a series of measures and metrics that allow practitioners to assess the performance of each mode in a corridor/at an intersection and identify the design and operational decisions needed to meet the established targets and, if required, make trade-offs.

Setting Targets provides a framework for practitioners to consider and document the context in which transportation projects occur, including, but not limited to, considerations of land-use, public realm, equity, climate change and other environmental considerations. Though these guidelines focus on what is in the control of a typical transportation project, and specifically the transportation elements, these other contextual considerations are of equal importance and as such warrant a voice in the process. [Chapters 3 and 4](#) describe the process of setting targets.

Measuring Performance provides tools for assessing Level of Service on segments and at signalized and unsignalized intersections. The Guidelines' approach to establishing performance measures and gradation metrics ([see Chapters 5 and 6](#)) seeks to measure the performance of a range of potential options and reflect the meaningful differences that exist within that range. A tool where too many options fall at one extreme or the other is likely not well calibrated to provide valuable feedback on the differences between options. In terms of the MMLOS guidelines, the gradations provide the measurement of each mode's experience and seek to identify meaningful points of difference across a range of options.

The approach taken for this tool is such that the majority of scenarios should result in scores approaching the middle of the range for each gradation. Targets and scores of LOS of A and F should be infrequent. The upper gradations in this tool (LOS A) have been calibrated to represent truly top-level experience for each mode. This LOS is likely to be rare and reserved for streets that place the highest priority on that given mode (and often do not include any emphasis on conflicting or competing modes). An LOS A is unlikely to occur in a "balanced" scenario, but rather ones that heavily favour certain modes. Conversely, LOS F represents a facility that does not meet industry accepted minimum standards for a variety of potential factors (e.g. safety, comfort, access, capacity, delay, etc.) and should typically not be targeted except in carefully considered circumstances.

1.4 Application/Limits of the OTC MMLOS Guidelines

1.4.1 Differences between Municipalities

The MMLOS guidelines are intended for the use of single, upper, and lower-tier municipalities across Ontario, regardless of size or land use context. The MMLOS guidelines are designed to be adoptable by municipalities in their entirety. In general, municipalities are recommended to make every effort to stay as close to the guidelines as possible to ensure consistency in evaluation of multi-modal user experience across Ontario.

It is acknowledged that Ontario contains a wide range of municipalities with different needs and contexts. Many municipalities may have their own in-house approaches to analyzing levels of service or to setting multi-modal performance targets for streets. Therefore, the MMLOS guidelines are also designed to be a foundation for municipalities to generate or update their own MMLOS guidelines and standards. Municipalities may choose to tailor the Street Types and/or Performance Targets presented in these guidelines to reflect local conditions and municipal goals/policies ([see Chapter 4](#)). Municipalities may also choose to tailor some of the Performance Measures presented in these guidelines to reflect locally established analysis methods. However, municipalities **are encouraged to adopt the gradations/metrics** ([see Chapter 6](#)) as published for the metrics identified in these guidelines to ensure consistency in evaluation of multi-modal user experience across Ontario. Additionally, the gradations in these guidelines are intended to reflect the current best understanding of user experience, which will not change significantly between locations and contexts.

It is recommended that municipalities create a set of local MMLOS guidelines to document any local modifications to improve transparency, traceability, and communication with stakeholders.

1.4.2 Scale/Focus of Analysis

The MMLOS guidelines are intended to be useful at two scales of analysis:

- At the corridor planning/functional design stage, the guidelines inform the conversations about modal priorities (i.e., setting the transportation goals for the street design), and aligning planned cross-section or design changes to reflect municipal goals and policies.
- At the operational stage, the guidelines can be used to understand the existing performance for all modes and to inform the development of desired design and operational changes, generally within the available property envelope.

Corridor planning/functional design studies typically include a program of stakeholder engagement whereas operational studies do not. Given this, corridor planning/functional design studies have the opportunity to collect input on LOS targets and some of the factors that influence targets (such as transportation equity – [see Section 3.5](#). They also can collect input on priorities and trade-offs if trade-offs are required).

These guidelines do not include analysis methods or parameters for network planning. They also do not replace existing existing detailed design parameters. The detailed design process should be driven by municipal design standards and other industry-accepted standards produced by organizations like the OTC, the Transportation Association of Canada (TAC), the Ontario Ministry of Transportation (MTO) and the National Association of City Transportation Officials (NACTO).



1.4.3 Operational Context of Streets

The measures and metrics in these guidelines apply to streets with posted speeds above 30 km/h and daily traffic volumes above 1000 vehicles per day that are operated and maintained by single, upper, and lower-tier municipalities across Ontario, regardless of size or land use context. In general, this will result in the guidelines being applied to collector and arterial roadways. However, the classification of a roadway may not always reflect its existing or planned operations, and as such streets classified as local should not be excluded based on their classification alone. As a guide focused on measuring the level of service of various users, the stated classification of a roadway does not impact their experience, but rather the traffic environment itself (along with other factors).

1.4.4 Looking Forward

This MMLOS tool provides measures and metrics to evaluate the impacts of projects that allocate or reallocate space in the right-of-way on the mobility experience of each mode. By necessity, an MMLOS tool is one that is intended to steer decisions looking forward, to improve the understanding of how competing interests are balanced by different design choices. While the MMLOS tools will be used to evaluate the existing condition (to establish a baseline for analysis of options and impacts) this tool should not be used to look backward and judge previous choices through the lens of today's attitudes towards mobility and best practices.

The need for an MMLOS tool comes largely out of a transportation planning and design paradigm that has been historically auto-centric, which has led to a lack of mobility choice and other negative impacts. Using this tool to measure the design of existing streets that are products of this past paradigm is likely to yield poor scores, particularly for active modes.

1.4.5 Duration of Analysis Validity

The analysis outlined in this version of the guidelines is valid unless any significant changes to the study area have occurred. The practitioner should review the analysis to validate its relevance and appropriateness in the present day.



1.5 Document Terminology

Note that throughout this document, the use of the following terms aligns with the accompanying definitions:

- The word “required” indicates an action that is necessary to meet the intent and be aligned with the process of the OTC MMLOS Guidelines.
- The word “should” indicates actions that are preferred when following the methodology. There may be context-specific reasons to deviate from the methodology and these must be well documented in the study.
- The adjective “encouraged” indicates actions that are recommended for each municipality using the OTC MMLOS Guidelines as the foundation for their local multi-modal analysis. However, these actions may be changed if the municipality is tailoring the OTC MMLOS Guidelines for their own local context.

1.6 Legislative Authority

The OTC MMLOS guidelines are consistent with the intent of the Ontario Highway Traffic Act and the Provincial Policy Statement (2020) under the Planning Act. For municipalities within the Greater Golden Horseshoe, the guidelines are consistent with the provincial growth plan (A Place to Grow, 2019). They also reflect the current practices for transportation planning and engineering in the Province of Ontario.

1.7 Best Practices in MMLOS Analysis

The development of the OTC MMLOS guidelines responds to the current lack of a standardized MMLOS tool in Ontario or nationally. Though several municipalities across Canada and North America have developed some form of an MMLOS methodology, there is no single generally agreed-upon methodology for MMLOS analysis that is currently used by municipalities across Canada.

The existing MMLOS tools used by other municipalities offered a range of insights and experiences to learn from. As such, the methodology, metrics, and targets of the OTC MMLOS guidelines built upon and/or were informed by MMLOS standards published or adopted by:

- City of Bellevue, WA, USA
- City of Calgary, AB, Canada
- City of Charlotte, NC, USA
- City of Fort Collins, CO, USA
- City of London, ON, Canada
- City of Ottawa, ON, Canada
- Florida Department of Transportation
- Global Designing Cities Initiative
- Halifax Regional Municipality, NS, Canada
- Mineta Transportation Institute
- National Cooperative Highway Research Program (NCHRP)
- Niagara Region, ON, Canada
- San Francisco Department of Public Health (SFPDH)
- Transportation Research Board (TRB)
- York Region, ON, Canada



1.8 How to Use these Guidelines

These guidelines include the underlying rationale and philosophies that led to the final methods for completing an MMLOS analysis.

Chapters that provide rationale and context/background:

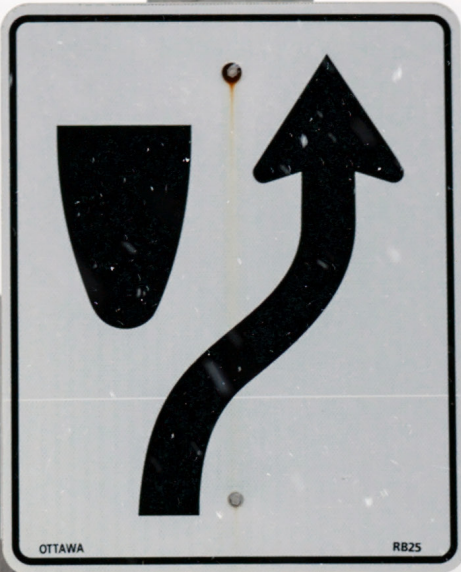
- **Chapter 1** describes the MMLOS Guidelines
- **Chapter 3** outlines the approach and rationale to setting targets
- **Chapter 5** outlines the approach and rationale to measuring performance/LOS.

Chapters that outline the MMLOS analysis methodology:

- **Chapter 2** guides practitioners on setting the scope for the analysis
- **Chapter 4** provides the methods to be used to set targets
- **Chapter 6** provides the methods to be used to measure performance/LOS
- **Chapter 7** provides the methods for making trade-offs
- **Chapter 8** guides practitioners in how to use the spreadsheet analysis tool.

Additional details on how to complete the MMLOS analysis as described in these guidelines can be found in the **Annex** and the User Guide that accompanies this document.

Figure 1.1 provides an overview of the steps for completing the MMLOS analysis featuring only the chapters that outline the MMLOS analysis methodology.



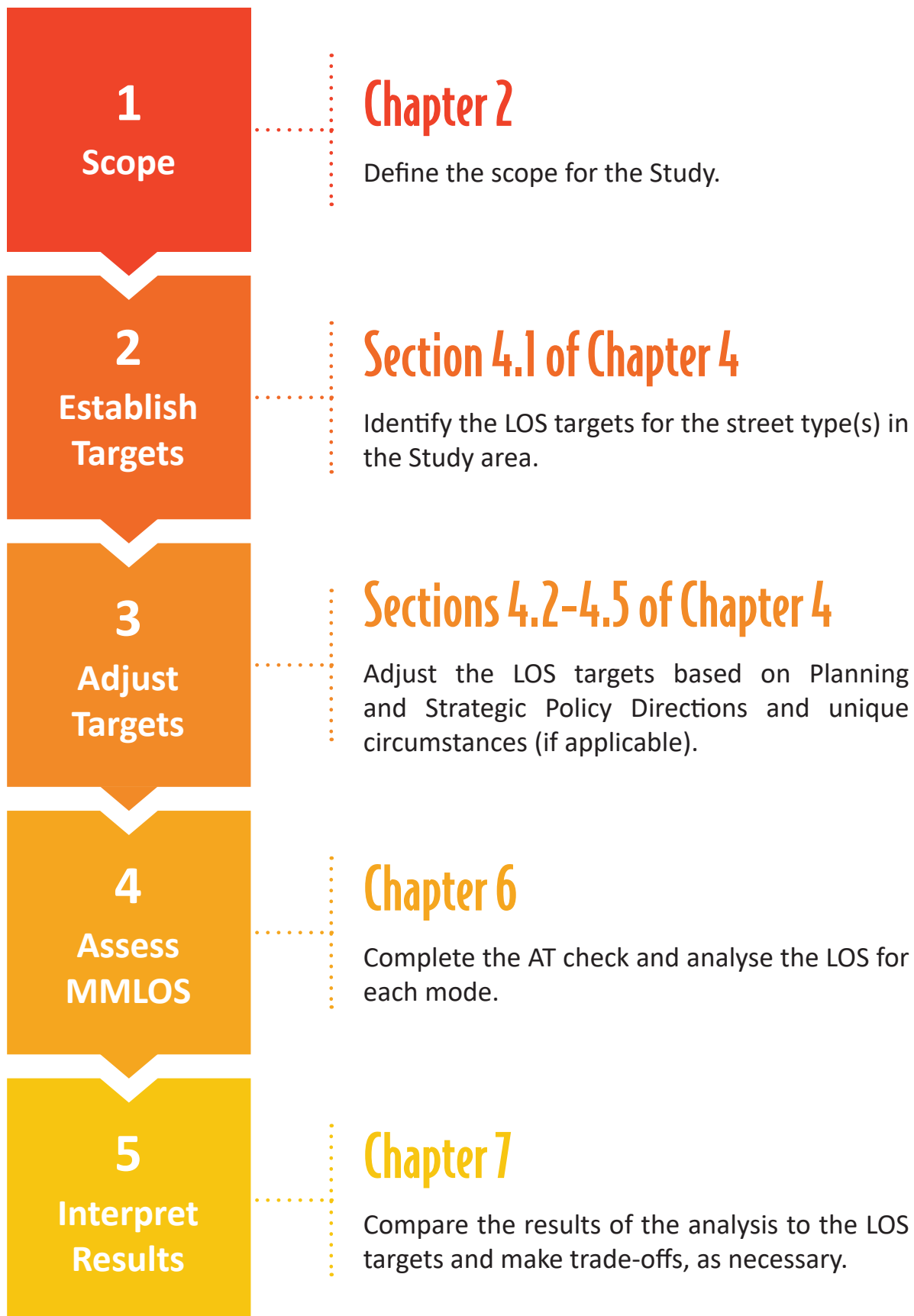


Figure 1.1: MMLOS Analysis Process

2.0 Setting the Scope for Analysis

This chapter guides practitioners on setting the scope for the analysis.



In this Chapter:

1. *Identify the Type of Study*
2. *Identify the Study Area*



2.1 Identify the Type of Study

A practitioner must first identify the type of study that's being completed – corridor planning/functional design or operational analysis. The OTC MMLOS methodology has similar, but slightly different approaches to analyzing streets at corridor planning/functional design stages as compared to the operational stage.

- **Planning projects** – corridor planning/functional design projects establish the priorities for each mode of transportation and the physical needs for future projects. Examples of corridor planning/functional design projects include (but are not limited to):
 - Environmental Assessments/functional designs (EAs)
 - Transit priority/HOV studies
 - Complete street transformation studies/designs
 - Secondary Plans (including Master Plan EAs)
- **Operations projects** – operational projects allocate space and time at the intersection and segment level on an existing street to align it with municipal goals and network priorities. Examples of operations projects include (but are not limited to):
 - Transportation/Traffic Impact Studies (TIS's)
 - Operational reviews/corridor optimization
 - Safety improvement studies



The OTC MMLOS findings could inform an improvement to the existing planning and operations data collection programs, which in turn could improve the next cycle of MMLOS review, forming a continuous improvement program.

2.2 Identify the Study Area

The practitioner must then define the study area for the analysis, including the segments and/or intersections (signalized or unsignalized intersections, excluding roundabouts) to be analyzed. Note that segments are the stretches of road between signalized intersections. A study area may include multiple segments and intersections.

A recommended study area should include segments that make up a corridor with **a consistent street function and adjacent land use**. This ensures that the recommendations of the MMLOS analysis support the intended role and function of a given street rather than fragment it. Points along a segment where the role and/or function of the corridor changes shall be considered points to 'split' the segment, separating it into two (or more) segments each with their own role/function.

Setting Targets



3.0 Approach to Setting Targets

This chapter describes the approach to set Level of Service targets for the MMLOS analysis. The approach acknowledges the fact that every street is different, with its own unique context, history, challenges, opportunities, role within the neighbourhood, and more. Because of this, there is no one “right” standard way to approach all street designs, even for those with similar contexts.



In this Chapter:

1. *Description of Levels of Service*
2. *Overview of Method for Setting Targets*
3. *Street Types*
4. *Adjustment Factors – Planning Directions*
5. *Adjustment Factors – Strategic Policy Directions*

3.1 Description of Levels of Service

Table 3.1 outlines qualitative descriptors of each LOS (A through F) for each of the modes. These descriptors are the basis for the targets that have been set in this MMLOS process, and should form the basis for any municipality to tailor their targets. These qualitative LOS descriptors are translated into quantitative LOS measures in [Chapter 6](#).

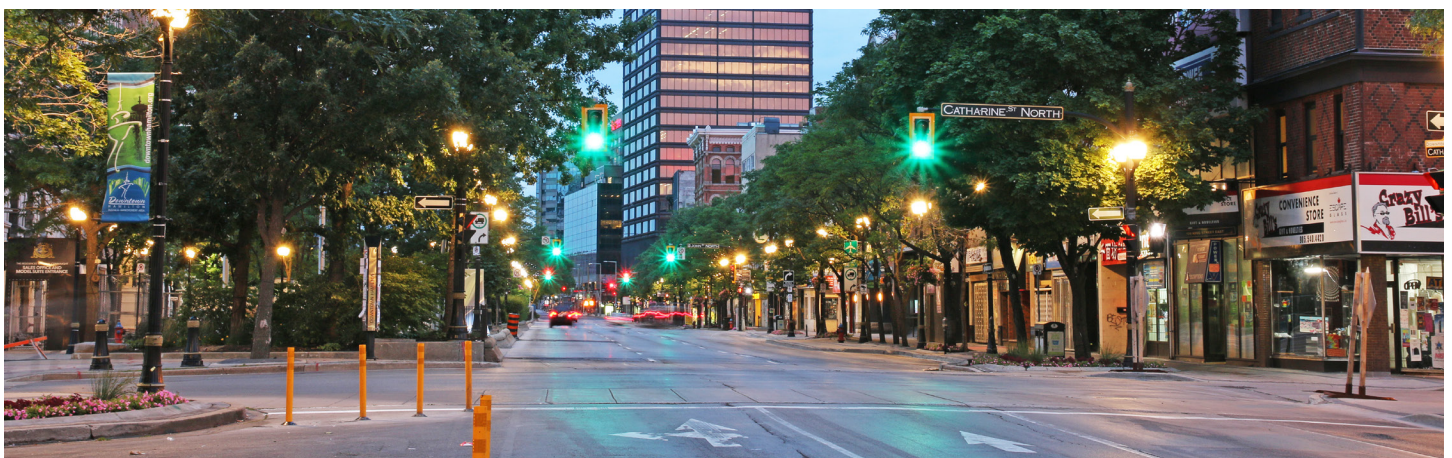


Table 3.1: Recommended MMLOS Targets

LOS Grade	LOS A	LOS B	LOS C	LOS D	LOS E	LOS F
	Provides the highest quality experience for a given mode	Provides a high-quality experience for a given mode	Provides a good-quality experience for a given mode	Provides a moderate-quality experience for a given mode	Provides just above the minimal targeted standard for a given mode	Provides the minimal targeted standard for a given mode
Pedestrians	<ul style="list-style-type: none"> • Pedestrians always have sufficient space to walk or roll in a social manner that is removed from traffic nuisance • Crossing distance and delay at intersections is always optimized for pedestrians • Crossing locations are always located with sufficient frequency to minimize detour 	<ul style="list-style-type: none"> • Pedestrians very often have sufficient space to walk or roll in a social manner that is removed from traffic nuisance • Crossing distance and delay at intersections is very often optimized for pedestrians • Crossing locations are very often located with sufficient frequency to minimize detour 	<ul style="list-style-type: none"> • Pedestrians often have sufficient space to walk or roll in a social manner that is removed from traffic nuisance • Crossing distance and delay at intersections is often optimized for pedestrians • Crossing locations are often located with sufficient frequency to minimize detour 	<ul style="list-style-type: none"> • Pedestrians occasionally have sufficient space to walk or roll in a social manner that is removed from traffic nuisance • Crossing distance and delay at intersections is occasionally optimized for pedestrians • Crossing locations are occasionally located with sufficient frequency to minimize detour 	<ul style="list-style-type: none"> • Pedestrians rarely have sufficient space to walk or roll in a social manner that is removed from traffic nuisance • Crossing distance and delay at intersections is rarely optimized for pedestrians • Crossing locations are rarely located with sufficient frequency to minimize detour 	<ul style="list-style-type: none"> • Pedestrians do not have sufficient space to walk or roll in a social manner that is removed from traffic nuisance • Crossing distance and delay at intersections is not optimized for pedestrians • Crossing locations are not located with sufficient frequency to minimize detour
Cyclists	<ul style="list-style-type: none"> • Cyclists always have sufficient space to ride in a social manner that is removed from traffic nuisance • Delay at intersections is always optimized for cyclists • Exposure to conflict at intersections is always minimized 	<ul style="list-style-type: none"> • Cyclists very often have sufficient space to ride in a social manner that is removed from traffic nuisance • Delay at intersections is very often optimized for cyclists • Exposure to conflict at intersections is very often minimized 	<ul style="list-style-type: none"> • Cyclists often have sufficient space to ride in a social manner that is removed from traffic nuisance • Delay at intersections is often optimized for cyclists • Exposure to conflict at intersections is often minimized 	<ul style="list-style-type: none"> • Cyclists occasionally have sufficient space to ride in a social manner that is removed from traffic nuisance • Delay at intersections is occasionally optimized for cyclists • Exposure to conflict at intersections is occasionally minimized 	<ul style="list-style-type: none"> • Cyclists rarely have sufficient space to ride in a social manner that is removed from traffic nuisance • Delay at intersections is rarely optimized for cyclists • Exposure to conflict at intersections is rarely minimized 	<ul style="list-style-type: none"> • Cyclists do not have sufficient space to ride in a social manner that is removed from traffic nuisance • Delay at intersections is not optimized for cyclists • Exposure to conflict at intersections is not minimized

LOS Grade	LOS A	LOS B	LOS C	LOS D	LOS E	LOS F
Transit	<ul style="list-style-type: none"> Transit riders' experience is always seamless and attractive Transit vehicles are never impeded by other traffic The pedestrian environment leading to transit stops provides the highest quality experience 	<ul style="list-style-type: none"> Transit riders' experience is very often seamless and attractive Transit vehicles are rarely impeded by other traffic The pedestrian environment leading to transit stops provides a high-quality experience 	<ul style="list-style-type: none"> Transit riders' experience is often seamless and attractive Transit vehicles are occasionally impeded by other traffic The pedestrian environment leading to transit stops provides a medium-quality experience 	<ul style="list-style-type: none"> Transit riders' experience is occasionally seamless and attractive Transit vehicles are often impeded by other traffic The pedestrian environment leading to transit stops provides a low-quality experience 	<ul style="list-style-type: none"> Transit riders' experience is rarely seamless and attractive Transit vehicles are very often impeded by other traffic The pedestrian environment leading to transit stops provides the minimal acceptable experience 	<ul style="list-style-type: none"> Transit riders' experience is not seamless or attractive Transit vehicles are almost always impeded by other traffic The pedestrian environment leading to transit stops is non-existent
Trucks	<ul style="list-style-type: none"> Driver is always able to navigate turns with minimal concern for infringing on other lanes or facilities Drivers never experience delay due to congestion 	<ul style="list-style-type: none"> Driver is very often able to navigate turns with minimal concern for infringing on other lanes or facilities Drivers rarely experience delay due to congestion 	<ul style="list-style-type: none"> Driver is often able to navigate turns with minimal concern for infringing on other lanes or facilities Drivers occasionally experience delay due to congestion 	<ul style="list-style-type: none"> Driver is occasionally able to navigate turns with minimal concern for infringing on other lanes or facilities Drivers often experience delay due to congestion 	<ul style="list-style-type: none"> Driver is rarely able to navigate turns with minimal concern for infringing on other lanes or facilities Drivers very often experience delay due to congestion 	<ul style="list-style-type: none"> Driver is not able to navigate turns with minimal concern for infringing on other lanes or facilities Drivers almost always experience delay due to congestion
Cars	<ul style="list-style-type: none"> Drivers never experience delay due to congestion Parking and loading options are always available where appropriate Dedicated turn lanes are always provided when warranted 	<ul style="list-style-type: none"> Drivers rarely experience delay due to congestion Parking and loading options are very often available where appropriate Dedicated turn lanes are very often provided when warranted 	<ul style="list-style-type: none"> Drivers occasionally experience delay due to congestion Parking and loading options are often available where appropriate Dedicated turn lanes are often provided when warranted 	<ul style="list-style-type: none"> Drivers often experience delay due to congestion Parking and loading options are occasionally available where appropriate Dedicated turn lanes are occasionally provided when warranted 	<ul style="list-style-type: none"> Drivers very often experience delay due to congestion Parking and loading options are rarely available where appropriate Dedicated turn lanes are rarely provided when warranted 	<ul style="list-style-type: none"> Drivers almost always experience delay due to congestion Parking and loading options are not available Dedicated turn lanes are not provided when warranted

3.2 Method for Setting Targets

Targets are set through a three step process:

1. Identify the Street Type and Base LOS Targets based on existing conditions ([see Section 3.3](#))
2. Identify and consider adjustment factors to the base LOS targets to reflect:
 - a. Planning directions for the corridor ([see Section 3.4](#))
 - b. Relevant global municipal plans and strategies ([see Section 3.5](#))
 - c. Targets set through previous planning exercises
3. Set final LOS Targets



3.3 Description of Street Types

Nine of the most common street types found in municipalities (based on role and function) have been identified as the backbone for the MMLOS evaluation process. These street types are described below. Generic street types have been used because municipalities have their own unique histories with naming types of streets.

