Guide for Setting

Posted Speed Limits on Manitoba Roadways

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1 INTRODUCTION

Speed management is a critical task that traffic authorities undertake to balance the safety and mobility needs of all road users throughout the transportation network. The speed that motorists travel greatly influences the severity of a collision, regardless of what caused the collision. In a roadway network where speed is properly managed, the safety of all road users is considered the primary goal and acceptable speeds are consistent with the roadway environment.

Aspects of speed management are described below. They include roadway geometric design, traffic calming and setting posted speed limits.

Roadway Geometric Design

A fundamental aspect of speed management is the concept of self-enforcing roadways. A self-enforcing roadway encourages motorists to select an appropriate speed simply through the visual cues provided by the roadway geometric design. Geometric design elements are the visible elements of the roadway, such as horizontal alignment, number and width of lanes, presence and type of median, sidewalks and cycling facilities. Appendix A provides additional information on geometric design.

Traffic Calming

Traffic calming is the broad term used to describe the process and measures to address concerns about the behaviour and speed of motorists. Traffic calming mostly uses physical tools known as horizontal deflection or vertical deflection. However, it also includes tools such as education, encouragement and enforcement to reduce vehicle speeds and traffic congestion. Appendix A provides additional information on traffic calming.

Setting Posted Speed Limits

Speed limits provide road users with a primary source of speed information and forms the basis for legal enforcement. The primary focus of this guide is to assist road authorities in setting credible, posted speed limits that match the intended function and physical characteristics of a roadway with the expectations of motorists. However, changing speed limits alone does not necessarily encourage a change in motorists' choice of speed. It should not be relied upon as a speed management strategy.

Recognizing that vehicle speeds have considerable influence on road safety and mobility for all road users, the *Guide for Setting Posted Speed Limits on Manitoba Roadways* provides a systematic, consistent and repeatable framework to recommend posted speed limits. This guide is intended to promote the application of a standard process across Manitoba for setting posted speed limits.

1.1 SCOPE

This guide is applicable to all municipal and provincial roadways in Manitoba, in both an urban and rural context.

This guide is not applicable to setting speed limits in school zones or work zones. For guidance about speed-zone setting in these areas, the reader should consult the Manitoba Infrastructure (MI) *Guide for Establishing Reduced-Speed School Zones* and the Manitoba Infrastructure *Work Zone Traffic Control Manual.*

1.2 INTENDED AUDIENCE

When recommending speed limits on portions of provincial highways for which the Minister of Infrastructure is the traffic authority, Manitoba Infrastructure uses the approach provided in this guide. The guide is also intended to be used by people involved in the design, operation and maintenance of the road system, acting on behalf of traffic authorities responsible for municipal roadways.

Some parts of the process require input from a professional engineer. The guide clearly identifies the areas where the application of engineering judgment is needed.

The contents of this guide have no legislative authority and are not intended to be interpreted as minimum standards by which traffic authorities are to be judged.

2 OVERVIEW OF SETTING SPEED LIMITS

This section presents the importance of speed limits in creating a safe environment for all road users, the legal framework for speed limits in Manitoba, key speed-related definitions, guiding principles and a standard approach for setting speed limits.

2.1 SAFETY

One of the many ways to create a safer road environment is to consider all road users in providing appropriate and credible posted speed limits that match the intended function and physical characteristics of a roadway with the expectation of all road users. Setting appropriate speed limits can influence driving behaviour. This may result in more consistent road speeds. Consistent and appropriate speeds on roads enhance safety for all road users, as it makes traffic more predictable.

The Manitoba Road Safety Plan highlights the importance of a Safe Systems Approach to improving road safety. Within the context of speed limits, the Safe Systems Approach is primarily intended for developed communities. It is still being refined for rural and remote applications.

The principles of the Safe Systems Approach are [1, p. 11]:

- *designing infrastructure that is forgiving of mistakes and protects vulnerable road users*
- *ensuring that speed limits are safe and appropriate, and managing speeds so other parts of the system work as intended*
- *educating the public on how to prevent collisions and instilling a traffic safety culture*
- *ensuring that vehicles are designed, manufactured and repaired as safely as possible*

A Safe Systems Approach requires commitment and collaboration between all levels of government and private sector stakeholders that have a mutual interest in road safety. It also requires strategic planning, long-term thinking and sustained funding commitments.

Vulnerable road users include road users who are particularly vulnerable in the case of a collision, particularly pedestrians and cyclists. Figure 1 highlights pedestrians' increasing vulnerability to serious injury from collisions as vehicle speeds increase.