Downtown Avenue

- A street through a high-activity central business area or urban core
- Moves moderate volumes of cycling, transit and vehicular traffic
- Priority on enhanced pedestrian environment; balances priority of other modes
- Width of vehicle zone is minimized
- Urban design is highest quality

Urban Main Street

- A community “Main Street” or “High-street”; adjacent land use is primarily retail or mixed-use commercial
- Moves moderate volumes of pedestrian, cycling, transit and vehicular traffic; might have transit priority features or lanes
- Balances priority between all modes
- Public realm is typically pedestrian (people) oriented; key local community destination
- Street design typically emphasizes access over mobility

Urban Boulevard

- A multimodal corridor through an urban neighbourhood
- Moves moderate volumes of pedestrian, cycling, transit and vehicular traffic
- Balances priority between all modes
- Adjacent land uses vary including residential, light commercial, schools, parks and community centres

Neighbourhood Connector

- Major mobility corridor that connects neighbourhoods
- Moves high volumes of vehicles over moderate distances
- Priority on vehicles and trucks; balances service to other modes
- Street design ideally has dedicated facilities for Active Transportation modes

Neighbourhood Main Street

- A community “Main Street” or “High-street”; street balances mobility and access
- Moves moderate to high volumes of cycling, transit and vehicle movements
- Balances priority of all modes
- Traditionally “auto-oriented” land use, but often subject to intensification or redevelopment
- Likely to have mixed, but predominantly commercial land-use

Neighbourhood Boulevard

- A multimodal corridor through a suburban neighbourhood
- Moves low to moderate volumes of cycling and vehicle movements
- Priority on cycling and pedestrian modes, balances other modes
- Adjacent land uses vary including residential, light commercial, schools, parks and community centres

Industrial Connector

- Major mobility corridor that connects industry with the surrounding areas and regional highway/freeway network
- Moves high volumes of vehicles and trucks over moderate distances
- Priority on trucks with typically limited pedestrian accommodation; balances service to other modes
- Adjacent land uses are often industrial/manufacturing

Industrial Boulevard

- A multimodal corridor through an industrial area that connects employees to jobs
- Moves moderate volumes of trucks, transit, cyclists and pedestrians
- Priority on trucks, balances other modes
- Adjacent land uses are often industrial/manufacturing

Rural Connector

- Major mobility corridor connecting rural areas to nearby urban centres
- Moves high volumes of vehicles and trucks over moderate distances
- Priority on vehicles and trucks, typically not served by conventional transit, and generally low accommodation for pedestrians and cyclists
- Adjacent land uses are typically rural uses (which may include agricultural, residential, or commercial)





3.4 Adjustment Factors – Planning Directions

Identifying the unique attributes, priorities, and goals of a community for a street early on will guide practitioners to decisions about what elements of the design to include in a limited ROW in a way that aligns with community values. Therefore, practitioners using the OTC MMLOS methodology must identify and record these unique attributes of their study area **before starting the analysis**. The identification process can be completed in collaboration with relevant municipal staff to ensure that the right objectives are identified and recorded.

Specifically, practitioners should identify and record the following for the study area:

- Planning priorities
- Modal priorities

3.4.1 Planning Priorities

Municipalities have long-term objectives for city-building and mobility in key corridors. These objectives - or *planning priorities* - are typically captured in a number of Council-endorsed or -approved planning documents (e.g., ambitious and strategic sustainable mode share targets for certain areas within the municipality, urban design plans for a neighbourhood or street, intensification goals for a district, etc.). Knowing these policy priorities gives practitioners clues about what kind of strategic objectives their street's design elements should be supporting.

Practitioners should record the study area's policy priorities at the start of the project by referring to relevant planning documents including (but not limited to):

- Applicable Secondary Plans
- Urban Design Guidelines and Public Realm Plans

3.4.2 Modal Priorities/Networks

Many municipalities designate certain corridors as priority routes for specific modes. For example some streets may be designated as truck routes, which are intended to enable the efficient movement of goods to, from, and through a community. Some streets may be key crosstown arterials that need to move large numbers of people in the peak periods, and others may run through dense urban cores that need to provide the highest quality pedestrian realms. Knowing which modes (if any) a municipality is attempting to prioritize within the study area helps practitioners understand what modes need to have the highest quality of service.

Two important things to note about mode priorities/networks:

1. The MMLOS guidelines support the creation of complete streets. Complete streets design principles fundamentally prioritize safety for all users over enhanced capacity or reduced delay. Though different modes will be prioritised in different corridors, this cannot come at the expense of safety for other modes.
2. Some modes are fundamentally inter-connected. Transit, for example, relies on good walking and cycling connections for transit riders to move between transit stops and front doors. Auto and truck network performance significantly overlaps at an operational level, as they run in the same space with little distinction between the two. Mode priorities for inter-connected modes should logically track.

Practitioners should record the study area's modal priorities at the start of the project by referring to relevant planning documents including (but not limited to):

- Transportation Master Plans
- Strategic plans for individual modes (e.g., Active Transportation Master Plans or Goods Movement Strategies)
- Transit Service Plans

3.5 Adjustment Factors – Strategic Policy Directions

Municipalities will also have a number of overarching priorities that will affect a given study area. Identifying the unique attributes, priorities, and goals of a community for a street early on will guide practitioners to decisions about what elements of the design to include in a limited ROW in a way that aligns with community values. Therefore, practitioners using the OTC MMLOS methodology must identify and record these unique attributes of their study area **before starting the analysis**. The identification process can be completed in collaboration with relevant municipal staff to ensure that the right objectives are identified and recorded.

Specifically, practitioners should identify and record the following for the study area:

- Policy priorities
- Equity priorities



3.5.1 Policy Priorities

Municipalities have a number of global long-term objectives for city-building and mobility. These objective - or *policy priorities* - are typically captured in a number of Council-endorsed or -approved planning documents that cover a diverse range of city-building practices. These policy priorities may include objectives like shifting mode share (e.g., reduce peak hour auto mode share by 15% by 2031), reducing impact of transportation on climate change, or others. Knowing these policy priorities gives practitioners clues about what kind of strategic objectives their street's design elements should be supporting.

Practitioners should record the study area's policy priorities at the start of the project by referring to relevant planning documents including (but not limited to):

- Official Plans
- Community-wide Strategic Plans
- Vision Zero and other Road Safety Plans
- Sustainability or Climate Action Plans

3.5.2 Equity Priorities

As municipalities work to transform mobility through physical changes, there is a growing understanding of the imbalance of priority and approach historically taken to planning transportation systems within different segments of communities. Mobility is a key quality of life determinant and existing systems do not always provide safe and convenient travel options to all people.

Some municipalities have developed targets or guidelines for rebalancing priority of travel modes, either generally or in specific neighbourhoods (e.g. the City of Toronto has identified 31 traditionally underserved neighbourhoods as Neighbourhood Improvement Areas (NIAs): each of the NIAs have specific neighbourhood planning strategies and action plans in response to resident and stakeholder-identified needs). Approved municipal policies and guidelines will be considered when setting targets for both corridor planning/functional design and operational studies. Where municipalities do not have established policies and/or guidelines, equity can still be considered in corridor planning/functional design studies through stakeholder engagement, establishing targets, and assessing priorities for the corridor. More detail on how to integrate equity into corridor planning/functional design studies is provided in [Chapter 4](#).

4.0 Method for Setting Targets

This chapter describes the calculations to set Level of Service targets for the MMLOS analysis.



In this Chapter:

1. *Establish the Base Level of Service Targets*
2. *Make Adjustments for Planning Directions*
3. *Make Adjustments for Strategic Policy Directions*
4. *Finalize Targets*
5. *Customize Targets*



4.1 Establish the Base Level of Service Targets

Table 4.1 contains the level of service targets for the nine street types that are the foundation of the MMLOS Guidelines. The targets were established based on a combination of best practices from transportation planning and engineering and contemporary knowledge around land-use and public realm planning. As transportation does not occur in a vacuum, the targets reflect the land use and activities they adjoin. Note: a single street/corridor can have different classifications (and thus, MMLOS targets) along its length when the function and/or adjacent land use of the street changes.

While the street types in **Table 4.1** cover the most common street types in Ontario, it is impossible to capture all of the diverse contexts and street types in a short list. Municipalities may choose to review, update (if necessary), and adopt the performance targets that make sense for their specific contexts.

Table 4.1: Recommended MMLOS Targets

	LOS Target				
	Peds	Bikes	Transit	Trucks	Cars
Downtown avenue	B	C	D	D	D
Urban main street	C	C	D	D	D
Urban boulevard	C	B	D	n/a	E
Neighbourhood connector	E	D	B	D	D
Neighbourhood main street	C	C	D	D	D
Neighbourhood boulevard	D	B	D	n/a	E
Industrial connector	E	D	D	B	D
Industrial boulevard	D	D	D	B	E
Rural connector	E	E	n/a ¹	D	D
Custom	X	X	X	X	X

1 Rural roads typically do not serve as transit route corridors where buses stop, which is what the Transit LOS is based on

4.2 Make Adjustments for Planning Directions

Planning directions are provided in a range of municipal documents. In general, the analyst is directed to consider the following adjustments to the base LOS:

- Where the street is identified as a priority corridor for a mode (in a TMP or Mode Plan), the target LOS should be increased by one grade.
 - E.g. for an *Urban Main Street* that is identified to be a Primary Truck Route, the target for Trucks should be increased to LOS C rather than LOS D.
- Where a significant change in the role and function of the street or the adjacent land uses is planned (e.g., the street is identified as an intensification corridor in the municipality's growth plan), appropriate increases or decreases to the base LOS targets should be considered.

Overall, the planning direction adjustments to Levels of Service should be limited to an increase or decrease of no more than one grade from the base LOS. The analyst is directed to document all source documents referenced in making adjustments for planning directions.

4.3 Make Adjustments for Strategic Policy Directions

Strategic policy directions are provided in a range of municipal documents. The strategic policy directions can be indirect in their impact on transportation mode priority and need to be interpreted before being applied to the LOS targets as adjustments (e.g., greenhouse gas reduction targets indicate support for lower LOS for cars and higher LOS for sustainable modes).

Overall, the strategic policy direction adjustments to Levels of Service should be limited to an increase or decrease of no more than one grade from the base LOS. The analyst is directed to document all source documents referenced in making adjustments for strategic policy directions.

4.3.1 Considering Equity Priorities

Practitioners should record the study area's equity priorities at the start of the project by completing actions such as (but not limited to):

- Referring to any data or strategies that the municipality maintains for traditionally underserved communities or neighbourhoods.
 - E.g. The City of Toronto has identified 31 traditionally underserved neighbourhoods as Neighbourhood Improvement Areas (NIAs). Each of the NIAs have specific neighbourhood planning strategies and action plans in response to resident and stakeholder-identified needs.
- Reviewing any relevant recent local news, initiatives, public surveys, etc. that come up when researching the study area.
- Considering and recording how specific design elements may disproportionately disadvantage a local population group.
 - E.g. eliminating a street design element that improves the experience for transit users in a low-income area where many transit riders are “captive” transit riders – people with no available mode alternatives for commuting.
- Considering how design decisions contribute to fostering age-friendly communities and respond to all-ages-and-abilities design approaches.
- Discussing the known community needs in the study area with municipal staff who have knowledge of recent community engagement initiatives and feedback.





4.4 Finalizing Targets

Consultants applying these guidelines as part of a TIS will need to submit their proposed targets to municipal staff for review and approval. It is recommended that these discussions take place before performance measurement is completed.

Municipalities will establish multi-modal targets for corridors as they gain experience with these guidelines. Targets set through previous studies should be considered to maintain consistency in planning and design decisions.



4.5 Customizing Targets

The OTC MMLOS guidelines have been designed to respond to the breadth of community contexts across Ontario, though is not able to capture the full diversity of land use and transportation contexts that manifest across the province. As such, providing jurisdictions the opportunity to customize their targets is the primary manner in which these guidelines can be tailored to better suit the local context. The following outlines the intended manner in which targets should be customized.

4.5.1 Unique Street Typologies

The street typologies presented in [Chapter 3](#) represent a broad spectrum of typical street typologies, but they are not definitive. If a municipality possesses a street typology that is not reflected in this list, custom street typologies may be created and corresponding targets assigned. It is recommended that targets be borrowed from the closest existing typology as a starting point, and adjusted slightly to reflect the differences present that necessitated a custom typology.

4.5.2 Unique Streets

Similar to where a whole street typology may be missing, individual corridors may possess significant deviations from the typologies presented. In this case, a custom set of targets may be established for an individual street. If this is desirable, it should be undertaken carefully, and the decision rationale well documented. All efforts should be made to fit the corridor within one of the existing typologies adopted, tailoring targets to individual streets too frequently can result in a process that lacks consistency, transparency, and accountability.

4.5.3 Unique Targets

Though the setting of modal targets in these guidelines are based on current industry best practices and understanding around transportation and land use, prioritization and balancing of modal priorities is at its core a policy choice. Where local policy significantly deviates from the complete streets approach to transportation taken in this guide, the targets may be calibrated to better reflect local policy. This policy calibration should occur at the *Street Target* level and not in the *Modal Targets*. If local policy places, for example, a higher emphasis on the pedestrian experience in a specific street typology, the target for that typology should be raised (e.g.: LOS C to LOS B) rather than adjusting the definition of LOS C.

The modal targets correspond directly to the technical criteria used to measure the MMLOS of a corridor ([Chapters 5 and 6](#)) and are based on a breadth of best practices. These targets and measures should remain consistent across the province in order to provide a common understanding and language around transportation performance.

Measuring Performance



5.0 Approach to Measuring Performance

This chapter describes the approach to the assessment of MMLOS. It presents the rationale for a design check on the Active Transportation elements of the design and the factors that are considered. It also presents the performance measures to be used to assess the Level of Service for segments, signalized intersections, and unsignalized intersections.



In this Chapter:

1. *Active Transportation Design Check*
2. *Performance Measures for Evaluating Level of Service*



5.1 Active Transportation Design Check

The first step in the performance analysis is the completion of a design check on the active transportation (AT) facilities. The OTC MMLOS methodology elevates the importance of safety (objective and subjective) for vulnerable modes by implementing a method that decouples the analysis of safety for active transportation users (e.g. presence of a sidewalk or a separated cycling facility) from the analysis of vehicle convenience (e.g. delay). The AT design check achieves this by screening the AT facilities and the roadway context before the LOS of active modes can be analysed. This is undertaken to help guarantee a minimum level or safety “floor” for all users, which should be inherent in the acceptable standards for all roadway designs.

The checks are based on best practices from the following guidance documents:

- Ontario Traffic Manual (OTM) Book 18 – Cycling Facilities
- Ontario Traffic Manual (OTM) Book 15 – Pedestrian Crossing Treatments
- Transportation Association of Canada (TAC) Geometric Design Guide for Canadian Roads
- National Association of City Transportation Officials (NACTO) Street Design Guides and “Don’t Give Up at the Intersection” complement to the *Urban Bikeway Design Guide*

The AT design check comprises segment and intersection checks for both pedestrians and cyclists. The pedestrian checks assess access to properties along the segments and ensuring the presence of crossings at intersections. The bicycle checks review the facility type based on vehicular speed and volume, as well as ensuring a continuous allocation of space through intersections.

While vehicular speed and volume play an important role in the overall experience of all active users, they are first and foremost the key drivers of safety and the willingness of users to occupy a facility. A facility that does not meet the current best practice guidance (and supporting evidence) around appropriate facility type based on roadway context is not considered to be usable by a broad range of users, and as such is not considered to provide service to that mode.

5.2 Performance Measures for Evaluating Level of Service

Table 5.1 contains the performance measures for MMLOS analysis. Not all measures are required for planning and functional design studies. Measures required **EXCLUSIVELY** for **operational analysis** have been highlighted in the table. Operational analysis includes measures related to time and distribution of time as an assignment of priority.

The methods for evaluating Level of Service outlined in this document use both time-based (i.e., operational) measures and non-time-based (i.e., design) measures. Combining these measures provides several advantages:

- Design measures are an indication of a more permanent state or enduring level of service for the modes of travel. They better reflect 24 hour conditions;
- Operational measures are an indication of the priority for mobility of travellers by each mode. They better reflect conditions during peak commuter hours.

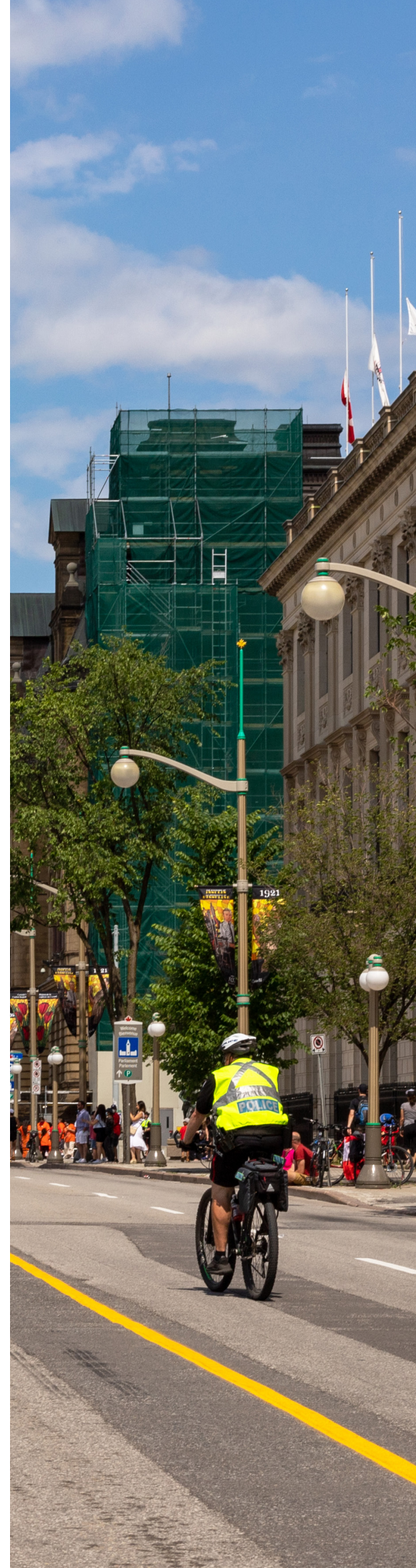


Table 5.1: Summary of Intersection and Segment Measures

	Walking	Cycling	Transit	Trucks	Cars
Segments	Pedestrian Facility Width	Bike Facility Width per Direction	Transit Facility Type	Width of Curb Lane	Mid-block V/C ratio
	Pedestrian Buffer Width	Bike Buffer Width	Presence of Transit Passenger Amenities	Car Level of Service	Curb Lane Conflicts
	Maximum Distance Between Controlled Crossings	Conflicts with Other Modes	Pedestrian Level of Service (as a measure of transit passenger access)		
Signalized Intersections	Enhanced Pedestrian Measures	Enhanced Bicycle Measures	Presence of Transit Priority Measures	Average Effective Turning Radius	Percentage of Turning Movements with Dedicated Lanes
	Average Effective Turning Radius	Average Effective Turning Radius			
	Signal Cycle Length ¹	Signal Cycle Length ¹	Transit Movement Delay ¹	Car Level of Service ¹	Intersection Delay ¹
	Number of Uncontrolled Conflicts ¹	Number of Uncontrolled Conflicts ¹	Pedestrian Level of Service ¹		
Unsignalized Intersections	Marked Controlled Crossings	Presence of Bike Facilities	Pedestrian Level of Service	Average Effective Turning Radius	
	Average Crossing Distance	Requirement to Stop			
	Average Effective Turning Radius	Average Effective Turning Radius			
			Transit Movement Delay ¹	Car Level of Service ¹	Intersection Delay ¹

¹ These measures are considered ONLY when completing **operational analysis**.

The rationale for the selected measures is presented below. Practitioners can refer to **Appendix A** for detailed calculation methodologies for each metric in [Table 5.1](#).

Segments

Pedestrians

Pedestrian facility width

- Facility width is a measure of comfort and accommodation for pedestrians
- All pedestrian facilities are, by definition, bi-directional
- Facility width needs to consider the requirements of mobility assistance devices and passing/overtaking
- Facility width should also consider that walking is often social and that people walking with others tend to walk side-by-side.

Pedestrian buffer width

- Pedestrian buffer width is a measure of comfort and environmental quality for pedestrians
- Separation from the adjacent vehicle lanes reduces nuisance impacts like noise, splash, fumes, etc.

Maximum distance between controlled crossings

- Maximum distance between controlled crossings is a measure of delay and convenience for pedestrians
- The maximum distance between pedestrian crossings has a considerable impact on the detour required for pedestrians when accessing amenities on the other side of the street, and resultantly the safety considerations of pedestrians choosing to cross mid-block without a dedicated crossing.

Bicycles

Bicycle facility width (per direction of travel)

- Facility width is a measure of comfort and accommodation for cyclists
- Bicycle facilities can be uni- or bidirectional, this measure is based on width per direction of travel.
- Bicycle facility width impacts the experience of cyclists in three key ways:
 - The ability to ride comfortably within the confines of the facility and avoid any obstacles that may be present
 - The ability to overtake another cyclist within the same facility
 - The ability to ride side-by-side with another cyclist so as to take advantage of the social nature of cycling.

Bicycle buffer width

- Bicycle buffer width is a measure of comfort and environmental quality for cyclists
- Separation from the adjacent vehicle lanes reduces nuisance impacts like noise, splash, wind gusts, fumes, etc.

Conflicts with other modes

- Conflicts with other modes within the bicycle facility is a measure of safety and comfort for cyclists
- Conflicts are caused by driveway crossings on a separated facility or by in-lane conflicts with vehicles sharing (loading), crossing, blocking a lane or bus stops.

Transit

Transit facility type

- Transit facility type is a measure of delay (and therefore priority) for transit.

Presence of transit passenger amenities

- Presence of transit passenger amenities is a measure of comfort and accommodation for transit riders.

Pedestrian level of service

- Pedestrian level of service is an indicator of the experience **for transit riders in the segment**
- Pedestrian levels of service indicate the level of comfort, safety, and delay for riders who are accessing or leaving the transit system at stops in the segment and represents a significant determinant to the overall transit experience.

Trucks

Width of curb lane

- Width of the curb lane is an indicator of comfort for truck drivers and safety for all vehicles
- Wider curb lanes allow trucks to maintain their lanes by providing space for minor maneuvering while avoiding friction with the curb.

Car level of service

- Car level of service is an indicator of vehicle experience in the intersections
- Truck safety and delay in the general stream of traffic tracks with car safety and delay.



Cars

Mid-block V/C ratio

- Mid-block V/C ratio is a measure of delay and convenience for cars and their occupants.

Curb lane conflicts

- Curb lane conflicts is a measure of safety and delay for cars
- Conflicts in the curb lane create the potential for collisions for drivers and other modes.



Signalized Intersections

Pedestrians

Enhanced pedestrian measures

- Enhanced pedestrian measures are an indicator of comfort and safety
- Pedestrians are more comfortable and their presence more conspicuous at intersections where enhanced pedestrian facilities exist

Average effective turning radius

- Average effective turning radius is a measure of safety and comfort for pedestrians
- Average effective turning radius has a strong influence on the speed of turning vehicles and therefore the comfort of pedestrians when crossing the roadway.

Signal cycle length

- Signal cycle length is a measure of delay (and therefore priority) for pedestrians
- Longer signal cycle lengths indicate a strong likelihood of longer average delays for pedestrians
- Pedestrians are the most heavily impacted mode by delay.

Number of uncontrolled conflicts

- Uncontrolled points of conflict are a safety and comfort concern for pedestrians
- Each point of conflict is a potential collision location and requires additional attention.

Bicycles

Enhanced bicycle measures

- Enhanced bicycle measures are an indicator of comfort and safety
- Cyclists are more comfortable and their presence more conspicuous at intersections where bicycle facilities exist
- Bicycle facilities also separate cyclists from vehicular traffic in time and/or space.

Average effective turning radius

- Average effective turning radius is a measure of safety and comfort for cyclists
- Average effective turning radius has a strong influence on the speed of turning vehicles which dictates cyclist comfort and safety when crossing an intersection.



Signal cycle length

- Signal cycle length is a measure of delay (and therefore priority) for cyclists
- Longer signal cycle lengths indicate a strong likelihood of longer average delays for cyclists
- Cyclists travel experience is strongly impacted by delay.

Number of uncontrolled conflicts

- Uncontrolled points of conflict are a safety and comfort concern for cyclists
- Each point of conflict is a potential collision location and requires additional attention.

Transit

Presence of transit priority measures

- Presence of transit priority measures is a measure of delay (and therefore priority) **for transit riders passing through the intersection**
- Transit priority measures reduce delay for transit riders
- Transit priority measures can be physical modifications, signal modifications and/or operational measures (e.g., transit exemptions from turn prohibitions).

Transit movement delay

- Delay experienced by vehicle movements serving transit vehicles is a measure of delay (and therefore priority) **for transit riders passing through the intersection.**

Pedestrian level of service

- Pedestrian level of service is an indicator of the experience **for transit riders boarding or alighting transit in close proximity to the intersection**
- Pedestrian levels of service indicate the level of comfort, safety, and delay for riders who are accessing or leaving the transit system at stops near the intersection.

Trucks

Average effective turning radius

- Average effective turning radius is an indicator of comfort for truck drivers executing right turns and safety for all travellers using all modes
- Larger average effective turning radii allow trucks to complete right turns at higher speeds and without tracking out of their lanes.

Car level of service

- Car level of service is an indicator of vehicle experience in the intersections
- Truck safety and delay in the general stream of traffic tracks with car safety and delay.

Cars

Percentage of turning movements with dedicated lanes

- Percentage of turning movements with dedicated lanes is an indicator of safety and delay for drivers
- Dedicated lanes allow vehicles passing through an intersection to avoid conflict with vehicles making a turn; similarly vehicles making a turn avoid conflict with through vehicles
- Turn lanes also reduce delay to vehicles passing through the intersection by separating them from vehicles slowing or waiting to make a turn.

Intersection delay

- Delay experienced by vehicles passing through the intersection creates a less desirable experience for drivers.



Unsignalized Intersections

Pedestrians

Marked controlled crossings

- The presence of marked controlled crossings (i.e. Pedestrian Crossovers, or PXOs) is a measure of delay and safety for pedestrians.
- Marked controlled crossings increase visibility and clearly indicate to drivers that pedestrians should be expected to cross.

Average crossing distance

- Average crossing distance for pedestrians is a measure of comfort and safety
- Pedestrians are exposed to collisions with vehicles when they are crossing intersections.

Average effective turning radius

- Average effective turning radius is a measure of safety for pedestrians
- Average effective turning radius has a strong influence on the speed of turning vehicles.

Bicycles

Presence of bicycle facilities

- Presence of bicycle facilities is a measure of comfort and safety
- Cyclists are more comfortable and more visible at intersections with dedicated facilities
- Bicycle facilities also physically separate cyclists from vehicular traffic.

Requirement to stop

- Requirement to stop is a measure of delay and convenience for cyclists
- The frequency of the need to stop and start is a significant determinant of cycling experience.

Average effective turning radius

- Average effective turning radius is a measure of safety for cyclists
- Average effective turning radius has a strong influence on the speed of turning vehicles.

Transit

Pedestrian level of service

- Pedestrian level of service is an indicator of the experience **for transit riders boarding or alighting transit in close proximity to the intersection**
- Pedestrian levels of service indicate the level of comfort, safety, and delay for riders who are accessing or leaving the transit system at stops near the intersection.

Transit movement delay

- Delay experienced by vehicle movements serving transit vehicles is a measure of delay (and therefore priority) **for transit riders passing through the intersection.**

Trucks

Average effective turning radius

- Average effective turning radius is an indicator of comfort for truck drivers executing right turns and safety for all travellers using all modes
- Larger average effective turning radii allow trucks to complete right turns at higher speeds and without tracking out of their lanes.

Car level of service

- Car level of service is an indicator of vehicle experience in the intersections
- Truck safety and delay in the general stream of traffic tracks with car safety and delay.

Cars

Intersection delay

- Delay experienced by vehicles passing through the intersection creates a less desirable experience for drivers.



6.0 Method for Measuring Performance

This chapter describes the calculations to assess MMLOS for segments and intersections.



In this Chapter:

1. *Active Transportation Design Check*
2. *Level of Service Evaluations*





6.1 Active Transportation Design Check

In order to pass the active transportation (AT) design check, practitioners must be able to answer YES to each of the checks laid out below. Facilities that do not meet the following checks should be demarcated with an X in the analysis which indicates that service is not provided for this mode.

Where facilities do not meet minimum guidance, mitigation measures to meet or exceed minimum guidance are required. If mitigation is not taken or the selected facilities continue to fall below current guidelines, the decision, accompanying rationale, along with any safety improvements to the existing condition should be recorded as part of the official project documentation.

6.1.1 Pedestrian Segments

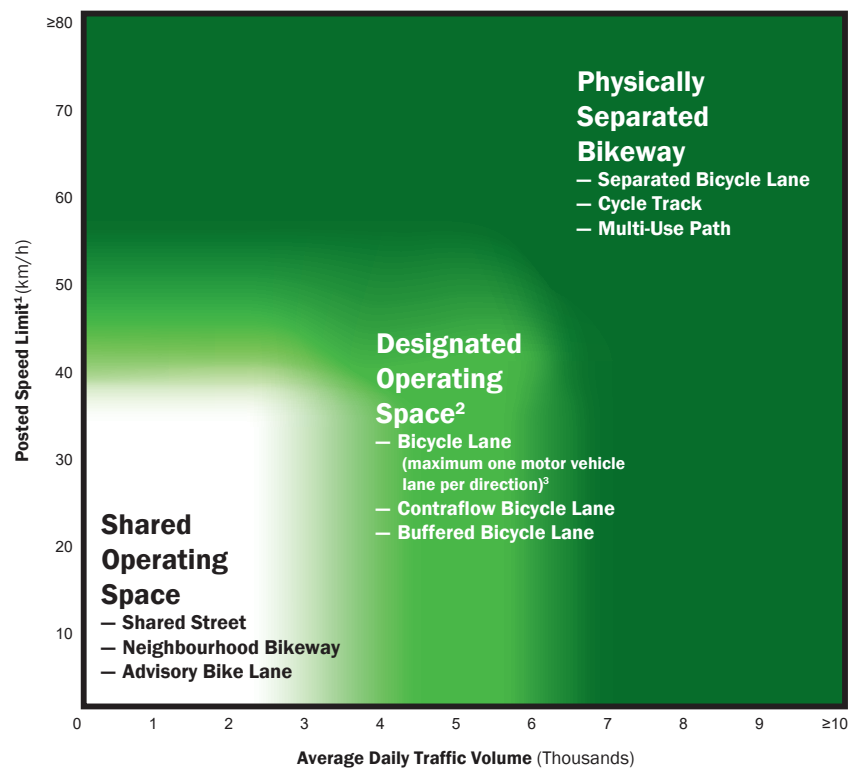
Access

Do the pedestrian facilities provide direct access to all properties along the segment? (Direct access can be provided by an adjacent facility or designated crossing to the property in question)

6.1.2 Bicycle Segments

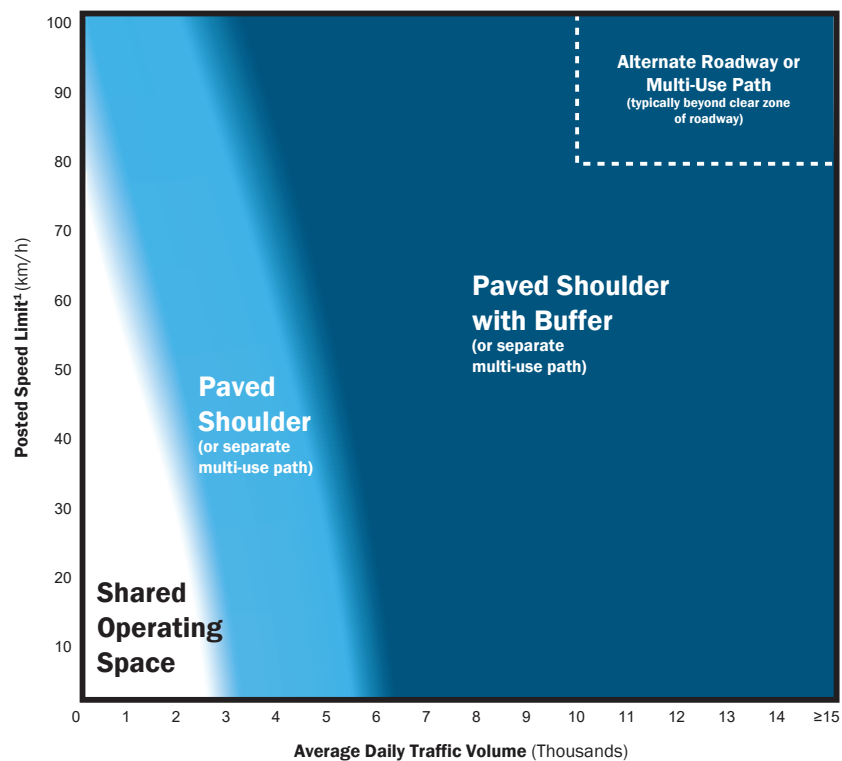
Separation

Does the bicycle facility selected correspond with the minimum appropriate facility type identified in the context appropriate nomograph (Figure 6.1, 6.2)?



- 1 Operating speeds are assumed to be similar to posted speeds. If evidence suggests this is not the case, practitioners may consider using 85th percentile speeds or implementing measures to reduce operating speeds.
- 2 Physically separated bikeways may always be considered in the designated operating space area of the nomograph.
- 3 On roadways with two or more lanes per direction (including multi-lane one-way roadways), a buffered bicycle lane should be considered the minimum with a typical facility being a physically separated bikeway.

Figure 6.1: OTM Book 18 Urban/Suburban Bike Facility Selection Tool (2021)



- 1 In rural town/hamlet/village contexts, the urban/suburban nomograph may be used.
- 2 Operating speeds are assumed to be similar to posted speeds. If evidence suggests this is not the case, practitioners may consider using 85th percentile speeds or implementing measures to reduce operating speeds.

Figure 6.2: OTM Book 18 Rural Bike Facility Selection Tool (2021)



6.1.3 Pedestrian Intersections

Continuity

Are marked pedestrian crossings provided to connect all approaching pedestrian facilities?

Accessibility

Have Accessibility for Ontarians with Disabilities Act (AODA) and municipal accessibility standards (if applicable) been considered?

6.1.4 Bicycle Intersections

Consistency

Does the approaching bike facility continue at a consistent width up to the edge of the intersection (crosswalk or curb edge of intersecting roadway)?

Continuity

Is a continuous amount of space and accompanying pavement markings delineated for cyclists through the intersection?

Connectivity

Does the intersection design provide features which facilitate all the intended turn movements for cyclists (e.g. bike boxes, queuing space, protected intersection, etc)?

6.2 Level of Service Evaluations

Tables 6.1, 6.2, and 6.3 present the gradation tables for the intersection and segment performance measures presented in *Chapter 5*. The tables organize the full range of possible inputs when analyzing MMLOS into regular intervals and assign an appropriate LOS grade, providing a meaningful differentiation between the LOS values for the purpose of comparison and analysis. The tables also present the weightings of each metric within each mode's analysis. More detailed descriptions of the measures and grades in the following tables can be found in the Annex and User Guide. Further, the Spreadsheet Analysis Tool discussed in Chapter 8 is designed based on the gradation tables below and can be used to assist practitioners in their analysis.

Table 6.1: Grades for Segment Measures

MODE	MEASURE	WEIGHT	LOS A	LOS B
PEDS ²	Pedestrian Facility Width (m)	33%	> 3.0	2.6 - 3.0
	Pedestrian Buffer Width (m)	33%	> 2.5	2.1 - 2.5
	Max Distance between Controlled Crossings (m)	33%	200 ³	201 - 230
BIKES ²	Bike Facility Width per Direction (m)	33%	> 2.4	2.2 - 2.4
	Bike Buffer Width (m)	33%	Has physical measures <u>and</u> buffer width > 1.0	Has physical measure <u>and</u> buffer width is 0.50 - 1.0
	Conflicts with Other Modes (In-lane conflicts and crossing point conflicts)	33%	Two “Low” conflict indicators	One “Low” conflict indicator and one “Moderate” conflict indicator
BUSES	Transit Facility Type	33%	Dedicated lanes	Intersection priority measures
	Transit Passenger Amenities	33%	Abundance of passenger amenities such as shelters, seating, shade trees, etc.	Moderate presence of passenger amenities such as shelters, seating, shade trees, etc.
	Pedestrian Level of Service	33%	A	B
TRUCKS	Width of the Curb Lane (m)	50%	> 4.0	3.9 - 4.0
	Car Level of Service	50%	A	B
CARS	Mid-Block V/C ratio	50%	< 0.60	0.60 - 0.69
	Curb Lane Conflicts (conflicts/km)	50%	None	1 - 2

1 For some measures, only a limited number of LOS scores are possible. The ones that cannot be obtained for that metric are marked as “n/a.”

2 For mixed AT facilities where pedestrians and cyclists share the operating space (e.g. multi-use paths, etc.) the facility should be scored based on the PED and BIKE metrics independently and the resulting scores discounted by one grade (ex: B -> C). This reflects the negative impact to the pedestrian and cycling experience that results from sharing the same operating space. It is noted that in areas of high pedestrian and bicycle activity that mixed-facilities should be avoided when possible.

3 Note there are also disadvantages to controlled crossings that are too close to one another which can result in collisions between vehicles and pedestrians. Refer to OTM Book 15 for further information on this.

LOS C	LOS D	LOS E	LOS F
2.1 - 2.5	1.8 - 2.0	1.5 - 1.7	< 1.5
1.6 - 2.0	1.3 - 1.5	1.0 - 1.2	< 1.0
231 - 260	261 - 290	291 - 320	> 320
1.9 - 2.1	1.6 - 1.8	1.2 - 1.5	< 1.2
n/a ¹	Has physical measures and buffer width is 0.30 - 0.49 <u>OR</u> Has no physical measures and width is ≥ 0.50	n/a ¹	No physical measures <u>and</u> buffer width is < 0.50
Two “Moderate” conflict indicators	One “Low” conflict indicator and one “High” conflict indicator	One “Moderate” conflict indicator and one “High” conflict indicator	Two “High” conflict indicators
n/a ¹	Mixed traffic with >1 lane/direction	n/a ¹	Mixed traffic with 1 lane
n/a ¹	Low presence of passenger amenities such as shelters, seating, shade trees, etc.	n/a ¹	No presence of passenger amenities such as shelters, seating, shade trees, etc.
C	D	E	F
3.7 - 3.8	3.4 - 3.6	n/a ¹	< 3.4
C	D	E	F
0.70 - 0.79	0.80 - 0.89	0.90 - 0.99	> 1.0
3 - 4	5 - 6	7 - 8	9 +

Table 6.2: Grades for Signalized Intersection Measures

MODE	MEASURE	WEIGHT	LOS A	LOS B
PEDS	Enhanced Pedestrian Measures	25%	> 1.0	0.76 - 1.0
	Average Effective Turning Radius (m)	25%	< 9.0	9.0 - 10.9
	Signal Cycle Length (s)	25%	< 60	61 - 75
	Number of Uncontrolled Conflicts (conflicts/approach)	25%	1.0	1.1 - 1.5
BIKES	Enhanced Bicycle Measures	25%	> 1.0	0.76 - 1.0
	Average Effective Turning Radius (m)	25%	< 9.0	9.0 - 10.9
	Signal Cycle Length (s)	25%	< 60	61 - 75
	Number of Uncontrolled Conflicts (conflicts/approach)	25%	1.0	1.1 - 1.5
BUSES	Transit Priority Measures	33%	Implementation of transit priority measures at all approaches for transit	n/a ¹
	Transit Movement Delay (s)	33%	0 - 10	11 - 20
	Pedestrian Level of Service	33%	A	B
TRUCKS	Average Effective Turning Radius (m)	50%	> 18	17 - 18
	Car Level of Service	50%	A	B
CARS	Percentage of Turning Movements with Dedicated Lanes	50%	85 - 100 %	60 - 84 %
	Intersection Delay (s)	50%	0 - 10	11 - 20

¹ For some measures, only a limited number of LOS scores are possible. The ones that cannot be obtained for that metric are marked as “n/a.”