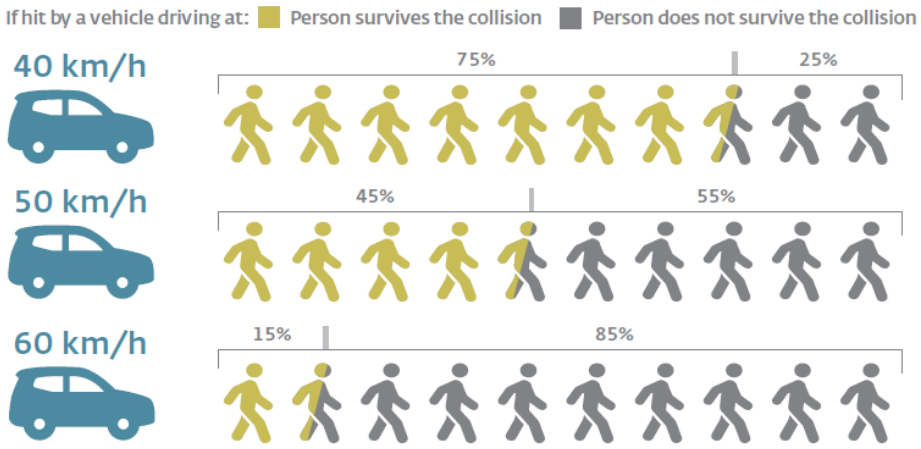

Figure 1: Pedestrian Risks Increase with Higher Speeds [1]

Although a posted speed limit may not control the speed at which a driver chooses to travel, if determined appropriately, speed limits are a factor that influence driver behaviours.

2.2 LEGAL FRAMEWORK FOR SETTING SPEED LIMITS IN MANITOBA

Speed limits on Manitoba roadways are defined in The Highway Traffic Act [2] and are always in effect, even when not posted. Section 94.2 of The Highway Traffic Act states that default speed limits on Manitoba roadways are:

- 50 km/h in designated restricted speed areas (restricted speed areas as defined in The Highway Traffic Act).
- 90 km/h in all other places outside of restricted speed areas.

Speed limits of 50 km/h or 90 km/h may not reflect the reasonable safe maximum speed of a specific roadway section, due to the prevailing roadway function, physical characteristics, traffic mix or land use conditions, which may suggest a higher or lower speed limit. In these instances, the traffic authority having responsibility may fix a speed limit as low as 20 km/h or up to 90 km/h for any geographic area, highway or portion of a highway.

2.3 KEY DEFINITIONS

The following are key definitions for understanding the concepts presented in this guide:

> **(Posted) Speed limit.** The maximum permissible speed at a specific location. In Manitoba, the default speed limit is 50 km/h within a restricted speed area and 90 km/h outside a restricted speed area. A different speed limit may be fixed for a particular roadway, but it must be properly signed.

- **Operating speed.** The measured speed at which motorists choose to travel on a given roadway. It is often defined using the 85th percentile speed, the 15 km/h pace, and per cent in pace (see Section 4). Speed choice by drivers is based on a variety of factors, including roadway and roadside characteristics, weather, traffic characteristics, vehicle characteristics and the purpose of the trip.
- **Target speed.** The speed at which motorists should operate on a roadway that considers the safety of all road users, while providing the appropriate level of mobility for motor vehicles. The target speed is not measured, it is determined based on the functional classification of the road (see Section 3.2), the anticipated mix of road users, the type of environment, and other contextual factors (see Section 3.1 and Section 5.2).

2.4 GUIDING PRINCIPLES FOR SETTING SPEED LIMITS

The intent of appropriate speed limits is to encourage speed limits that are compatible with the roadway function and surrounding environment, while considering the safety of all road users. The following guiding principles can help provide safe, credible speed limits [3]:

- ***Reduce speeds while maintaining reasonable mobility.*** Maximizing safety is the most important objective, and all things being equal, a slower speed environment is safer for all road users.
- ***Permit the right speed on the right road.*** Motor vehicle speeds and the safety of all road users must be carefully considered in network planning, so operating speeds are not unnecessarily restricted.
- ***Promote consistency in speed between road users.*** As differences in speed increase between motorists, more lane changing, overtaking and rear-end conflicts are created. Greater differences in speed increase the probability of a serious injury or fatality for both motorized and non-motorized road users.
- ***Minimize changes in speed limits.*** As best as possible, roadway systems should permit the motorist to travel at a consistent speed. Abrupt and unexpected changes in speed limit should be avoided.

2.5 APPROACH FOR THE EVALUATION OF SPEED LIMITS

Evaluating and implementing speed limits may involve six elements:

- an initiation event
- a context and classification assessment
- a preliminary speed limit analysis
- an engineering speed limit study

- implementation
- monitoring and evaluation

The sequential nature of these elements is shown in Figure 2 and described on the following pages.