LOS C	LOS D	LOS E	LOS F
0.51 - 0.75	0.26 - 0.50	0.01 - 0.25	0
11.0 - 12.9	13.0 - 14.9	15.0 - 17.9	≥ 18
76 - 90	91 - 105	106 - 120	> 120
1.6 - 2.0	2.1 - 2.5	2.6 - 3.0	> 3.0
0.51 - 0.75	0.26 - 0.50	0.01 - 0.25	0
11.0 - 12.9	13.0 - 14.9	15.0 - 17.9	≥ 18
76 - 90	91 - 105	106 - 120	> 120
1.6 - 2.0	2.1 - 2.5	2.6 - 3.0	> 3.0
Implementation of transit priority measures at a minimum of one but not all approaches for transit	n/a ¹	n/a ¹	No transit priority measures at any approaches for transit
21 - 35	36 - 55	56 - 80	> 80
C	D	E	F
15 - 16	13 - 14	11 - 12	< 11
C	D	E	F
35 - 59 %	10 - 34 %	n/a ¹	< 10 %
21 - 35	36 - 55	56 - 80	> 80

Table 6.3: Grades for Unsignalized Intersection Measures

MODE	MEASURE	WEIGHT	LOS A	LOS B
PEDS ¹	Average Crossing Distance (m)	33%	< 7.0	7.0 - 8.9
	Marked Controlled Crossings	33%	100% of movements	n/a ¹
	Average Effective Turning Radius (m)	33%	< 9.0	9.0 - 10.9
BIKES ¹	Presence of Bicycle Facilities	33%	Bike facility on all approaches	Bike facility on $\frac{3}{4}$ or $\frac{2}{3}$ approaches
	Requirement to Stop	33%	0 - 15 %	16 - 30 %
	Average Effective Turning Radius (m)	33%	< 9.0	9.0 - 10.9
BUSES	Transit Movement Delay (s)	50%	0 - 10	11 - 20
	Pedestrian Level of Service	50%	A	B
TRUCKS	Average Effective Turning Radius (m)	50%	> 18	17 - 18
	Car Level of Service	50%	A	B
CARS	Intersection Delay (s)	100%	0 - 10	11 - 20

¹ For some measures, only a limited number of LOS scores are possible. The ones that cannot be obtained for that metric are marked as “n/a.”

LOS C	LOS D	LOS E	LOS F
n/a ¹	9.0 - 10.9	n/a ¹	> 11.0
n/a ¹	n/a ¹	50% of movement	<50% of movements
11.0 - 12.9	13.0 - 14.9	15.0 - 17.9	≥ 18
n/a ¹	Bike facility on ½ or ⅓ approaches	n/a ¹	No bike facility
31 - 50 %	51 - 70%	71 - 85 %	> 85 %
11.0 - 12.9	13.0 - 14.9	15.0 - 17.9	≥ 18
21 - 35	36 - 55	56 - 80	> 80
C	D	E	F
15 - 16	13 - 14	11 - 12	< 11
C	D	E	F
21 - 35	36 - 55	56 - 80	> 80

7.0 Interpreting the Results

It is anticipated that many practitioners will complete the MMLOS analysis to find that they cannot meet the performance targets for all modes within the available ROW width. In such situations, practitioners should work with project stakeholders to determine the trade-offs that need to be made - determining which modes should be prioritized and improved and which modes should be allowed to fall below their desired performance targets. Practitioners should be guided by the following when making trade-offs:

1. Balance the deviation from the mode targets

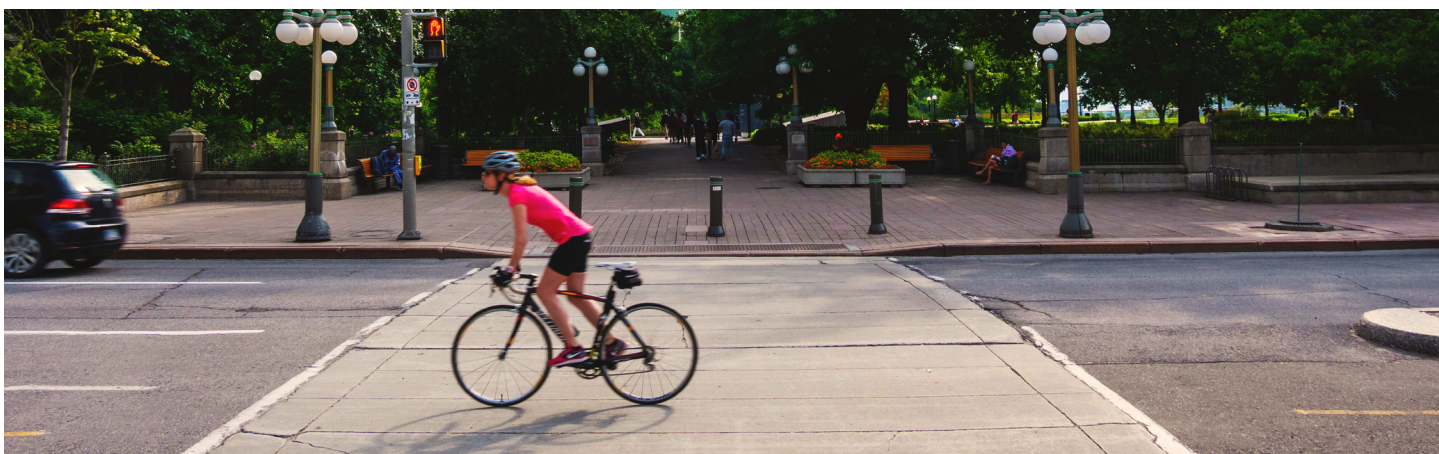
The mode targets have been set considering a comprehensive range of factors, including street context, mode priority plans, strategic municipal priorities, and others. Given this, the practitioner should attempt to meet all targets equally. Where variance from target cannot be avoided, the practitioner should look to balance the variation without prioritizing one mode well above the others.

2. Respect the guidance from approved strategic plans

First priority in making trade-offs should be given to all approved mode plans that were adopted within the last five years. Municipalities set these strategic plans while engaging with community residents, and expectations have been set.

3. Monitor effects on the transportation system

Set up a program to monitor how the system reacts to any changes made based on the outcomes of the MMLOS analysis. This will allow practitioners to identify changes that may need to occur in the future and iterate planning efforts.



8.0 Spreadsheet Analysis Tool

The MMLOS tool is intended to provide an intuitive, easy, and simple way for practitioners to assess various LOS for different transportation modes and determining the target LOS for each mode based on the context and location of the project. The main goal is to create a standardized tool that streamlines the evaluation and reporting process, reducing the hassle for practitioners to create separate tools for each different project and scenario. The ideal tool will have the following characteristics:

- Simple and easy to use
- Useful for a variety of stakeholders to view, analyze, present, and understand the results
- A highly expandable tool that can be applied to a diverse range of projects and scenarios
- Easy to maintain, change, and update
- Deliver information and results in an easy-to-understand and visualized format






With these characteristics in mind, a Microsoft Excel spreadsheet tool has been created to provide a standardized evaluation and reporting method that offers clear communication to a variety of stakeholders, both technical and non-technical. This section of the report provides an overview of how to maneuver, use, and apply the tool and an explanation of all the key elements in the tool.



Overview

The basic layout of the interface of the analysis tool is shown in [Figure 8.1](#).

Figure 8.1: MMLOS Tool Interface

Actual	C	B	D	D	C
SCENARIO: 1 Baseline Rd & Clyde Ave					
Area Type: Regional Connector 2					
MODE	 3				
Type 4					
SIGNALIZED INTERSECTIONS 5					
Target 6	C	B	C	D	D
Adjustment for Planning Direction	None	None	None	None	None
Reasons (if applicable) 7					
Adjustment for Strategic Policy	None	None	None	None	None
Reasons (if applicable)					
Actual 8	C	B	D	D	C
Active Transportation Design Check					
9 Are marked pedestrian crossings provided to connect all approaching pedestrian facilities?					Yes
Does the approaching bike facility continue at a consistent width up to the edge of the intersection (crosswalk or curb edge of intersecting roadway)?					Yes
Is a continuous amount of space and accompanying pavement markings delineated for cyclists through the intersection?					Yes
Does the intersection design provide features which facilitate all the intended turn movements for cyclists (e.g. bike boxes, queuing space, protected intersection, etc)?					Yes
MMLOS Evaluation					
10 Measure 1	Enhanced Pedestrian Measures	Enhanced Bicycle Facilities	Transit Priority Measures	Average Effective Turning Radius (m)	% of Movements with Dedicated Turn Lanes
	> 1	0.51 - 0.75	Implementation of transit priority measures at a minimum of one but not all	11 - 12	85 - 100%
Measure 2	Average Effective Turning Radius (m)	Average Effective Turning Radius (m)	Transit Movement Delay (s)	Car Level of Service	Intersection Delay (s)
	11 - 13	Less than 9	36 - 55	C	Larger than 80
Measure 3	Signal Cycle Length (s)	Signal Cycle Length (s)	Pedestrian Level of Service	-	-
	106 - 120	61 - 75	D		
Measure 4	Number of Uncontrolled Conflicts	Number of Uncontrolled Conflicts	-	-	-
	9 - 10	8 - 10			

The analysis tool is broken into the following elements and users should complete the analysis in the following order:

1. **Scenario Header:** This area allows analysts and practitioners to enter the project name or enter text that identifies the project and scenario to be evaluated. *Analysts should start the tool by first filling in the **Scenario Header** with the project or scenario name.*
2. **Area Type:** This field presents a drop-down list that allows analysts to select the appropriate area type or road type matching their studied scenario. After selecting the appropriate area type, the **Target** field will automatically lookup the appropriate target LOS for each mode.
3. **Mode (No Input Required):** The symbols here identify different modes included in the study. They are used to associate the inputs in the columns below.
4. **Intersection/Road Information:** This area allows analysts and practitioners to enter the specific intersection and road name that are about to be evaluated. Users can include details about the intersections, road names, and other relevant information in this field.
5. **Intersection/Road Type:** This field presents a drop-down list of 3 intersection and road types that analysts can choose from. Analysts will need to classify their studied scenario into one of the three available types: **signalized intersections**, **unsignalized intersections**, or **segments**.
6. **Target LOS (No Input Required):** Target LOS will be automatically adjusted based on the conditions (area type and intersection/road type) entered above. This row displays the target LOS for each mode of the study.
7. **Adjustments:** The adjustment fields provide opportunities and flexibilities for analysts and practitioners to adjust the target LOS based on local planning directions and policies. They can choose from a drop-down list to move up or move down their LOS target. In the **reasons** field, analysts are able to include a note to justify why they have chosen to move their LOS target up or down.





After completing all the above sections, analysts will see the finalized target LOS.

8. **Actual LOS (No Input Required):** Actual LOS is automatically calculated and determined based on the inputs entered in the columns below.
9. **Active Transportation Design Check:** Active transportation design check is a list of questions that focus on screening the active transportation facilities and the roadway context to ensure a minimum level of safety is achieved for all road users. Analysts can select “Yes” or “No” from the drop-down list to determine if they can proceed with the analysis of walking or cycling modes.

Note that if the analysts answered “No” for one or more of the cyclist-related questions, they will not be able to obtain the actual LOS results for the cyclist mode. A grey bar will block the corresponding “Actual” LOS field, which indicates no results will be displayed because the studied intersections or road segments failed one of the related active transportation design check questions. Improvements to the intersections or road segments will need to be made first before attempting the MMLOS tool again.

10. **Evaluation/Input:** This is the area where analysts enter data about the studied scenario based on field data collections, calculations, simulations, and any other analyses. There is a drop-down list for each measure where analysts can choose the appropriate option applied to their study.

The evaluation/input section includes up to four measures for each mode. Each has a header describing the specific measure applied to the corresponding mode. Each measure is controlled by a drop-down list with options or value ranges available for analysts to choose from. Based on the value entered for each mode and measure, the actual LOS will be automatically calculated and displayed.

After analysts finish inputting all the measures, they will be able to find the actual LOS results in the “Actual” row above. This will allow them to see if the actual LOS is meeting the target and decide if further changes need to be made to the intersection or road segment.



Glossary

Active transportation – modes of travel that use human activity to propel people forward, such as walking and cycling

Encouraged – a term in the OTC MMLOS guidelines that indicates actions that are recommended for each municipality using the OTC MMLOS Guidelines as the foundation for their local multi-modal analysis; these actions may be changed if the municipality is tailoring the OTC MMLOS Guidelines for their own local context.

Facility – infrastructure made specifically for users of a certain mode of travel (e.g. pedestrian facilities include sidewalks, multiuse pathways, etc.; cycling facilities include separated bike lanes, cycle tracks, multiuse pathways, paved shoulders in rural areas, etc.; transit facilities include transitways, transit-only lanes, the general roadway, etc.)

Level of service (LOS) – a metric obtained through analysis to describe the level of comfort and convenience to a given mode of travel; traditionally refers to the experience of vehicles only as calculated using the North American Highway Capacity Manual (HCM) methodology but can refer to the experience of other mode of travel when indicated (i.e. pedestrian LOS)

Mode – a way of moving people or goods, such as driving, taking public transit, cycling, walking, using heavy trucks, etc.

Multi-modal level of service (MMLOS) – a methodology that assigns LOS metrics for all modes of travel

Required – a term in the OTC MMLOS guidelines that indicates an action that is required to meet the intent and be aligned with the process of the OTC MMLOS Guidelines

Should – a term in the OTC MMLOS guidelines that indicates actions that are preferred when following the methodology; context-specific reasons to deviate from the methodology must be well-documented

Appendix





Ontario Traffic Council

User Guide for Multi-Modal Level of Service Guidelines

20-3587

2022



DILLON
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Segments



Pedestrians

Facility Width



The width of pedestrian facilities (e.g., sidewalks, trails) is a basic measure of the amount of walking space that is given to pedestrians along a road segment. This width is the foundational element that ensures pedestrians can move safely along the roadway.

The pedestrian facility width can be considered the space between the property line (or building face) and the edge of the roadway or boulevard, that is improved for use by pedestrians and is free of utilities, trees, parking meters, and other objects.

The intent for this measure is to quantify *the effective width available for walking and rolling* free of obstacles along the side of the roadway segment to assess its sufficiency for providing a safe walking environment.

The example demonstrates the basic measurement of pedestrian facility width, where there is a strong demarcation between the facility and boulevard space.

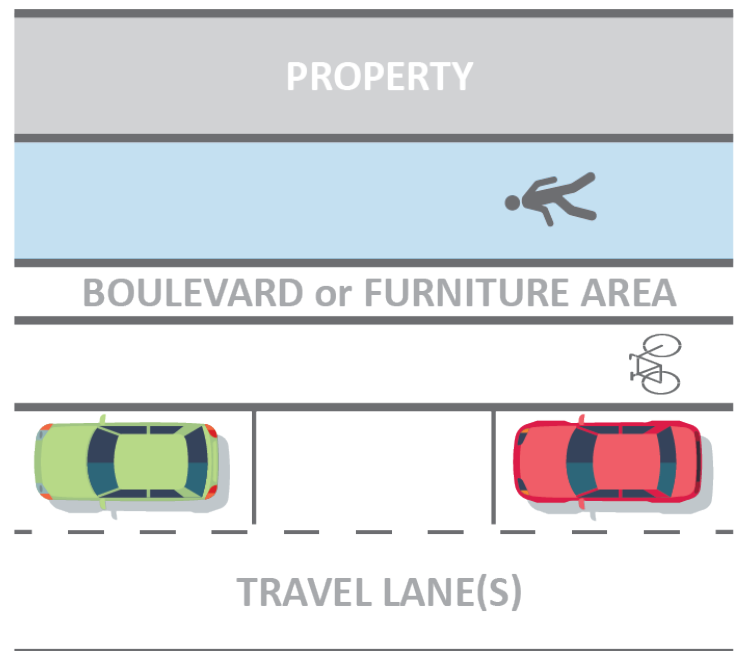
The separation between facility and boulevard may be indicated by differences in material (e.g., brick, grass, trees), but may not be obvious when both areas are comprised of the same material. To determine the pedestrian facility width, look for elements that reduce the effective width of the pedestrian facility for walking, such as parking meters, bike racks, and power poles. Such items would be located in the buffer, often referred to as a “furnishing zone” rather than the facility width.

Where there is variation along a segment, take the minimum width as a representative pedestrian facility width.

Improvements to the pedestrian facility width can be implemented through approaches such as: expansion to right-of-way boundaries; property acquisition; relocation of furnishings infringing on the facility; reduction of boulevard width; reduction of vehicle lane width; removal of vehicle lanes; removal of on-street parking; or, removal of bus lay-bys.

Remain cognisant of required minimums for vehicle and pedestrian facility types, transit stops, accessibility legislation, and other considerations.

Facility
Width



Pedestrians

Buffer Width



This is a measure of the overall pedestrian level of comfort and environmental quality as it considers the space provided to separate pedestrians from motor vehicles and other modes.

The buffer width can be considered the space between the edge of the pedestrian facility nearest the roadway and the edge of the nearest vehicular travel lane.

The intent of this measure is to quantify *the width of space between pedestrians and motor vehicle* traffic to measure the level of comfort of pedestrians on a given segment. Increasing the width of the buffer zone will create a more comfortable environment for pedestrians as it will increase the physical distance between pedestrians and motor vehicle traffics which has the benefit of decreased nuisance impacts of vehicle lanes such as noise, fumes, splash, etc.

The example shows the boundaries of the buffer zone, which includes a boulevard, cycle track, and an on-street parking lane. The parking lane provides greater space between pedestrians and moving vehicles and is therefore included in the buffer width.

As a general rule, the combined pedestrian facility width and buffer width should include the entire width of space where pedestrians can comfortably be found in a way that does not put them at conflict with motor vehicles on the roadway and which does not involve trespassing or loitering.

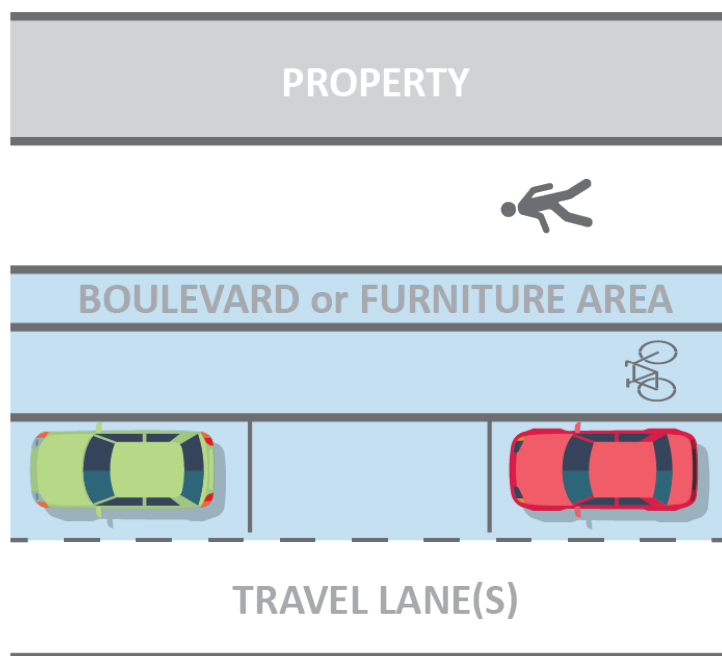
A buffer may take many forms, including but not limited to:

- Boulevard,
- Furniture zone,
- Cycling Facilities, and
- Parking protection.

Where there is variation in the buffer width along a segment, take a minimum of three measurements of width and calculate the average to produce a representative buffer width.

Approaches to increase the buffer width include: expansion to right-of-way boundaries, reduction of vehicle lane width, addition of parking, addition of cycling facilities, removal of vehicle lanes, removal of on-street parking, and property acquisition.

Buffer
Width



Pedestrians



Max Distance between Controlled Crossings

This measure considers the maximum distance between controlled pedestrian crossings along a given segment. Shorter distances between controlled crossings along a corridor are a significant determinant of the convenience and attractiveness of walking in comparison to other modes.

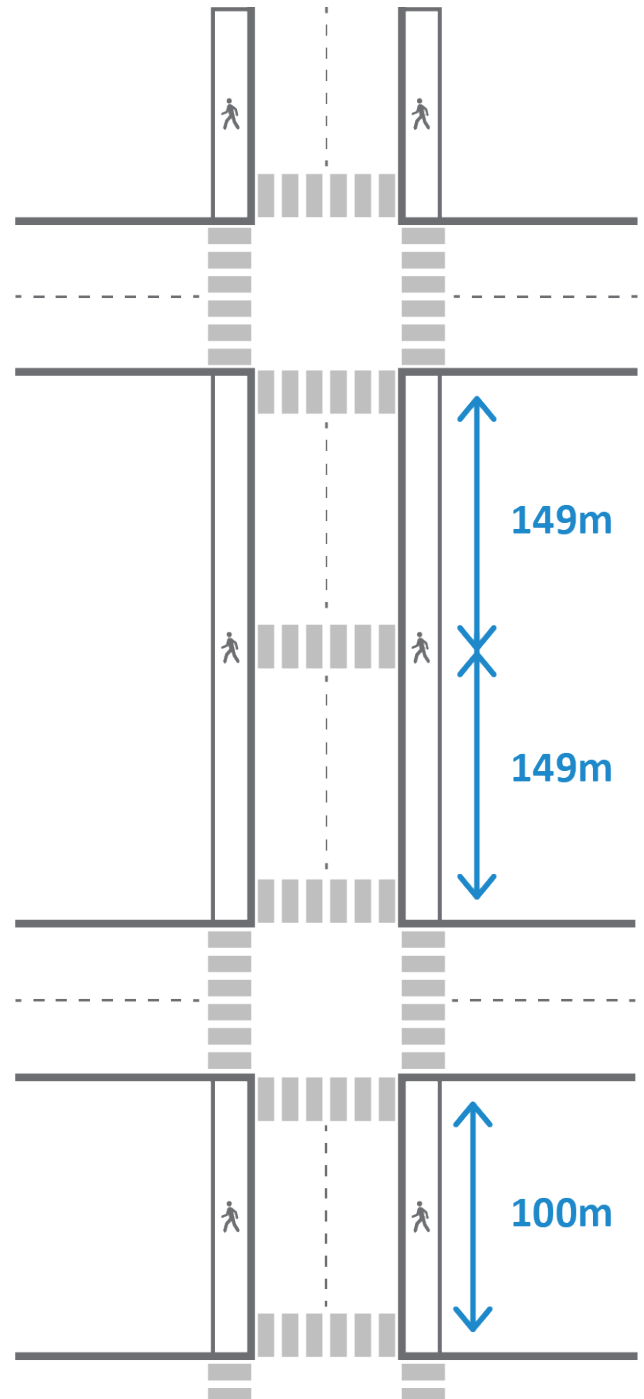
The intent of this measure is to quantify *the detour required for pedestrians to access destinations on the opposite side of the street*. Shorter distances between controlled crossings result in more direct routes for pedestrians to access a desired location or connect to the surrounding street network.

Controlled crossings in the Ontario context are defined as crossings where a traffic control exists and provides pedestrians with a safe and legal crossing point with priority over motor traffic. This can include at stop signs, signalized intersections, and Pedestrian Crossovers (PXOs).