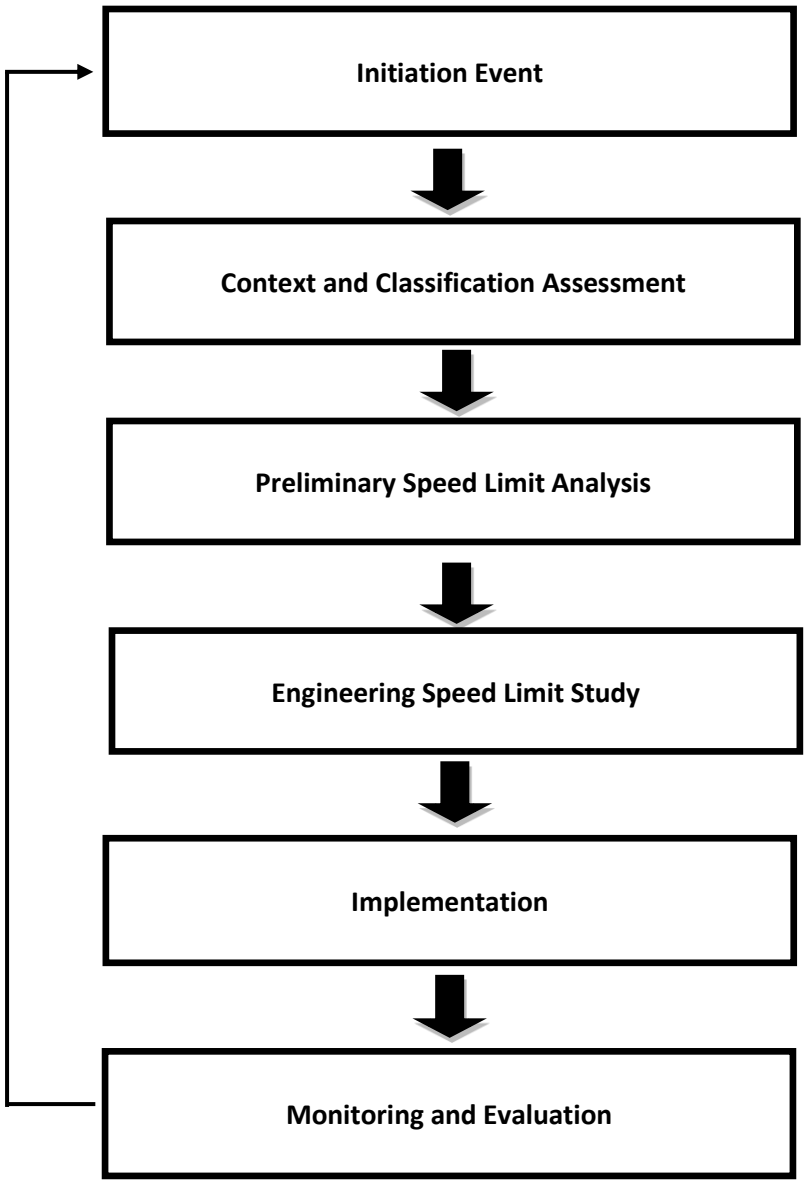

Figure 2: Approach for the Evaluation of Speed Limits

INITIATION EVENT: Each traffic authority should define situations that may require a speed limit analysis. Such situations may include:

- requests by a resident, elected official or other stakeholder

- significant changes in the roadway driving environment (e.g., changes in roadside development, changes in roadway cross-section, and addition or elimination of driveways)
- roadway sections with an experience of excess collisions
- roadway sections for which speeding infractions are routinely identified by law enforcement personnel

The process for initiating a speed limit analysis on provincial roadways, for which the minister is the traffic authority, is outlined in Section 8.

CONTEXT AND CLASSIFICATION ASSESSMENT: Assessing the context and classification of a roadway ensures the selected speed limit is appropriate in relation to the applicable road users, surrounding land use and as part of the greater transportation network. There are cases where vehicle operating speeds are not appropriate for a given context and classification – this triggers further analysis and action in the engineering speed limit study.

PRELIMINARY SPEED LIMIT ANALYSIS: The preliminary speed limit analysis requires the collection of vehicle speed data to determine the range of speed limits that would be within plus or minus 10 km/h of the 85th percentile operating speed. By following the guiding principles and additional information provided in this guide, it is generally acceptable to implement speed limits that are within plus or minus 10 km/h of the 85th percentile operating speed. (See Section 4 for 85th percentile definition.) This process is fairly simple and can generally be completed by traffic authorities responsible for municipal roadways. The preliminary speed limit analysis is described further in Section 4.

ENGINEERING SPEED LIMIT STUDY: Where there is a desire by the traffic authority to set a speed limit not supported by the operating speeds, as determined in the context and classification assessment and preliminary speed limit analysis, an engineering study should be completed. Speed limits that are significantly different than operating speeds can contribute to greater speed dispersion and increased risk of collisions. The engineering study should identify potential issues causing the divergence and propose potential solutions. Engineering studies are described further in Section 5.

IMPLEMENTATION: Speed limits must be properly established by regulation, rule or bylaw, and must be properly identified with the appropriate signage. Signage should be placed following the guidance provided in the *Manual of Uniform Traffic Control Devices for Canada* [4].

MONITORING AND EVALUATION: When a new speed limit is implemented, it is recommended that a review of traffic operations and a spot speed study be conducted approximately two (2) to twelve (12) months after the new speed limit is posted. This will help evaluate the effectiveness of the new speed limit and identify if any additional actions are necessary.

3 CONTEXT AND FUNCTIONAL CLASSIFICATION ASSESSMENT

Assessing the context and classification of a roadway ensures the selected speed limit is appropriate for the applicable road users, in relation to the surrounding land use, applicable road users, and as a part of the greater transportation network. The following section outlines the characteristics of various contexts and functional classifications, which can guide the selection of an appropriate and safe speed limit (adapted from [5]).

3.1 CONTEXT

The context indicates the nature of the land and development adjacent to the road. The following contexts may occur [5]:

Table 1: Context Descriptions

Context	Land use	Building density	Building setback from roadway	Pedestrian and cycling activity
Rural	Agricultural, with sparse other land uses	Sparse	High	Rare
Rural town	Mixed use, commercial main streets	Low	Low	Very high
Suburban	Mixed land uses, with commercial and residential often separate	Moderate	Moderate	Moderate
Urban	Mixed land uses	High	Low	High
Urban core	Mixed land uses	Very high	Very low	Very high

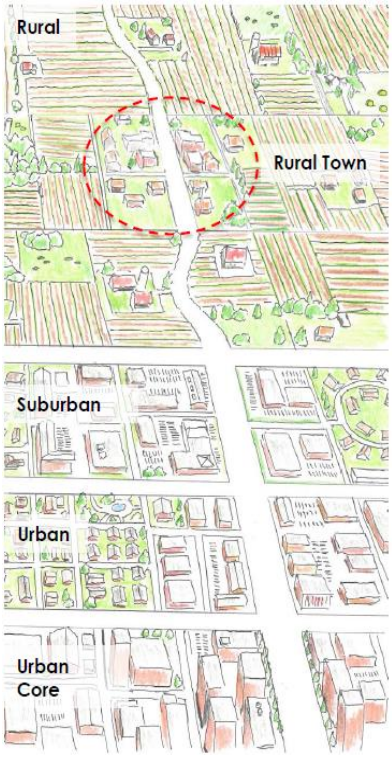

Figure 3: Contexts [5, p. 3]

3.2 FUNCTIONAL CLASSIFICATIONS

The functional classification system identifies the role of a roadway, and its place in the municipal, regional, or provincial transportation network. Functional classifications may include freeways, expressways, arterials, collectors and local roads. The key differences among these classifications focus on mobility and land access.

Table 2: Functional Classification System Description

Functional Classification	Mobility and Accessibility	Desirable Access Types
Freeway	Focus on mobility for vehicles, with pedestrians and cyclists on separated facilities or lower road classification	All intersecting roadway (may include freeways, expressways and arterials) accesses at interchanges; no direct property access
Expressway	Focus on mobility for vehicles, with pedestrians and cyclists on separated facilities or lower road classification	Intersecting roadway (may include freeways, expressways or arterials) accesses at interchanges or signalized intersections; no direct land use access
Arterial (primary and secondary)	Balance mobility and access for various road users, with desirable physical separation between vehicles and pedestrians and cyclists	Access to intersecting roadways (may include expressways, arterials and collectors) and land uses is provided at signalized and unsignalized intersections
Collector	Balances access and mobility for various road users, depending on the context	Access to intersecting roadways (may include arterials, collectors and locals) and land uses is provided at signalized and unsignalized intersections, as well as driveways
Locals	Focuses on direct land use access for all road users	Direct access to land uses provided at driveways and intersecting roadways (may include collectors and locals) at unsignalized intersections

3.3 SPEED LIMITS FOR VARIOUS CONTEXTS AND FUNCTIONAL CLASSIFICATIONS

The following table provides a range of appropriate target speed limits for each context and functional classification. In the case that the preliminary speed limit analysis does not align with the identified target speed limit, further consult the engineering speed limit study step.

Table 3: Appropriate Target Speed Limits that Promote Safer Operations

	Rural	Rural Town	Suburban	Urban	Urban Core
Freeway	80-110 km/h	NA	80-110 km/h	NA	NA
Expressway	80-110 km/h	NA	80-100 km/h	NA	NA
Primary Arterial	80-100 km/h	50-80 km/h	60-80 km/h	50-60 km/h	50-60 km/h
Secondary Arterial	70-100 km/h	50-70 km/h	50-80 km/h	40-50 km/h	40-60 km/h
Collector	60-100 km/h	40-50 km/h	40-60 km/h	40-50 km/h	30-50 km/h
Local	50-90 km/h	30-50 km/h	30-50 km/h	30-50 km/h	30-50 km/h

4 PRELIMINARY SPEED LIMIT ANALYSIS

The preliminary speed limit analysis requires the collection of vehicle operating speed data to determine the ideal range of speed limits based on the operating speeds. Figure 4 illustrates each of the steps that are further described on the following pages.