To calculate, measure the distance(s) between controlled pedestrian crossings on the segment. The greatest distance is the one that shall be used to produce a score for this measure. Note that controlled crossings can be located mid-block and not only at intersections.

Measurements should be taken from centre of crossing to centre of crossing. It is possible that the length of the segment is equivalent to the max distance between intersections in cases where marked crossings exist only at the two ends of a segment. In the example, the max distance between controlled pedestrian crossings is 149m.

Two possible ways to improve the score for this measure include designing shorter street block lengths and introducing more PXOs along a corridor. However, a PXO should not be added simply to improve this measure if there is no practical purpose in doing so, such as in cases where there is no access to destinations on either side of the proposed crossing. It is up to the practitioner to use their best judgement and follow OTM guidelines to determine what is appropriate in such circumstances.



Bicycles

Facility Width



This measure considers the horizontal space, or width, available to a cyclist as they travel along a corridor and is conceptually similar to pedestrian facility width.

The cycling facility width can be considered the dedicated space available for cyclists to travel along a segment in a given direction. For a bike lane, it would be the width of the bike facility excluding the buffer area, whereas for a multiuse path it would be the width of the path in the direction of travel (i.e. one half the width of a bi-directional multiuse path).

The intent of this measure is to quantify *the effective width available for cycling* along a segment to assess its sufficiency for providing a safe and comfortable environment for cyclists. The wider the bike facility width, the more comfortable the street is for cyclists.

The example shows the boundaries of the bicycle facility where there is a clear demarcation between the cycling facility and the buffer area.

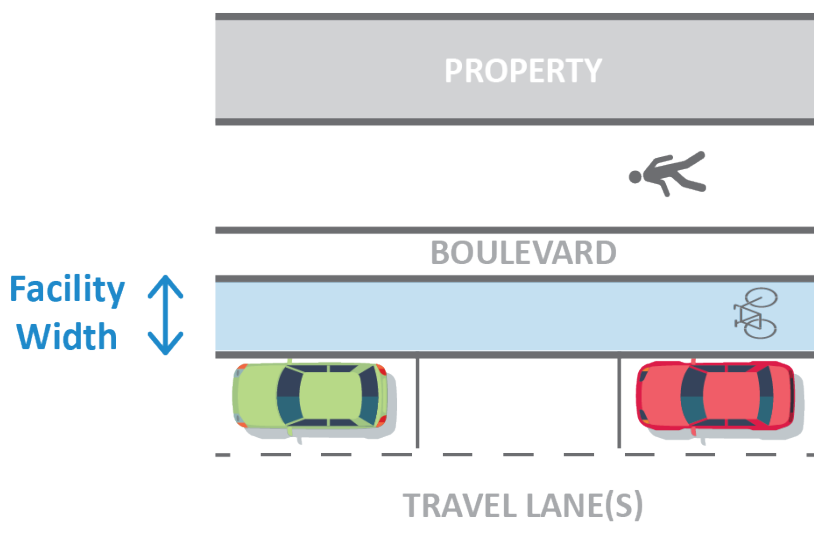
The separation between facility and surroundings may be indicated in a variety of ways, including but not limited to:

- Differences in material (e.g. asphalt, grass, etc.),
- Differences in colour (e.g. painted bike lanes),
- Presence of some form of buffer (e.g. boulevard, parking protection, painted buffer),
- Painted lines, and
- Street curb and gutter.

Consideration should also be given to the “shy zone” that exists between cyclists and adjacent vertical elements. Furnishings such as railing, retaining walls, etc. reduce the effective width of a facility. Refer to OTM Book 18 for guidance on appropriate shy zone widths.

Where there is variation in cycling facility width along a segment, take the minimum width as a representative facility width.

Improvements to the cycling facility width can be implemented through approaches such as: expansion to right-of-way boundaries, reduction of boulevard width, reduction of vehicle lane width, removal of vehicle lanes, or removal of on-street parking.



Bicycles

Buffer Width



This measure considers the space provided to separate cyclists from motor vehicles. The buffer width can be measured as the space between the edge of the vehicular travel lanes and the edge of the bicycle facility that lies closest to the vehicular lanes.

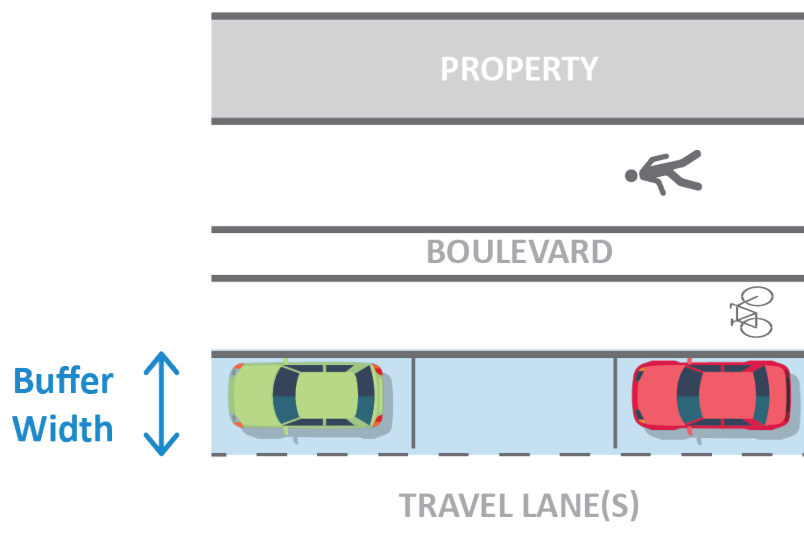
The intent of this measure is to quantify *the width of space between cyclists and motorized vehicles* to measure the level of comfort of cyclists on a given street. Increasing the width of the buffer zone will create a more comfortable environment for cyclists.

The example shows the boundaries of the buffer width where there is a clear demarcation between the buffer area, the adjacent bike facility on one side and the vehicle travel lanes on the other. In the example, the buffer takes the form of a parking lane (Refer to OTM Book 18 for appropriate buffer space between cycling facilities and parked cars), but the buffer zone may take many other forms, including but not limited to:

- Painted lines,
- Boulevards, and
- Raised curbs.

Where there is variation in the buffer width along a segment, take a minimum of three measurements of width and calculate the average to produce a representative buffer width.

Approaches to increase the buffer width include: expansion to right-of-way boundaries, reduction of boulevard width, reduction of vehicle lane width, removal of vehicle lanes, or addition/movement of on-street parking in the form of a parking protected bike lane.



Bicycles

Conflicts with Other Modes



This measure considers the amount of interaction between bikes and other modes in the bicycle facility. It is a quantitative measure of safety and comfort based on both in-lane conflicts and crossing point conflicts between bicycles and other modes.

In-lane conflicts (or modal mixing) consider the conflict that occurs between vehicles or pedestrians and cyclists when operating in shared space, such as in a sharrow lane or on a multi-use pathway. Crossing point conflicts consider locations where vehicles or pedestrians will cross or block the bicycle facility, which may include such locations as driveways or PXOs.

The intent of this measure is to **determine the safety and comfort of cyclists when traversing a segment.**

The analyst must consider both in-lane conflict and crossing point conflict to obtain a score for this measure. A value of “low”, “moderate”, or “high” is determined for each of the two indicators of conflict, where:

- In-lane conflict considers the volume of vehicles or pedestrians sharing the space with cyclists in vehicles or pedestrians per hour.
- Crossing point conflict is determined by counting the locations where other modes will cross the bicycle facility, and dividing it by the length of the segment to obtain a value of crossing points per kilometer.

Values of “low”, “moderate”, or “high” are determined based on the tables below and an overall score for the segment is determined based on the values of the two conflict indicators.

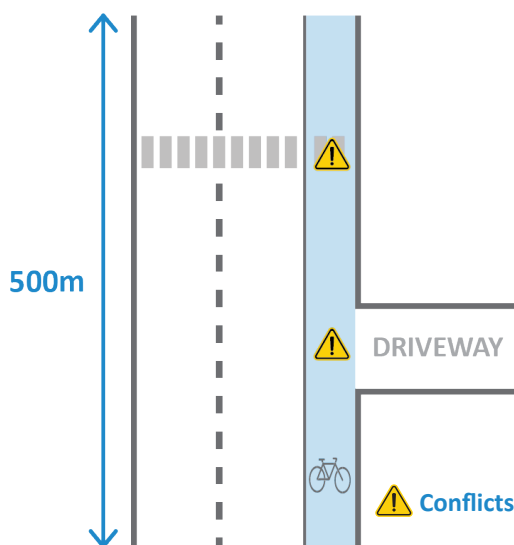
Crossing Point Conflict	Number of Crossing Points per km
Low	< 3
Moderate	3 - 7
High	> 7

In-Lane Conflict (Modal Mixing)	Volume (veh/h or ped/h)
Low	< 50
Moderate	50 - 300
High	> 300

LOS	Combination of Conflict Indicators
A	Two “Low” indicators
B	One “Low” indicator and one “Moderate” indicator
C	Two “Moderate” indicators
D	One “Low” indicator and one “High” indicator
E	One “Moderate” indicator and one “High” indicator
F	Two “High” indicators

In the example, there are two crossing points where bikes will conflict with other modes on the 500m segment. This equates to an average of four conflicts per kilometer, which is a “moderate” crossing point conflict. Since bicycles travel in a dedicated lane, in-lane conflict is “low”. Based on these two values, the segment is assigned a score of B for this measure.

Approaches to reducing the number of conflicts between bicycles and other modes include, but are not limited to: providing dedicated facilities for cyclists, minimizing driveways or providing alternative driveway access, and introducing floating bus stops and loading zones.



Transit

Facility Type



This measure evaluates the transit facility present along a segment. In general, the greater the level of dedicated space for transit, the higher the facility scores. Conditions that place public transit vehicles in mixed-traffic conditions with no dedicated transit facilities score lower.

The intent of the measure is to *evaluate the space dedicated to transit vehicles along a segment* through a simple observation of the type of facility present for transit vehicles.

To evaluate, choose the transit treatment used from the following discrete list of possibilities:

- Dedicated lanes;
- Intersection priority measures;
- Mixed traffic with more than one lane per direction; and,
- Mixed traffic with one lane per direction.

Improving the transit treatments to any of the treatments higher on the list above will result in a higher score on this measure.

Transit

Passenger Amenities



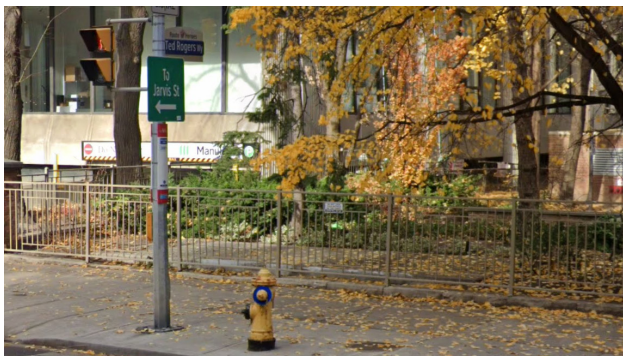
This measure considers the comfort and convenience provided to transit riders at transit stops and stations. These amenities contribute to the overall experience of transit and can have a significant impact on whether or not a user chooses transit over another mode.

The purpose of this measure is to **determine the level of comfort and convenience provided to transit riders**, which ultimately contributes to the attractiveness of transit.

Transit passenger amenities include anything present at the transit stop or station that contributes to the comfort and convenience of transit riders. This may include such things as shelters (heated or unheated), seating, shade trees, ticket machines, transit schedules and/or live transit ETAs, etc.

To measure, the practitioner shall examine the segment for number/quality of passenger amenities including (but not limited to) those listed above. Segments that have a high frequency of high-quality passenger amenities are assigned a score of A, whereas segments that have no passenger amenities are assigned a score of F. Any segment that lands in between (low to moderate level of passenger amenities) are to be assigned a score of B or D. Note that since this is a qualitative measure, it is up to the practitioner to use their best judgment in determining where high, moderate and low frequency of passenger amenities exist.

Additional amenities, including shelters, seating, shade trees, and transit schedules/live ETAs, can be introduced to improve the segment from the standpoint of passenger accommodation and comfort.



LOS F

Amenities: none



LOS A

Amenities: Shelter, heated shelter, seating, fare payment, live transit ETAs

Transit



Pedestrian Level of Service (on segment)

This measure looks at the accessibility of transit along the segment since all riders must act as a pedestrian at some point in order to access transit. It considers the level of comfort, safety, and delay for riders accessing or leaving the transit system at stops along the segment.

The purpose of this measure is to *quantify the overall pedestrian experience of transit riders on the segment*.

Pedestrian level of service is determined in the pedestrian segment analysis, and the outcome is directly applied to this measure as given in the table below.

Pedestrian Segment Analysis Result	Value of Pedestrian Level of Service for Transit Segment Analysis
A	A
B	B
C	C
D	D
E	E
F	F

Refer to description of Pedestrian Level of Service on segments and relevant measures starting on page 59 of the User Guide for further information.

Truck

Average Width of Curb Lane



This measure looks at the average mid-block curb lane width along a segment. As trucks tend to be larger than the majority of other vehicles on the road, they generally require larger lane widths in order to be safely accommodated. Trucks also generally travel in the curb lane of a roadway, allowing more agile vehicles to pass the truck on the left-hand side where applicable.

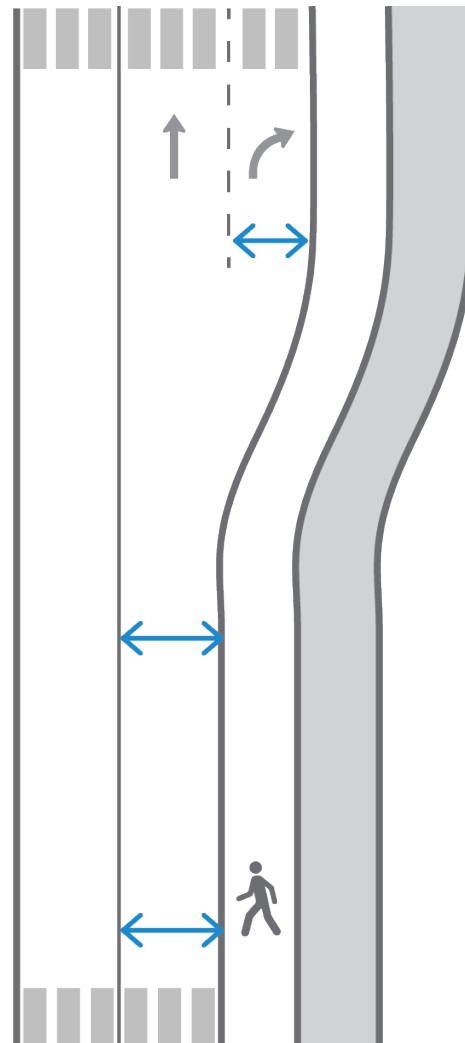
Therefore, the intent of this measure is to **determine the extent of safety and comfort experienced by trucks along the segment.**

To calculate, measure the width of the curb lane along the segment. In locations with variable curb lane width, it is recommended that the width of at least three locations along the segment are averaged to determine the final value. This can be accomplished via field measurement, or through application of CAD, GIS, or online mapping tools.

The example shows three measurement locations along the segment that would be averaged to determine the final value for this measure.

To improve this measure, widen curb lanes along corridors that permit truck movement. It should be noted that wider travel lanes have been associated with higher travel speeds, and while beneficial for trucks can have detrimental safety implications for other modes.

In practice, available right-of-way may limit the possibility of widening lanes along a corridor. Additionally, all roadway designs and lane widths are subject to relevant provincial and local design guidelines and existing policies that determine the modal priority of a given corridor. Roads should thus be planned and designed in accordance with the intent and requirements of these guidelines. Road designs should also never compromise user safety for the sake of a higher score on this measure.



Truck



Car Level of Service

This measure acts as an indicator of truck experience along a segment since trucks regularly operate in mixed traffic with cars.

The intent of this measure is to **quantify the level of safety and delay experienced by trucks travelling within the general traffic stream**, assuming they follow the safety and delay of cars in the same traffic stream.

Car level of service is determined in the car segment analysis, and the outcome is directly applied to this measure as given in the table below.

Car Segment Analysis Result	Value of Car Level of Service for Truck Segment Analysis
A	A
B	B
C	C
D	D
E	E
F	F

Refer to description of Car Level of Service on segments and relevant measures starting on page 70 of the User Guide for further information.

Cars

Mid-block V/C Ratio



This measure considers the average volume to capacity ratio (V/C ratio) mid-block for the segment. In traditional traffic engineering principles, the closer the V/C value is to 1, the closer a corridor is to operating at its capacity. Since congestion is never desirable as a driver, the lower the V/C ratio, the better the experience for car traffic.

Therefore, the intent of the measure is to *quantify the freedom of movement for cars along the segment*.

To calculate this, use applicable traffic-related software, or other typical intersection or corridor analysis methods to determine the average V/C ratio for the segment. Some assumed capacities in vehicles per hour per lane (vphpl) are shown below for the road classifications outlined in the guidelines.

Facility Type	Capacity (vphpl)
Downtown Avenue	800
Urban Main Street	900
Urban Boulevard	700
Neighbourhood Connector	1000
Neighbourhood Main Street	900
Neighbourhood Boulevard	700
Industrial Connector	1000
Industrial Boulevard	700
Rural Connector	1000

Possible ways to improve this measure include designing for roadways with more vehicle capacity or diverting traffic volumes from the segment (through network planning, the use of effective TDM, etc.).

In reality, ROW limitations and existing local/provincial policies that determine the modal priority of a given corridor can prevent improvements to this measure. Refer to governing local/provincial policies regarding corridor priority and intent. Additionally, the aforementioned “typical capacities” may not be applicable to each roadway in the study area. Confirm the suitability of the capacities used in your analysis.

Cars



Curb lane conflicts

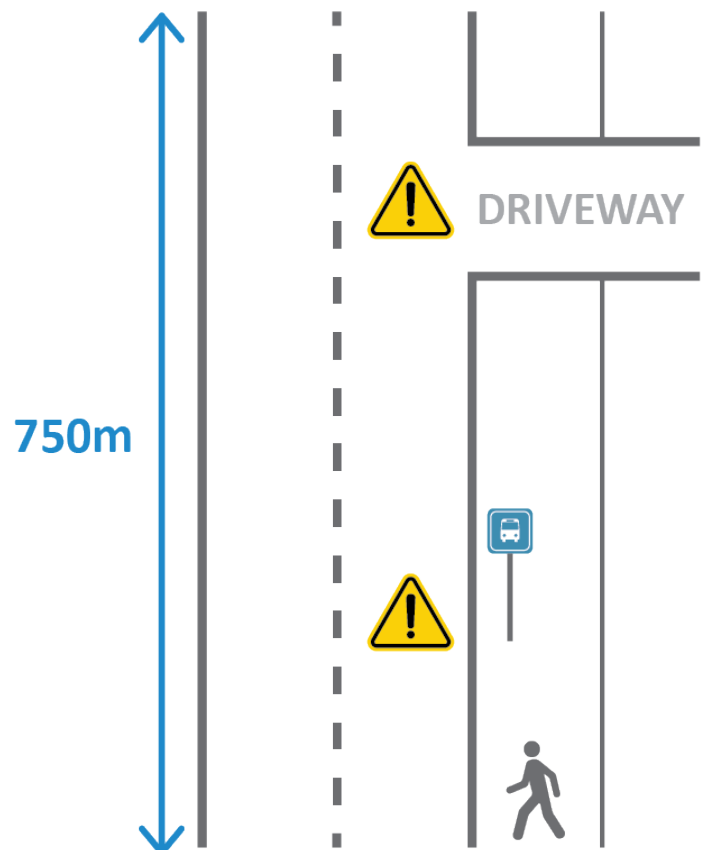
This is a measure of the safety and delay of cars as conflicts in the curb lane can create the potential for collisions between cars and other modes. It is a qualitative measure that varies in scale from no curb lane conflicts to high curb lane conflicts.

The intent of this measure is to *determine the safety and ease of movement of cars traveling in the curb lane.*

To measure, observe the number of curb lane conflicts that exist along the segment, which may include but are not limited to on-street parking, cycling facilities, driveways and bus stops. Segments with no curb lane conflicts are assigned a score of A, whereas segments with high curb lane conflicts (15 or more per km) are assigned a score of F. Any segment that falls in between (low to moderate curb lane conflicts) are to be assigned a score between B and E.

In the example, there are two curb lane conflicts on the 750m segment. This roughly equates to three curb lane conflicts per kilometer, which is equivalent to LOS C.

Approaches to reducing the number of curb lane conflicts include: removing or reducing the hours of on-street parking, reducing driveways on the segment or providing alternative driveway access, and introducing separate through and right-turn lanes.



Conflicts

Signalized Intersections



Pedestrians

Enhanced Pedestrian Measures



This measure presents a simple calculation that examines the presence of enhanced pedestrian measures at an intersection.

The intent of the measure is to *observe the level of accommodation provided to pedestrians at intersections*, which influences pedestrian comfort and safety.

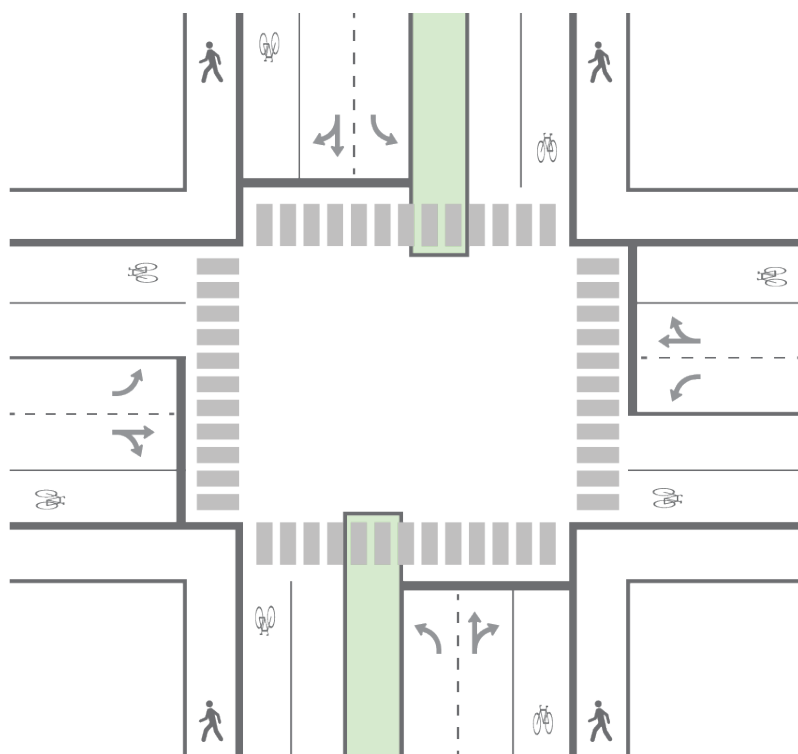
The value for this measure is determined by counting the total number of enhanced pedestrian measures at an intersection and dividing it by the total number of approaches. The more enhanced pedestrian measures, the more comfortable and safe the intersection will feel for pedestrians.

Enhanced facilities are considered anything beyond the presence of a standard pedestrian facility, and can include (but are not limited to) refuge islands, pedestrian storage space, raised intersections, leading pedestrian intervals (LPIs) and protected phases.

In the example, there are two pedestrian refuge islands, and all four crossings have LPIs. There are six total enhanced pedestrian measures on the four approaches, which equates to 1.5 measures per approach for an LOS of A.

The score for this measure at a particular intersection can be improved by introducing additional enhanced pedestrian facilities at the intersection, such as those noted above.

All intersection designs will be subject to relevant provincial and local design guidelines and should be designed in accordance with the intent and requirements of these guidelines. Intersection designs should never compromise user safety for the sake of a higher score on this measure.



Note: all four pedestrian crossings have LPIs

Pedestrians

Average Effective Turning Radius



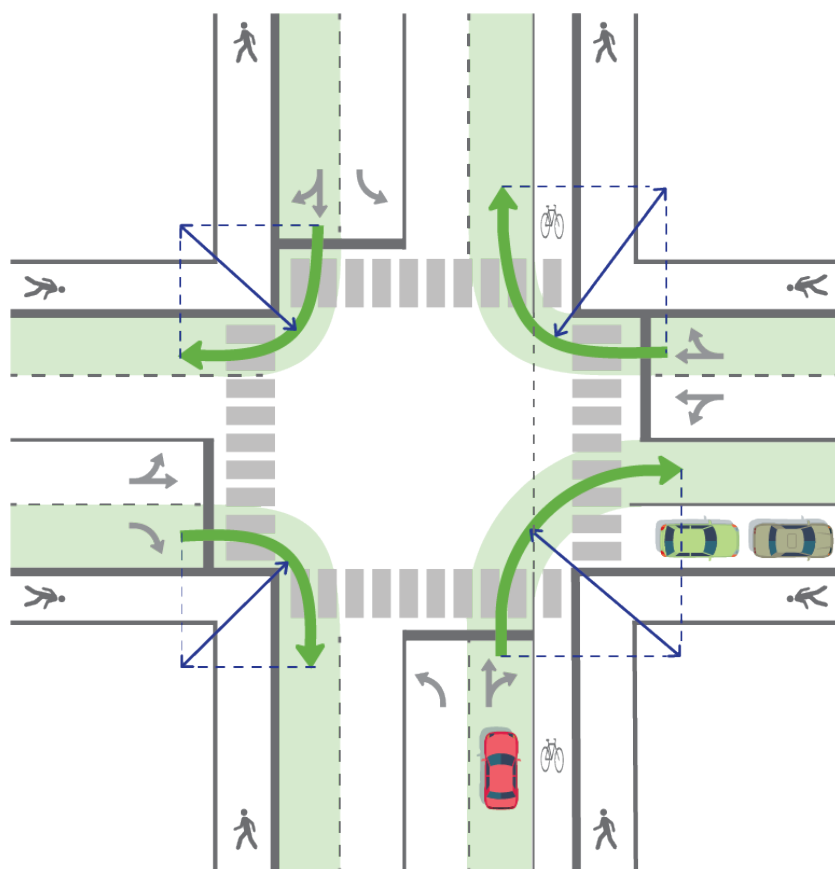
Average effective turning radius is ultimately a measure of safety and comfort for pedestrians since the turning radius of a vehicle significantly influences the speed at which a vehicle can turn.

The intent of this measure is to quantify *the level of comfort pedestrians will feel when crossing at an intersection*, primarily based on the anticipated travel speed of turning vehicles. Reducing the average effective turning radius will in turn reduce vehicle turning speeds and improve safety for pedestrians as they navigate the intersection.

To calculate this measure, take the average of the effective turning radii of all right-turns at the intersection where vehicle movement is permitted. The effective turning radius is the radius of the vehicle's traveled path from the turning lane of the departing leg to the first available lane of the receiving leg. This can be determined via field measurement, or through application of CAD, GIS, or online mapping tools. The effective turning radius will be greater than the curb radius when vehicle lanes are wider than necessary or when parking lanes and/or bike lanes are present.

The example gives all effective turning radii at the intersection that must be measured to determine the average value. Note the effective turning radii are generally much larger than the radii of the pavement curbs.

Approaches to reducing the effective turning radius include: removing/prohibiting on-street parking at intersections and reducing curb radius.



Pedestrians

Signal Cycle Length



This is a relative measure of the delay pedestrians experience due to the length of the cycle at a signalized intersection.

The intent for this measure is to evaluate *the delay experienced by pedestrians at intersections*. The longer a cycle length is, the longer a pedestrian may have to wait to proceed at an intersection and the less convenient the pedestrian travelling experience is. Long delays also increase the likelihood of non-compliance and therefore can have safety implications for pedestrians.

To calculate this measure, obtain signal timing information from the municipality to determine the full cycle length for the signal controlling pedestrian movements.

Shortening the overall signal cycle length and designing smaller intersections with shorter crossing lengths (since the pedestrian phases, based on the time required to traverse the pedestrian crossing at an average walking speed, often govern the signal length) are two possible solutions to improve the score for this measure.

Attention should be paid to the fact that any modifications to the traffic signal timing will affect all modes. Additionally, modification of phase or interval lengths should never be done at the expense of motorist, cyclist, or pedestrian safety.

Pedestrians

Number of Uncontrolled Crossings



An uncontrolled conflict occurs within an intersection where a pedestrian may be in conflict with another mode and there is no traffic control to direct their interaction. These are the areas within an intersection where pedestrians are vulnerable during normal operation.

For this measure, count the number of uncontrolled conflict points for the intersection. These consist of:

- Permitted left turns,
- Right turn on red,
- Right turn on green, and
- Right turn channels.

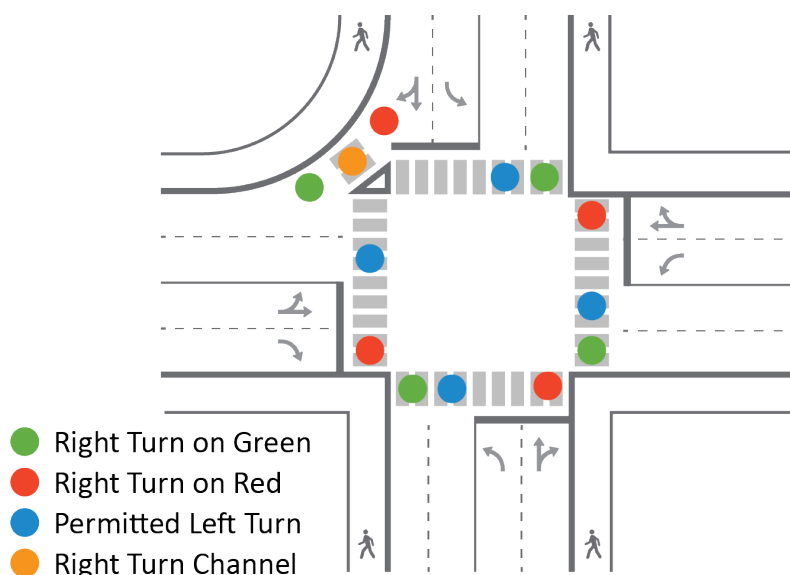
The intent for this measure is to quantify *the sources of risk to pedestrians as they cross the street*, primarily from turning cars, trucks, and buses. By examining the points where conflict can occur, we can quantify a simple examination of the safety of an intersection for pedestrians. Reducing the number of conflicts or giving the pedestrians priority in the intersection will serve to improve safety for pedestrians as they move through the intersection.

The value for this measure is calculated by dividing the number of conflicts at the intersection by the number of legs at the intersection. The example shows the location and source of uncontrolled conflicts at a four-leg intersection. The signal operates with permitted left turns on all phases, which means left turning vehicles will cross the crosswalk while pedestrians move. Right turns on red are allowed; vehicles turning right on green will cross the crosswalk; and, there is a right turn channel. The right turn channel represents three conflicts, as this is a higher risk situation for pedestrians.

There are 13 uncontrolled conflicts for pedestrians at the 4-legged intersection. The value for this measure is therefore equal to $13/4$ or 3.25, which equates to a score of F.

Approaches to reduce the number of uncontrolled conflicts at an intersection include: prohibition of turning movements; implementation of protected phasing; no right on red (NROR); installation of PXOs at right-turn channels to provide pedestrian priority; removal of right turn channels; and one-way street conversion .

In practice, some risk to pedestrians at the conflicts can be reduced through the implementation of Leading Pedestrian Intervals (LPI), though the conflicts would remain.





Enhanced Bicycle Measures

This measure presents a simple calculation that examines the presence of enhanced cycling measures at an intersection.

The intent of the measure is to **observe the level of accommodation provided to cyclists at intersections**, which influences cyclist comfort and safety.

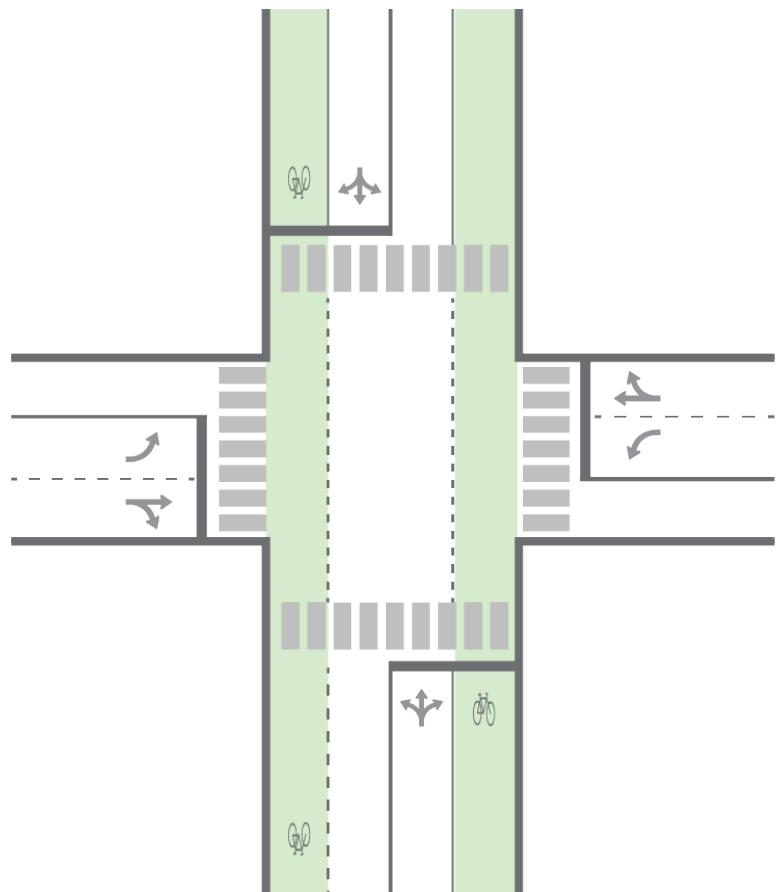
The value for this measure is determined by counting the total number of enhanced bicycle measures at an intersection and dividing it by the total number of approaches. The more approaches that have enhanced bike facilities, the more comfortable and safe the intersection will feel for cyclists.

Enhanced facilities are considered anything beyond the presence of a basic bike facility, and can include (but are not limited to) crossrides, green conflict markings, dedicated intersection features, protected intersection features, bicycle signal heads, leading bike intervals (LBIs) and protected phases.

In the example, two of the four approaches have crossrides and the same two approaches have LBIs (as noted). There are four total enhanced bicycle measures, which equates to an average of one measure per approach, equivalent to LOS B.

The score for this measure at a particular intersection can be improved by introducing additional enhanced cycling facilities at the intersection, such as those noted above.

All intersection designs will be subject to relevant provincial and local design guidelines and should be designed in accordance with the intent and requirements of these guidelines. Intersection designs should never compromise user safety for the sake of a higher score on this measure.



Note: the northbound and southbound approaches have LBIs

Bicycles

Average Effective Turning Radius



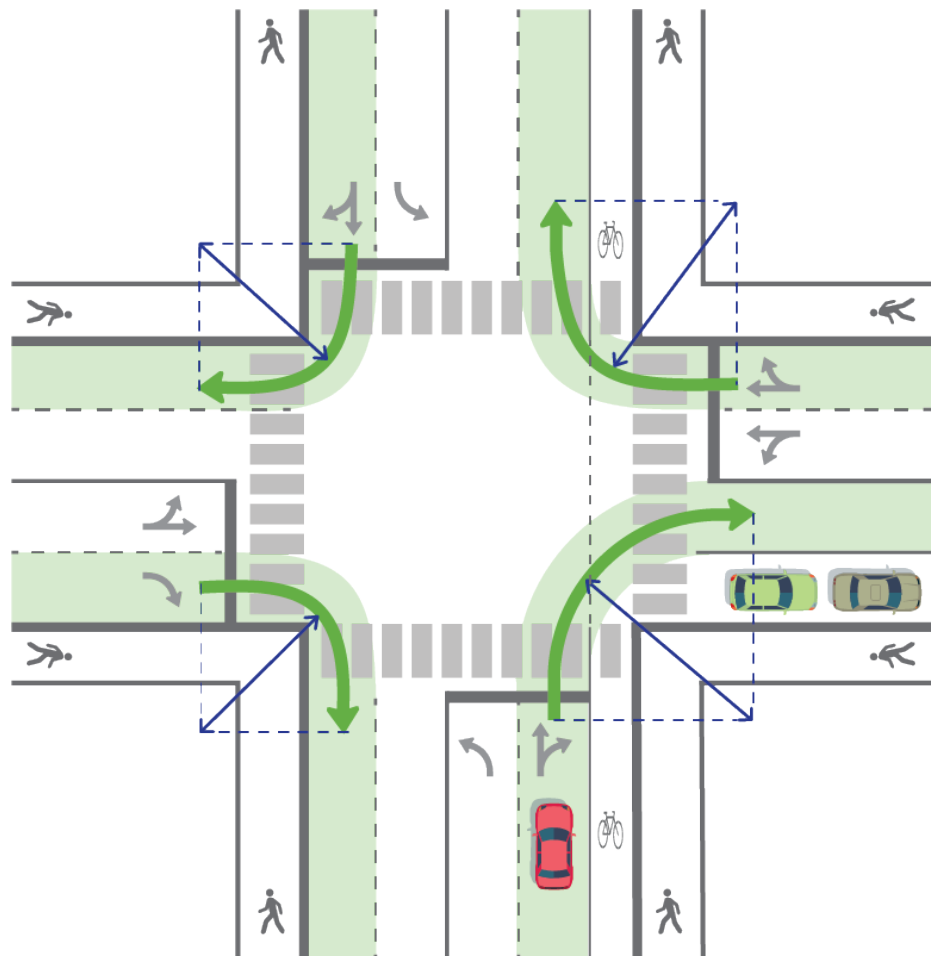
Average effective turning radius is ultimately a measure of safety and comfort for cyclists since the turning radius of a vehicle significantly influences the speed at which a vehicle can turn.

The intent of this measure is to quantify *the level of comfort cyclists will feel when crossing at an intersection*, primarily based on the anticipated travel speed of turning vehicles. Reducing the average effective turning radius will in turn reduce vehicle turning speeds and improve safety for cyclists as they navigate the intersection.

To calculate this measure, take the average of the effective turning radii of all right-turns at the intersection where vehicle movement is permitted. The effective turning radius is the radius of the vehicle's traveled path from the turning lane of the departing leg to the first available lane of the receiving leg. This can be determined via field measurement, or through application of CAD, GIS, or online mapping tools. The effective turning radius will be greater than the curb radius when vehicle lanes are wider than necessary and/or when parking lanes and/or bike lanes are present.

The example gives all effective turning radii at the intersection that must be measured to determine the average value.

Approaches to reducing the effective turning radius include, but are not limited to, the following: removing/prohibiting on-street parking at intersections, reducing pavement curb radius and reducing vehicle lane widths.



Bicycles

Signal Cycle Length



This is a proxy for the relative delay that cyclists experience due to the length of the cycle at a signalized intersection.

The intent for this measure is to evaluate *the delay experienced by cyclists at intersections*. The longer the signal cycle length is, the longer a cyclist may have to wait to proceed at an intersection and the less convenient the cycling experience is.

To calculate this measure, obtain signal timing information from the municipality to determine the full cycle length for the signal controlling cyclist movements.

Shortening the overall signal cycle length and designing smaller intersections with shorter crossing distances (as pedestrian crossing time often dictates cycle length) or fewer lanes are some possible solutions to improve the score for this measure.

Attention should be paid to the fact that any modifications to the traffic signal timing will affect all modes. Additionally, modification of phase or interval lengths should never be done at the expense of motorist, cyclist, or pedestrian safety.

Bicycles

Number of Uncontrolled Conflicts



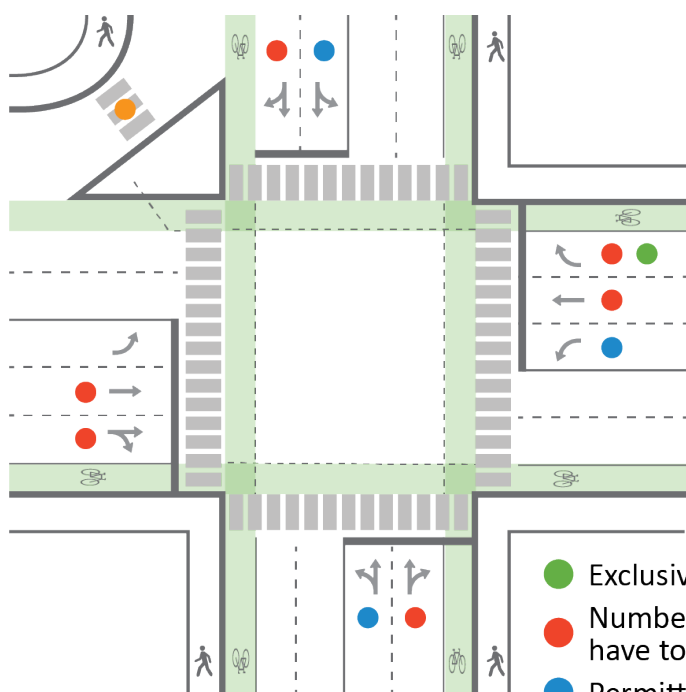
An uncontrolled conflict occurs within an intersection where a cyclist may be in conflict with another mode and vulnerable. This measure considers the number of locations at an intersection where cyclists need to cross moving vehicle traffic streams to move through the intersection.

The intent of the measure is to **quantify the sources of risk to cyclists as they cross an intersection**, primarily from turning cars, trucks, and buses. As with pedestrians, by examining the points where conflict can occur, we can quantify a simple examination of the safety of an intersection for cyclists.

To calculate this, count the total number of the following conditions present at the intersection, and divide that value by the number of legs at the intersection:

- Permitted left turns for vehicles,
- Exclusive right turn lanes for vehicles,
- Right turn channels for vehicles, and
- Number of lane changes required for a cyclist to make a left turn (through or through-right lanes).

In the example, there are **11** total conflicts at the 4-legged intersection: **3** permitted left turns assuming the EBL is protected, **1** right turn channel, **1** exclusive right turn, and **6** possible lanes that a cyclist in the curb lane would have to change to turn left. The value for this measure is therefore $11/4$ or 2.75, which equates to a score of E.



- Exclusive Right Turn
- Number of Lanes Bike would have to cross to turn Left
- Permitted Left Turn
- Right Turn Channel

Narrower roadways (due to a lesser overall number of lanes) are one way to improve the score for this measure. Other ways to improve this score include: minimizing the number of right turn channels; minimizing the number of exclusive right turn lanes; and protecting all left turns at an intersection.

In practice, all intersection designs will be subject to relevant provincial and local design guidelines and should be designed in accordance with the intent and requirements of these guidelines. Intersection designs should never compromise user safety for the sake of a higher score on this measure.



Presence of Transit Priority Measures

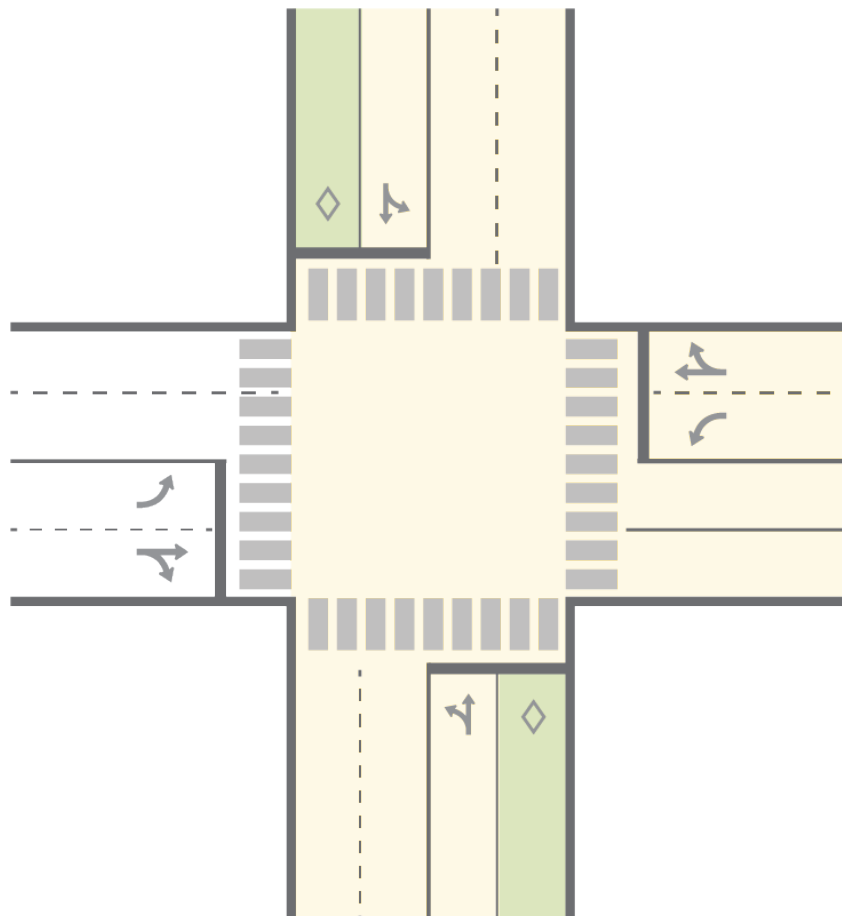
This performance measure looks at the transit priority measures present at an intersection, which may be in the form of dedicated transit lanes, transit signal priority, or other treatments.