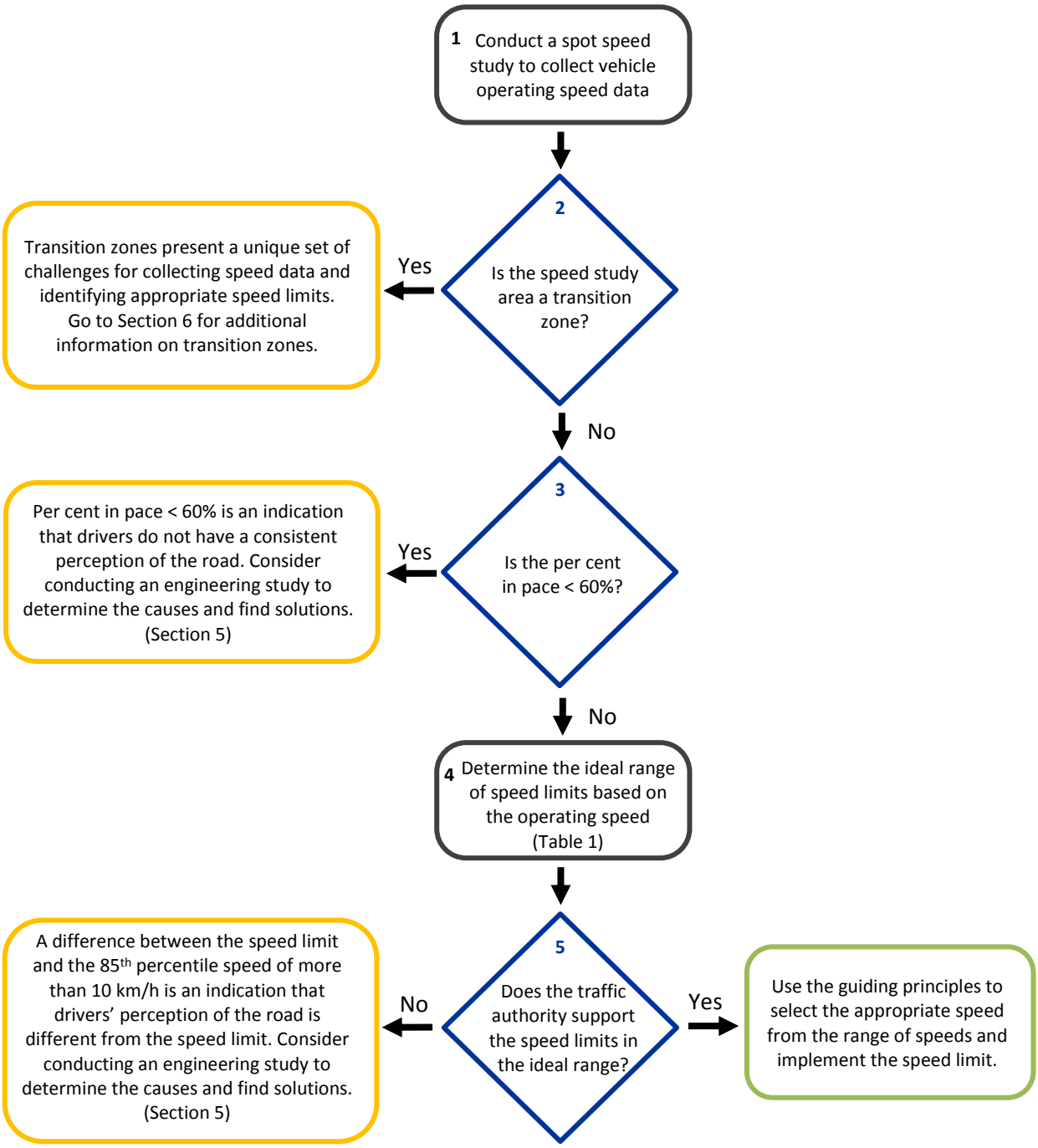

Figure 4: Preliminary Speed Limit Analysis Steps

STEP 1: Conduct a spot speed study to collect vehicle operating speed data

The operating speed is the speed at which motorists choose to travel on a given roadway. Speed choice by drivers is based on a variety of factors, including roadway and roadside characteristics, weather, traffic characteristics, vehicle characteristics, and the purpose of the trip. This results in a range of operating speeds. The operating speed characteristics represent the prevailing speeds at the time of data collection and can vary according to levels of congestion, hour of day, day of week, weather, lighting conditions, and road surface conditions. Operating speed data should be collected during ideal driving and weather conditions.

The operating speed for a particular road section can be estimated by measuring individual speeds through a spot speed study. The methodology to complete a spot speed study is described in the TAC *Speed Management Guide* [3] and included in Appendix B. The following describes operating speed characteristics:

- ***85th Percentile Speed***. The 85th percentile speed is the speed at or below 85 per cent of the measured speeds in a spot speed study.
- ***15 km/h pace.*** The 15 km/h pace is the 15 km/h range of speeds that encompasses the greatest percentage of measured speeds in a spot speed study.
- ***Per cent in pace.*** The per cent in pace is the percentage of measured speeds that fall within the 15 km/h pace.