The intent of this measure is to **determine the level of delay experienced by transit riders** based on the transit priority measures present at an intersection.

The score is determined by counting the number of approaches with transit priority measures relative to the total number of transit approaches, where a transit priority measure can be in the form of infrastructure or signal priority. If all approaches have transit priority measures, the intersection is assigned a score of A. If none of the approaches have transit priority measures, the intersection is assigned a score of F.

The example illustrates an intersection where three of the four approaches serve transit. Of the three approaches, two have priority measures. This falls under the “transit priority measures at a minimum of one but not all approaches for transit” category, therefore the intersection is assigned a score of C for this measure.

Introducing dedicated transit lanes, queue jumps, or other treatments on approaches of the intersection would improve this measure.



Transit

Transit Movement Delay



This measure for transit refers to the delay experienced specifically by transit vehicles at an intersection.

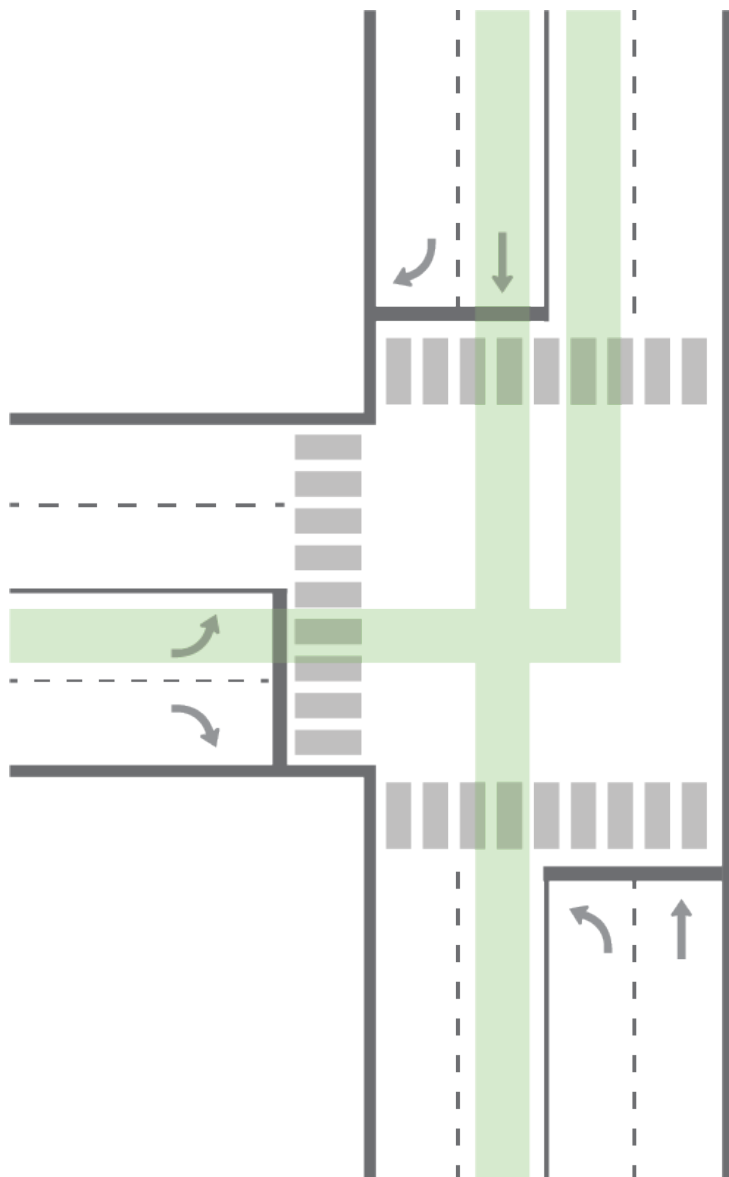
The intent for this measure is to **quantify the average delay experienced by transit** in order to determine the level of convenience for transit. The shorter the delay felt by transit, the more convenient a transit trip is.

To calculate this measure, use applicable traffic-related software or other typical intersection analysis methods to determine the delay for each movement used by transit. The delay should be measured regardless of whether transit operates in mixed traffic conditions or on dedicated facilities. Then, calculate the average delay for the movements used by transit to obtain the final value for this measure.

In the example, only two movements at the intersection are used by transit and therefore the average transit delay should be calculated using the eastbound left and southbound through movement delays.

Possible ways to improve this measure include: implementing transit signal priority at signalized intersections; optimizing the signal timing to provide more time for movements with transit routes; exclusive transit lanes or queue jumps; and, shortening the overall cycle length.

In reality, any modification of the traffic signal will likely affect all movements and modes. Keep this in mind when dealing with this measure. Additionally, modification of phasing or splits should not be modified in a way that would compromise the safety of users of any mode (e.g., minimum pedestrian crossing times).





Pedestrian Level of Service (at signalized intersections)

This measure looks at the accessibility of transit near intersections since all riders must act as a pedestrian at some point in order to access transit. Its purpose is to *quantify the level of comfort, safety, and delay* for riders accessing or leaving the transit system at stops near an intersection.

Pedestrian level of service at the study intersection is determined in the pedestrian signalized intersection analysis, and the outcome is directly applied to this measure as given in the table below. The pedestrian level of service at an intersection considers uncontrolled conflicts, average crossing distance, signal cycle length, and average effective turning radius at the intersection. This measure is used with the understanding that poor pedestrian comfort, safety or delay are significant deterrents to transit use.

Pedestrian Intersection Analysis Result	Value of Pedestrian Level of Service for Transit Intersection Analysis
A	A
B	B
C	C
D	D
E	E
F	F
O	F

Refer to description of Pedestrian Level of Service at signalized intersections and relevant measures starting on page 73 of the User Guide for further information.

Truck

Average Effective Turning Radius



This measure evaluates the average effective turning radius at an intersection. The larger this radius is, the easier it is for the truck to navigate turns.

The intent of the measure is to *evaluate how easily trucks can navigate in the road environment*.

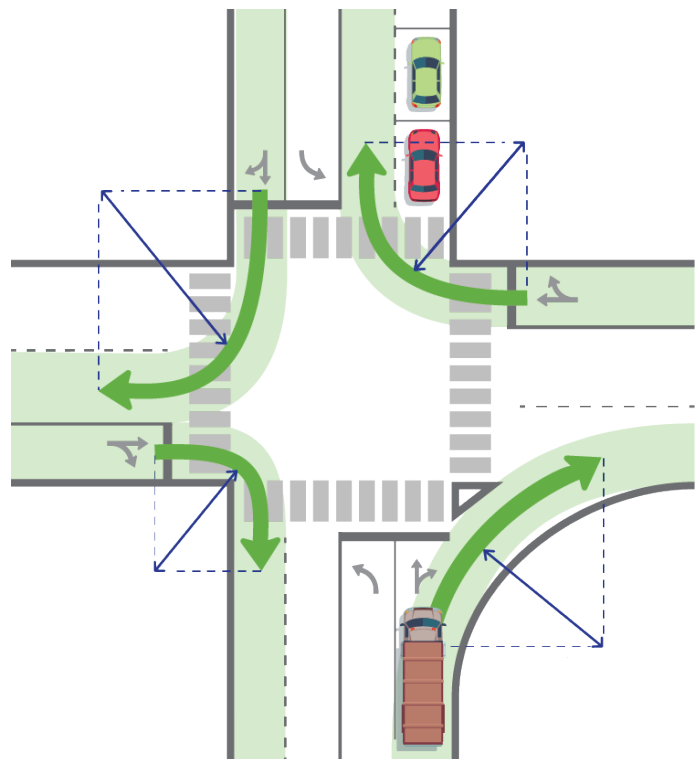
The effective turning radius refers to the actual path to be traced by the truck when turning right. It is NOT the radius of the pavement curb. The example below shows the path of travel for right turning vehicles where the arrows represent the effective turn radius.

To calculate this measure, take the average of the turning radii at the intersection for right-turns at all approaches where truck movement is permitted. Turning radii must be measured from the furthest practical point where the truck could begin and complete the turn (i.e. mid-lane, not at the pavement curb). This can be accomplished via field measurement, or through application of CAD, GIS, or online mapping tools.

When determining the path that would be travelled, also keep in mind the effects of any curbside parking lanes or other features that would shrink or increase the effective turning radius.

To improve this measure, design curbs with larger radii at any right-turn movements that permit trucks.

In reality, all intersection designs are subject to relevant provincial and local design guidelines and should be designed in accordance with the intent and requirements of these guidelines. A redesign of an entire intersection to accommodate larger radii will also affect other intersection users and may not be the most efficient solution to improving the truck LOS. Intersection designs should never compromise user safety for the sake of a higher score on this measure.





Car Level of Service (at signalized intersections)

This measure acts as an indicator of truck experience at an intersection since trucks regularly operate in mixed traffic with cars.

The intent of this measure is to *quantify the level of safety and delay experienced by trucks travelling at intersections within the general traffic stream*, assuming they follow the safety and delay of cars in the same traffic stream.

Car level of service is determined in the car signalized intersection analysis and the outcome is directly applied to this measure as given in the table below. Car level of service considers the percent of movements with exclusive lanes and car delay at intersections.

Car Signalized Intersection Analysis Result	Value of Car Level of Service for Truck Intersection Analysis
A	A
B	B
C	C
D	D
E	E
F	F

Refer to description of Car Level of Service at signalized intersections and relevant measures starting on page 86 of the User Guide for further information.

Cars



Percentage of Turning Movements with Dedicated Lanes

This is a measure of the number of turning movements at an intersection that have dedicated lanes. The more turning movements that are served by dedicated lanes, the simpler it is for vehicles to move safely through the intersection and the more that vehicles can be separated into individual phases to reduce conflicts.

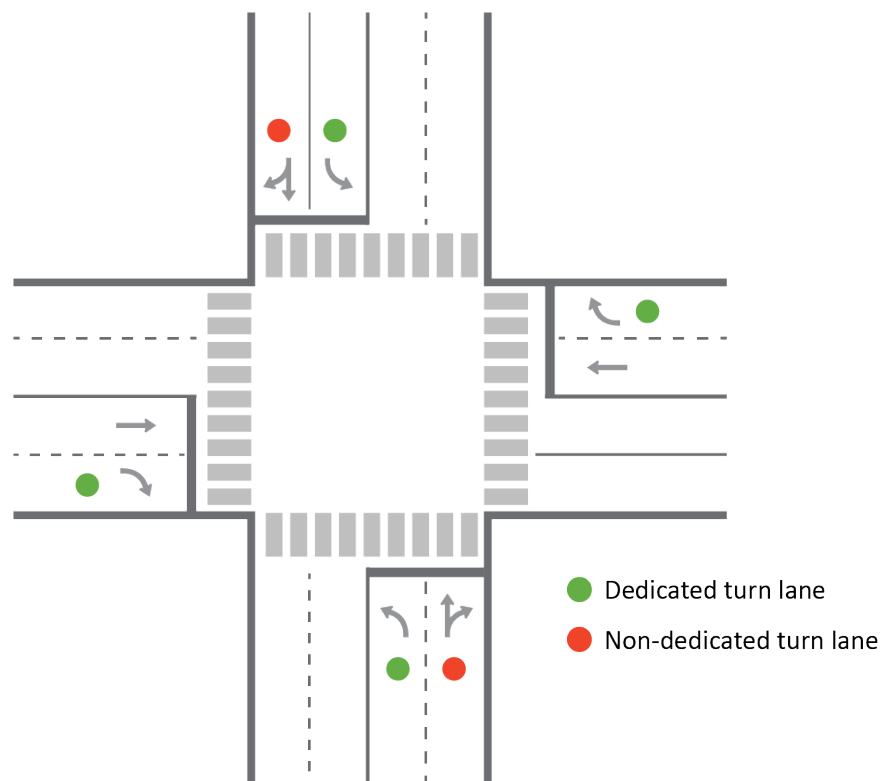
The intent of this measure is to *quantify the ability of a vehicle to move safely and efficiently through an intersection.*

To calculate, count the number of turning movements with exclusive lanes at the intersection and divide by the total number of turning movements. In the example shown below, there are four exclusive turning movements for vehicles – two left and two right – and six turning movements in total. Note that eastbound and westbound left turns are prohibited at this intersection. This results in a value of 67% for this measure, which equates to a score of B.

Note that double-left or double-right turning lanes should be counted as one turning movement with a turning lane. This is because double turning lanes serve to improve queuing and capacity at an intersection, not safety.

Introducing exclusive left- or right-turning lanes on more approaches to an intersection will improve the score for this measure.

In reality, all intersection designs are subject to relevant provincial and local design guidelines and should be designed in accordance with the intent and requirements of these guidelines. A redesign of an entire intersection to accommodate exclusive turning lanes will affect other intersection users and may impact the volume-to-capacity ratio and/or delay of the intersection. Additionally, intersection designs should never compromise user safety for the sake of a higher score on this measure.



Cars



Intersection Delay

This measure refers to the average delay experienced by cars on all movements at an intersection.

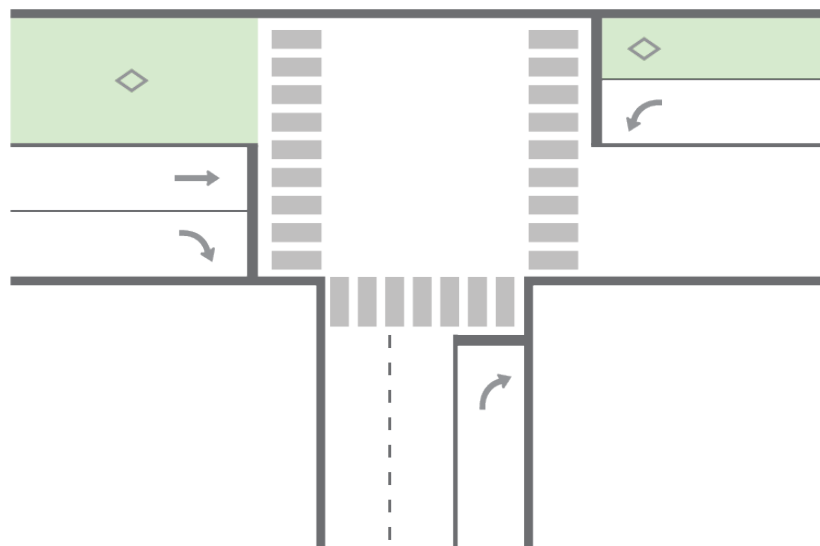
The intent for this measure is to **calculate the average delay experienced by automobiles** in order to determine the level of convenience for vehicles. The shorter the delay felt by cars, the more efficient and convenient the trip is for them.

To calculate this, use applicable traffic-related software or other typical intersection analysis methods to determine the delay for each movement on which cars are allowed. The delays for movements permitting cars should then be volume-averaged. Delays for intersection legs with vehicle prohibitions (e.g. “transit only”) should not be included in this average calculation.

In the example shown, the WBT delay would not be included in the car delay average weighing since cars are prohibited on that movement. All other movements would be included in the calculation. Where cars are permitted on all turning movements, the overall intersection delay can be used.

Possible ways to improve this measure include: designing smaller intersections to reduce often governing pedestrian walking time; optimizing the signal timing to provide more time for car movements; and shortening cycle lengths.

In practice, when modifying a plan or design for this measure, keep in mind that any optimization of the traffic signal may affect all movements and motorized modes. Additionally, modification of phase or interval lengths should never be done at the expense of safety of users of any mode.



Unsignalized Intersections



Pedestrians



Average Crossing Distance

This is a measure of the distance a pedestrian must walk to cross the intersection at marked crossings. It collects the crossing distance for all marked crossings to create a representative average for the intersection.

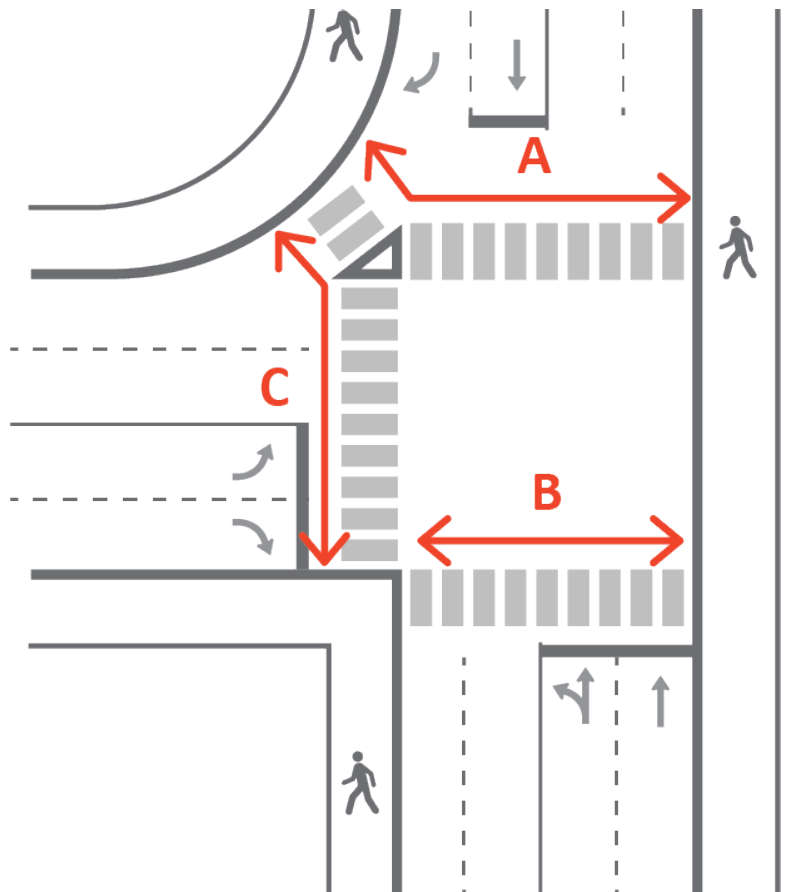
This provides a quantification of how well-sized the intersection is for crossing on foot. The longer the average crossing distance is at an intersection, the more intimidating the crossing will be for pedestrians, particularly those with mobility issues. Shortening the crossing distances creates a more comfortable and pedestrian-friendly environment.

The intent for this measure is to quantify **the average crossing distance of all marked crosswalks at the intersection**. This gives us a picture of how well the environment is sized for pedestrians. Reducing this distance will create a more comfortable and attractive environment for walking.

The example shows the distances to be measured at a three-leg intersection. There are three pedestrian crossings at this intersection: Northern Crossing (A); Southern Crossing (B); and Western Crossing (C). The value for this measure shall be determined by calculating the average of distances A, B and C.

Note that distance shall be measured from curb to curb where the pedestrian enters the intersection to where they leave. Do not discount for medians or breaks in the path.

Approaches to reduce the average crossing distance include: removal of exclusive turning lanes, removal of general travel lanes, reduction of lane widths, installation of PXOs at right-turn channels to provide pedestrian priority, removal of right turn channels, and closure of intersection legs or individual approaching/ departing segments (e.g. bulbouts).



Pedestrians

Marked Crossings



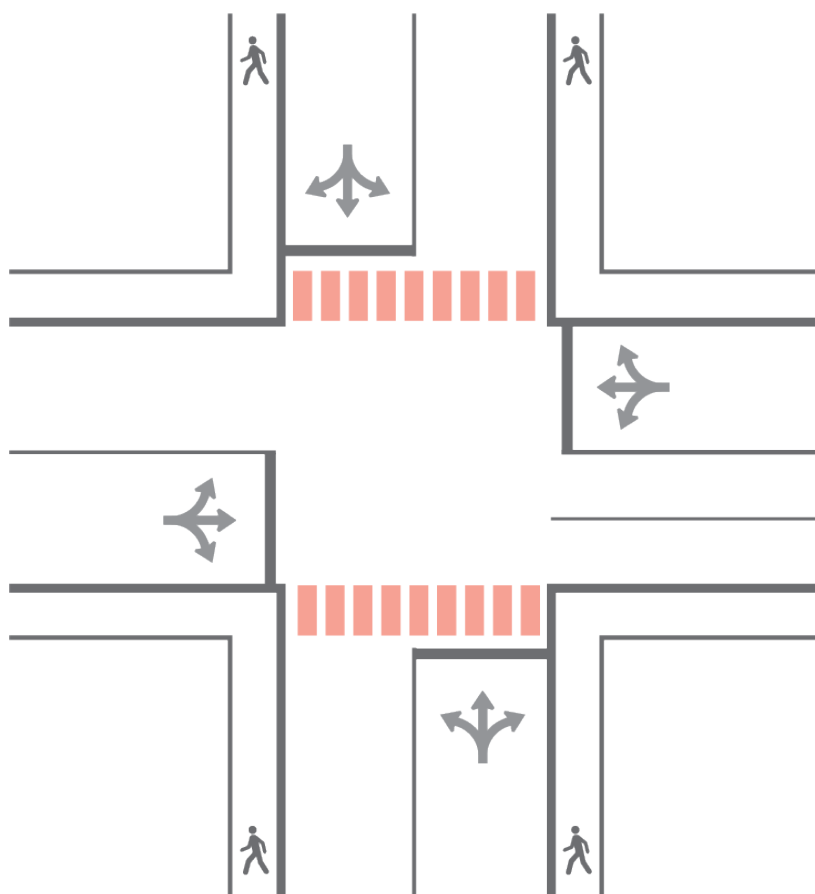
This measure considers the number of legs of an intersection with marked crossings (i.e. Pedestrian Crossovers, or PXOs). Marked crossings improve both safety and level of delay for pedestrians as the markings act as an indicator to drivers that pedestrians are expected at the intersection and that they have priority to cross.