STEP 2: Determine if the study area is a transition zone

A transition zone is the section of roadway between a rural high-speed highway and a community or roadway with a much lower speed limit. Transition zones present unique challenges for identifying appropriate speed limits.

If the study area is a transition zone, refer to Section 6.5 for additional information before continuing.

STEP 3: Check the percent in pace

The per cent in pace is the percentage of measured speeds that fall within the 15 km/h pace. FHWA [6] states that an ideal speed distribution contains at least approximately 70 per cent of the vehicles within the pace.

If less than 60 per cent of the vehicles are within the pace, it may indicate that drivers do not perceive the roadway function and physical characteristics in a consistent manner. As differences

in speed increase between motorists, more lane changing, overtaking and rear-end conflicts are created. Greater differences in speed increase the probability of a serious injury or fatality for both motorized and non-motorized road users. An engineering speed limit study may be beneficial to identify potential issues causing the differences in speed and propose potential solutions.

STEP 4: Determine the ideal posted speed range

The speed limit and the 85th percentile speed should be relatively comparable. This indicates that the function and physical characteristics of the roadway are properly understood and are being well respected by motorists.

The 85th percentile speed should ideally be within plus or minus 10 km/h of the speed limit. Table 4 provides the ideal speed limit range for various 85th percentile speeds. The TAC *Manual of Uniform Traffic Control Devices for Canada* requires that speed limits only be posted in multiples of 10 km/h.

Table 4: Ideal Speed Limit Range Based on Operating Speeds

85th percentile speed	Ideal speed limit based on 85th percentile speed
≤ 50 km/h	≤ 50 km/h
51 – 60 km/h	50 km/h or 60 km/h
61 – 70 km/h	60 km/h or 70 km/h
71 – 80 km/h	70 km/h or 80 km/h
81 – 90 km/h	80 km/h or 90 km/h
91 – 105 km/h	90 km/h or 100 km/h
≥ 106 km/h	100 km/h*

* In Manitoba, speed limits of 100 or 110 km/h may only be regulated by the Lieutenant Governor in Council.

STEP 5: Select the recommended speed limit

It is generally acceptable for the traffic authority to set the speed limit within the ideal posted speed range in Table 4, based on the 85th percentile speed. Use the guiding principles (Section 2.4) and additional information provided in this guide to select the appropriate speed limit and the beginning and end points defining the speed limit area.

In some instances, there may be a desire to set a speed limit outside of the speed range based on the 85th percentile speed. This may occur when the current vehicle speeds are considered inappropriate for the type of adjacent land uses and the pedestrian, cyclist and other activity that

occurs along the roadway. Speed limits that are not within plus or minus 10 km/h of the 85th percentile operating speed should only be set based on an engineering study (see Section 5). The engineering study should identify potential issues causing the divergence and propose potential solutions.

It is generally inappropriate to set a speed limit that is inconsistent with drivers' perceptions. Speed limits that are significantly different than operating speeds can contribute to greater speed dispersion and increased risk of collisions. The function and physical characteristics of the roadway should help drivers to select the appropriate speed. The road cues and the speed limit should provide a uniform message.

Appendix C provides a typical outline of a preliminary speed limit study. Appendix D provides an example of a preliminary speed limit study using the methodology outlined in this section.

5 ENGINEERING SPEED LIMIT STUDY

An engineering speed limit study can help identify, review and propose solutions for roadways where the traffic authority has concerns with the current operating speeds. The engineering speed limit study should, at a minimum, identify and summarize:

- the operating speed based on the observed vehicle speeds on the roadway
- the target speed based on the road function and physical characteristics of the roadway
- collision history
- traffic calming tools, if appropriate, that may be implemented to better align the operating speed with the target speed

5.1 OPERATING SPEED

The operating speed is the speed at which motorists choose to travel on a given roadway. Speed choice by drivers is based on a variety of factors, including roadway and roadside characteristics, weather, traffic characteristics, vehicle characteristics and the purpose of the trip. This results in a range of operating speeds on a highway. The vehicle operating speed data, collected as part of the preliminary speed limit analysis, should be included as part of the engineering study. Additional operating speed data may need to be collected at supplementary locations.

5.2 TARGET SPEED

The target speed is the speed at which vehicles should operate on a facility in order to promote the safety of all users, while providing the appropriate level of mobility for motor vehicles. The following factors can influence target speed:

- pedestrian exposure
- cyclist exposure
- stakeholder input
- roadside environment
- roadside hazards
- average lane width
- presence of a median
- horizontal and vertical alignment
- roadway surface type
- number of intersections with public roads
- number of private access driveways
- on-street parking

A significant divergence between the operating speed and the target speed is usually a result of a road where the risks are not apparent to the driver. The engineering study should identify potential issues causing the divergence and propose potential solutions. Typical causes of differences in operating speeds and target speeds include [7]:

- The road is being used for a different function than its original intention (e.g., a local road used by through traffic, resulting in higher speeds).
- The road has been over-designed, compared to its function and surrounding land use.
- The function of the road and the surrounding land use are inconsistent.
- The risks that are present along the road have been overstated in the target speed evaluation.

One method to determine the target speed is to use the TAC *Guidelines for Establishing Posted Speed Limits* [7], which provides an easy, consistent and repeatable reference source. The *Guidelines for Establishing Posted Speed Limits* provides an evaluation tool to assess appropriate target speed, based primarily on the classification, function and physical characteristics of a roadway. The higher the level of risks, the lower the target speed.

5.3 COLLISION HISTORY

A collision history review can identify sections of roadway that are performing more poorly from a road safety perspective. A high collision frequency or rate at a location may indicate any number of operational or geometric issues and does not necessarily indicate speed as a primary contributing factor. A closer analysis of the collision types, locations, time of day, weather conditions and other factors is useful for understanding the role of speed, if any, in the collisions. NCHRP Report 613 [8] describes the following collision patterns where inappropriate speed is more likely to be a contributing factor:

- rear-end collisions – drivers not anticipating the location of the back of a queue
- run-off-road collisions – drivers avoiding conflicts in the roadway proper
- angle collisions – drivers accepting gaps that are too small

Analysis of the collision data is necessary to determine if these patterns could also be attributed to other factors, such as driver inattention or impairment, geometric conditions (alignment or sight distance) or other conditions that do not meet a driver's expectations.

5.4 TRAFFIC CALMING

Traffic calming is the broad term used to describe the process and measures to address concerns about the behaviour and speeds of motorists. When traffic volumes, vehicle speeds or driver behaviour are considered inappropriate for the type of adjacent land uses and the pedestrian, cyclist and other activities that occur along the roadway, traffic calming may be considered. The

engineering study should identify appropriate traffic calming measures and their expected benefits. Additional information on traffic calming is provided in Appendix A.

Traffic authorities can help motorists to perceive the speed limit as credible if they provide engineering countermeasures that support the speed limit and match the level of activity, conflict and risk in the roadway setting.

6 SPECIAL CONSIDERATIONS

The following sections describe fundamentals of speed limit design that should be understood when completing a preliminary speed limit analysis and setting a speed limit.

6.1 MINIMUM LENGTH OF SPEED LIMIT AREAS

The length of any particular individual speed limit should typically be set as long as possible, provided that the roadway characteristics and function remain consistent. Frequent changes in the speed limit are confusing for drivers, may lead to a loss of respect for the speed limit, and decrease voluntary compliance. Therefore, it is desirable to minimize the number of speed limit changes, and to provide minimum lengths for each speed limit.

TAC [3] states that from a human factors perspective, it may be best to coordinate the minimum length with the time required to travel the length of roadway at the speed limit. This results in different minimum lengths for different speed limits, but provides drivers with some consistency, and ensures an adequate length to provide enforcement. Table 5 provides the minimum lengths, based on 30 seconds of driving time.

Table 5: Ideal Minimum Speed Limit Lengths

Posted Speed Limit (km/h)	Ideal Minimum Length (m) [1]
50	400
60	500
70	600
80	650
90	750
100	850

1 The ideal minimum lengths do not apply to speed limits in transition zones.

In many instances, a balance will need to be struck between providing minimum lengths for speed limits, and locating the beginning and end of speed limits, at locations where there are definite changes in the character of the roadside development.

6.2 LOCATING THE BEGINNING AND END OF SPEED LIMITS

The preferred location for the beginning and end points of speed limits is where there are definite changes in the character of the roadside development, such as:

- density of access points and intersections
- lateral distance of buildings
- presence of roadway lighting
- number and width of lanes
- type and width of shoulders
- change in the presence of sidewalks, curbs or ditches

It is often desirable to begin and end a speed limit to encompass an important road intersection or the driveway of a major generator like a school or residential development. It is important to note the location of other traffic control devices along the roadway when considering the placement of speed limit signage.

6.3 SEASONAL SPEED LIMITS

Seasonal speed limits apply for a specified period during the year, generally at locations where traffic and vulnerable road user volumes significantly vary (e.g., a resort area that is popular in summer, but only sparsely populated for the remainder of the year). In these instances, it may be necessary to conduct the target speed analysis for both situations and collect operating speed data during different time periods. Section 97(2) of The Highway Traffic Act authorizes restricted speed zones for specified periods of the year.

6.4 HAZARDOUS CONDITIONS

Speed limits should not be used to warn motorists of hazardous conditions (e.g., a sharp curve in the roadway). If a hazardous condition exists within the roadway, the condition should be corrected. As an alternative, an appropriate warning sign, in conjunction with an advisory speed tab, should be posted so motorists are aware of the reason they should be reducing their speed.

6.5 SPEED LIMITS IN TRANSITION ZONES

A transition zone is the section of roadway between a rural high-speed highway and a community or roadway with a much lower speed limit. Transition zones present unique challenges for identifying appropriate speed limits.