The intent for this measure is to evaluate *the delay and level of safety experienced by pedestrians at intersections*. Pedestrians will experience less delay and feel more comfortable at intersections with marked crossings.

This measure is calculated by dividing the number of legs of the intersection that have marked crossings by the total number of intersection legs.

The example illustrates a four-leg intersection. Two of the four legs have marked crossings, therefore the value for this intersection is $2/4 = 0.5$ or 50%. This equates to a score of D.

Increasing the number of legs of an intersection with marked crossings will improve the performance of the intersection for this measure.



Pedestrians



Average Effective Turning Radius

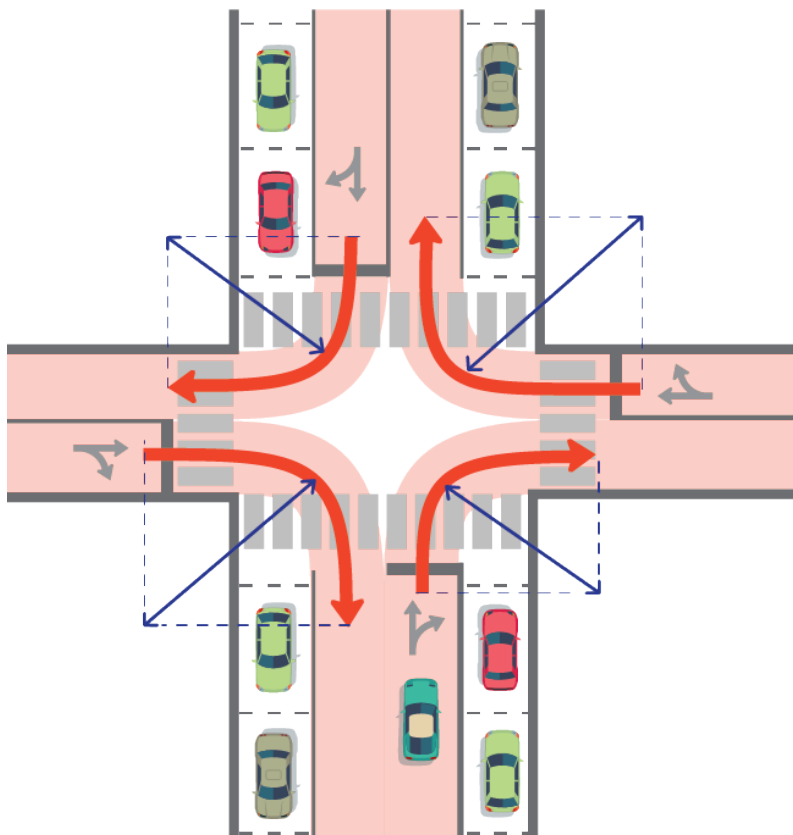
Average effective turning radius is ultimately a measure of safety and comfort for pedestrians since the turning radius of a vehicle significantly influences the speed at which a vehicle can turn.

The intent of this measure is to quantify the *level of comfort pedestrians will feel when crossing at an intersection*, primarily based on the anticipated travel speed of turning vehicles. Reducing the average effective turning radius will in turn reduce vehicle turning speeds and improve safety for pedestrians as they navigate the intersection.

To calculate this measure, take the average of the effective turning radii of all right-turns at the intersection where vehicle movement is permitted. The effective turning radius is the radius of the vehicle's traveled path from the turning lane of the departing leg to the first available lane of the receiving leg. This can be determined via field measurement, or through application of CAD, GIS, or online mapping tools. The effective turning radius will be greater than the curb radius when vehicle lanes are wider than necessary or when parking lanes and/or bike lanes are present.

The example gives all effective turning radii at the intersection that must be measured to determine the average value. Note the effective turning radii are generally much larger than the radii of the pavement curbs.

Approaches to reducing the effective turning radius include: removing/prohibiting on-street parking at intersections and reducing curb radius.



Bicycles

Presence of Bicycle Facilities



This measure presents a simple calculation that examines the presence of cycling facilities at an intersection.

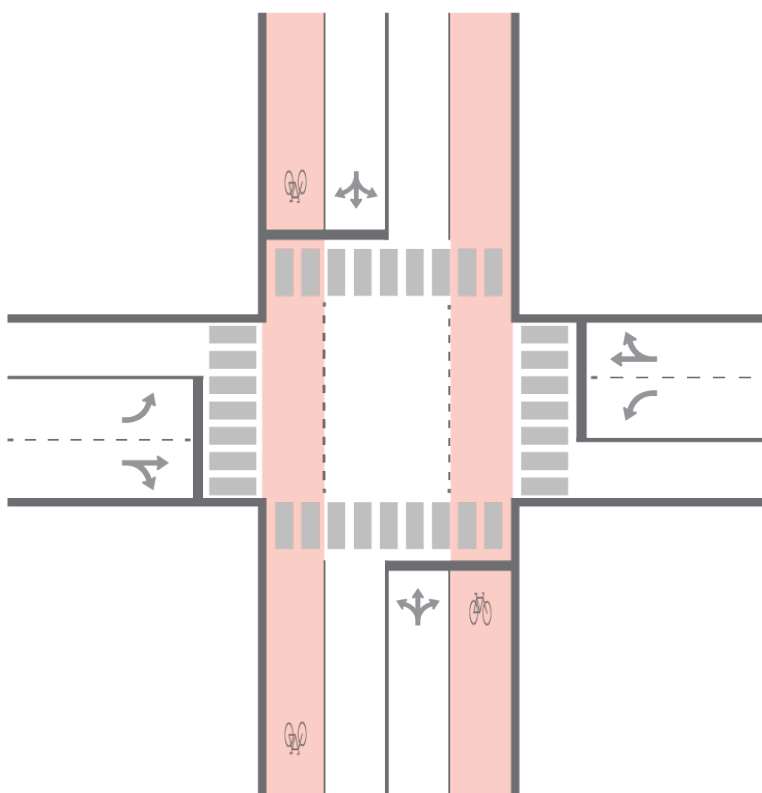
The intent of the measure is to **observe the level of accommodation provided to cyclists at intersections**, which influences cyclist comfort and safety.

The value for this measure is determined by calculating the ratio of the number of approaches that have bicycle facilities to the number of total approaches at the intersection. The more approaches that have bike facilities, the more comfortable and safe the intersection will feel for cyclists.

In the example, two of the four approaches have bike facilities, giving a 2/4 ratio which equates to an LOS D.

The score for this measure at a particular intersection can be improved by introducing dedicated cycling infrastructure.

All intersection designs will be subject to relevant provincial and local design guidelines and should be designed in accordance with the intent and requirements of these guidelines. Intersection designs should never compromise user safety for the sake of a higher score on this measure.





Bicycles

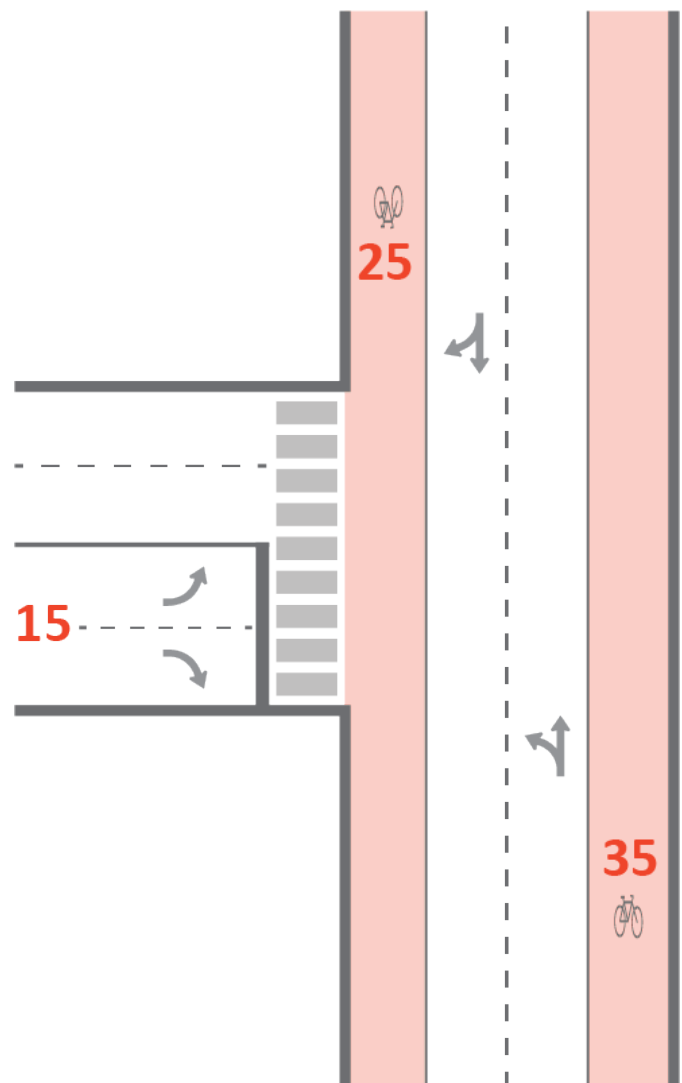
Requirement to Stop

This measure considers the level of delay and convenience for cyclists at an intersection by looking at the frequency in which a cyclist would need to stop at a given intersection.

The intent of this measure is to evaluate *the convenience and level of delay for cyclists at intersections*. Cyclists will experience less delay at intersections where they are not required to stop, which will also contribute to the level of convenience and ease to traverse the intersection.

This measure considers the percentage of cyclists that are required to stop at the unsignalized intersection. This is calculated by dividing the number cyclists on the minor street by the total number of cyclists travelling through the intersection. The example illustrates an unsignalized intersection where the major street runs north/south and the minor street runs east/west. The percentage of cyclists that are required to stop can be calculated as $15/(15+25+35) = 0.2$ or 20%. This equates to a score of B.

Increasing the number of legs of the intersection that do not require cyclists to stop or improving the accommodation provided to cyclists on the major street would improve the score for this intersection.



Bicycles

Average Effective Turning Radius



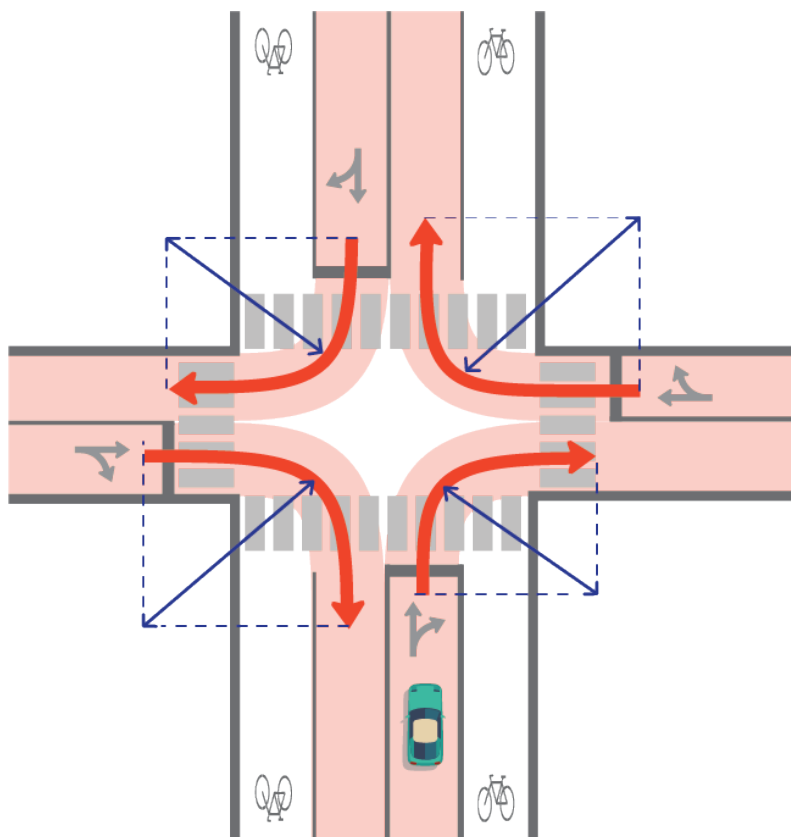
Average effective turning radius is ultimately a measure of safety and comfort for cyclists since the turning radius of a vehicle significantly influences the speed at which a vehicle can turn.

The intent of this measure is to quantify *the level of comfort cyclists will feel when crossing at an intersection*, primarily based on the anticipated travel speed of turning vehicles. Reducing the average effective turning radius will in turn reduce vehicle turning speeds and improve safety for cyclists as they navigate the intersection.

To calculate this measure, take the average of the effective turning radii of all right-turns at the intersection where vehicle movement is permitted. The effective turning radius is the radius of the vehicle's traveled path from the turning lane of the departing leg to the first available lane of the receiving leg. This can be determined via field measurement, or through application of CAD, GIS, or online mapping tools. The effective turning radius will be greater than the curb radius when vehicle lanes are wider than necessary and/or when parking lanes and/or bike lanes are present.

The example gives all effective turning radii at the intersection that must be measured to determine the average value.

Approaches to reducing the effective turning radius include, but are not limited to, the following: removing/prohibiting on-street parking at intersections, reducing pavement curb radius and reducing vehicle lane widths.





Transit Movement Delay

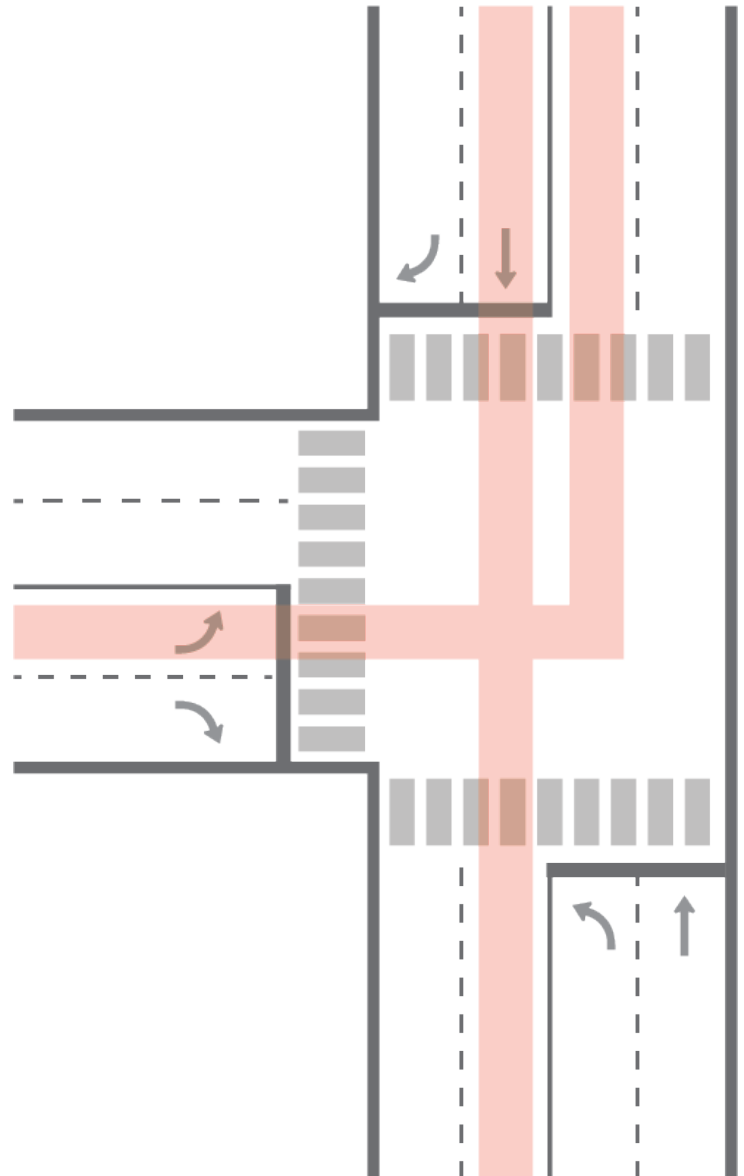
This measure for transit refers to the delay experienced specifically by transit vehicles at an intersection.

The intent for this measure is to **quantify the average delay experienced by transit** in order to determine the level of convenience for transit. The shorter the delay felt by transit, the more convenient a transit trip is.

To calculate this measure, use applicable traffic-related software or other typical intersection analysis methods to determine the delay for each movement used by transit. The delay should be measured regardless of whether transit operates in mixed traffic conditions or on dedicated facilities. Then, calculate the average delay for the movements used by transit to obtain the final value for this measure.

In the example, only two movements at the intersection are used by transit and therefore the average transit delay should be calculated using the eastbound left and southbound through movement delays.

Possible ways to improve this measure include introducing exclusive transit lanes or queue jump lanes.



Transit

Pedestrian Level of Service



This measure looks at the accessibility of transit near intersections since all riders must act as a pedestrian at some point in order to access transit. Its purpose is to quantify the level of comfort, safety, and delay for riders accessing or leaving the transit system at stops near an intersection.

Pedestrian level of service at an intersection is determined in the pedestrian intersection analysis (signalized or unsignalized), and the outcome is directly applied to this measure as given in the table below. The pedestrian level of service at an unsignalized intersection considers average crossing distance, priority crossings, and average effective turning radius at the intersection. This measure is used with the understanding that poor pedestrian comfort, safety or delay are significant deterrents to transit use.

Pedestrian Unsignalized Intersection Analysis Result	Value of Pedestrian Level of Service for Transit Intersection Analysis
A	A
B	B
C	C
D	D
E	E
F	F

Refer to description of Pedestrian Level of Service at unsignalized intersections and relevant measures starting on page 89 of the User Guide for further information.

Truck



Average Effective Turning Radius

This measure evaluates the average effective turning radius at an intersection. The larger this radius is, the easier it is for the truck to navigate turns.

The intent of the measure is to *evaluate how easily trucks can navigate in the road environment*.

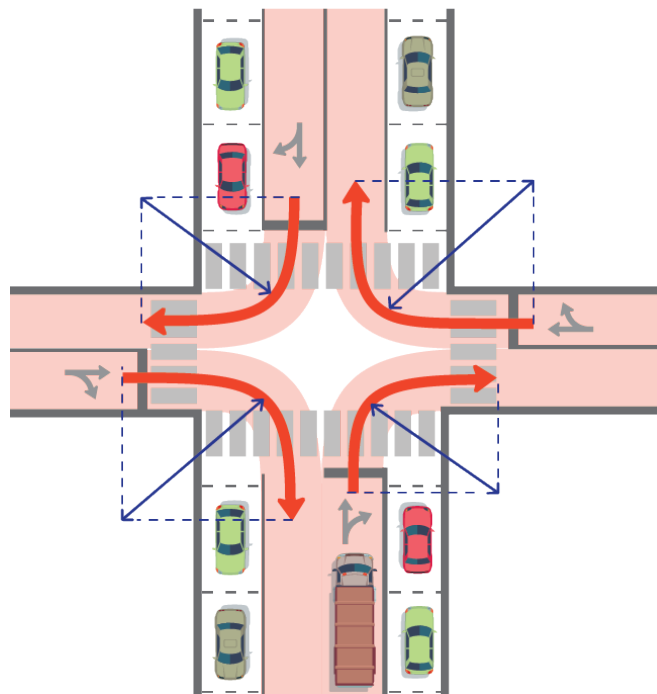
The effective turning radius refers to the actual path to be traced by the truck when turning right. It is NOT the radius of the pavement curb. The example below shows the path of travel for right turning vehicles where the arrows represent the effective turn radius.

To calculate this measure, take the average of the turning radii at the intersection for right-turns at all approaches where truck movement is permitted. Turning radii must be measured from the furthest practical point where the truck could begin and complete the turn (i.e. mid-lane, not at the pavement curb). This can be accomplished via field measurement, or through application of CAD, GIS, or online mapping tools.

When determining the path that would be travelled, also keep in mind the effects of any curbside parking lanes or other features that would shrink or increase the effective turning radius.

To improve this measure, design curbs with larger radii at any right-turn movements that permit trucks.

In reality, all intersection designs are subject to relevant provincial and local design guidelines and should be designed in accordance with the intent and requirements of these guidelines. A redesign of an entire intersection to accommodate larger radii will also affect other intersection users and may not be the most efficient solution to improving the truck LOS. Intersection designs should never compromise user safety for the sake of a higher score on this measure .



Truck

Car Level of Service (at unsignalized intersections)



This measure acts as an indicator of truck experience at an intersection since trucks regularly operate in mixed traffic with cars.

The intent of this measure is to **quantify the level of safety and delay experienced by trucks travelling at intersections within the general traffic stream**, assuming they follow the safety and delay of cars in the same traffic stream.

Car level of service is determined in the car intersection analysis, and the outcome is directly applied to this measure as given in the table below.

Car Unsignalized Intersection Analysis Result	Value of Car Level of Service for Truck Intersection Analysis
A	A
B	B
C	C
D	D
E	E
F	F

Refer to description of Car Level of Service at unsignalized intersections and relevant measures starting on page 99 of the User Guide for further information.

Cars



Intersection Delay

This measure refers to the average delay experienced by cars on all movements at an intersection.

The intent for this measure is to **calculate the average delay experienced by automobiles** in order to determine the level of convenience for vehicles. The shorter the delay felt by cars, the more efficient and convenient the trip is for them.

To calculate this, use applicable traffic-related software or other typical intersection analysis methods to determine the delay for each movement on which cars are allowed. The delays for movements permitting cars should then be volume-averaged. Delays for intersection legs with vehicle prohibitions (e.g. “transit only”) should not be included in this average calculation.

In the example shown, the WBT delay would not be included in the car delay average weighing since cars are prohibited on that movement. All other movements would be included in the calculation. Where cars are permitted on all turning movements, the overall intersection delay can be used.

Possible ways to improve this measure include: designing smaller intersections to reduce often governing pedestrian walking time; optimizing the signal timing to provide more time for car movements; and shortening cycle lengths.

In practice, when modifying a plan or design for this measure, keep in mind that any optimization of the traffic signal may affect all movements and motorized modes. Additionally, modification of phase or interval lengths should never be done at the expense of safety of users of any mode.