Transition zone speed limits may be considered when there is a difference in posted speed of greater than or equal to 40 km/h between successive speed limits. The recommended speed limit

change interval in transition zones is 20 km/h or 30 km/h increments, to help motorists better differentiate between speed limits and adapt their driving behaviour accordingly. For example, a transition zone speed limit of 70 km/h may be introduced between a 100 km/h and 50 km/h speed limit.

The purpose of transition zone speed limits is to reduce speeds incrementally before a vehicle enters a community after travelling on a high-speed rural highway. In order to ensure a high rate of motorist compliance with the intended role of these speed limits, it is critical to have transition zones that are properly designed with realistic and clearly posted speed limits.

Transition zone speed limits are typically short in length. A minimum transition speed zone 250 metres long is desirable. This allows for the placement of reduced speed ahead signs and a sufficient speed limit length to achieve compliance.

Transition zone speed limits may be considered for the following conditions:

- existing operational or safety issues (e.g., due to speed differential between vehicles or speed exceeding what is suitable for the roadway environment)
- a history of overly aggressive braking at the entrance to the lower speed limit area
- low speed limit compliance in the lower speed limit area
- expected compliance with a transition zone speed limit

Transition zone speed limits are not always beneficial and a difference in posted speed of greater than or equal to 40 km/h between successive speed limits is acceptable. Several studies have shown that transition zone speed limits did not significantly impact the variance in speeds as vehicles travel from the higher speed limit to the lower speed limit [9] [10]. An engineering speed limit study may be beneficial in evaluating the desirability of a transition zone speed limit and identify any treatments that may improve the operation of the transition zone.

When considering transition zone speed limits, it is important to understand that speed limit compliance issues may arise if the speed reduction seems unjustified (in the opinion of drivers) due to the rural nature of the roadway cross-section. It is recommended that the speed limit be as consistent as possible with the characteristics of the road. The physical characteristics in the transition zone should be self-explanatory in guiding drivers to lower their speeds. The road cues and the posted speed limit should provide a uniform message.

7 SUMMARY

Speed limits provide road users with a primary source of speed information (in addition to the design of the road and the roadside) and form the basis for legal enforcement. One of the many ways to create a safer road environment is to provide credible speed limits that match the intended function and physical characteristics of a roadway with the expectation of drivers.

Traffic authorities can complete a preliminary speed limit analysis by collecting vehicle operating speed data to determine the ideal speed limit, based on current vehicle operating speeds. It is generally acceptable for the traffic authority to set the speed limit within the ideal posted speed range, based on the 85th percentile speed. In these cases, the traffic authority can use the guiding principles and additional information provided in this guide to select the appropriate speed limit and the beginning and end points defining the speed limit area.

Where there is a desire by the traffic authority to set a speed limit not supported by the operating speeds, an engineering study should be completed. Posted speed limits that are significantly different than operating speeds can contribute to greater speed dispersion and increased risk of collisions. The engineering study should identify potential issues causing the divergence and propose potential solutions. The function and physical characteristics of the roadway should be self-explanatory in guiding drivers to select the appropriate speed. The road cues and the speed limit should provide a uniform message.

8 PROVINCIAL HIGHWAY SPEED LIMIT REVIEW PROCESS

Manitoba Infrastructure (MI) applies the following process when reviewing applications for changes to speed limits on provincial highways, as overviewed in Figure 5.

Application Submitted

Applications requesting a review of or change to speed limits on provincial routes may be submitted online, using the intake form accessed by municipal officials at Municipalities Online.

Initial Review

MI will review the application for completeness and accuracy. If required, MI will contact the applicant for further information or clarification.

Data Collection, Analysis and Recommendation

MI collects any needed data in collaboration with the applicant. Data may include operating speeds, road user types and volumes, collision history, and site context and conditions. MI analyzes data to identify appropriate speed limits for the location. Based on the data and analysis, an initial recommendation is provided by the delegated official.

Clarification

When the initial request is not supportable, data is refined and additional options are developed and discussed in consultation with the applicant.

Approved

MI will develop and arrange for the approval of any necessary supporting regulations. A notice of acceptance is sent to the applicant, outlining any conditions or requirements, when regulations are approved and registered. Once regulations are in place, MI will install required signs.

Reviewed

An Interdepartmental Review Committee reviews all applications not approved as requested. The decision may be overturned and moved to approved, or upheld and moved to change denied.

Change Denied

A notice of denial is sent to the applicant, with MI's reasons for concern. The notice will offer the appeal process.

Appeal Process

The local government may appeal the submission by filing an appeal. An executive committee, appointed at the minister's discretion, will review the application, data and analysis. The committee would review the file and render an appeal decision. The appropriate correspondence (approved or approval denied) would then be sent to the applicant.

Approval Denied

A final notice of denial is sent to the applicant, with MI's explanation of the denial.

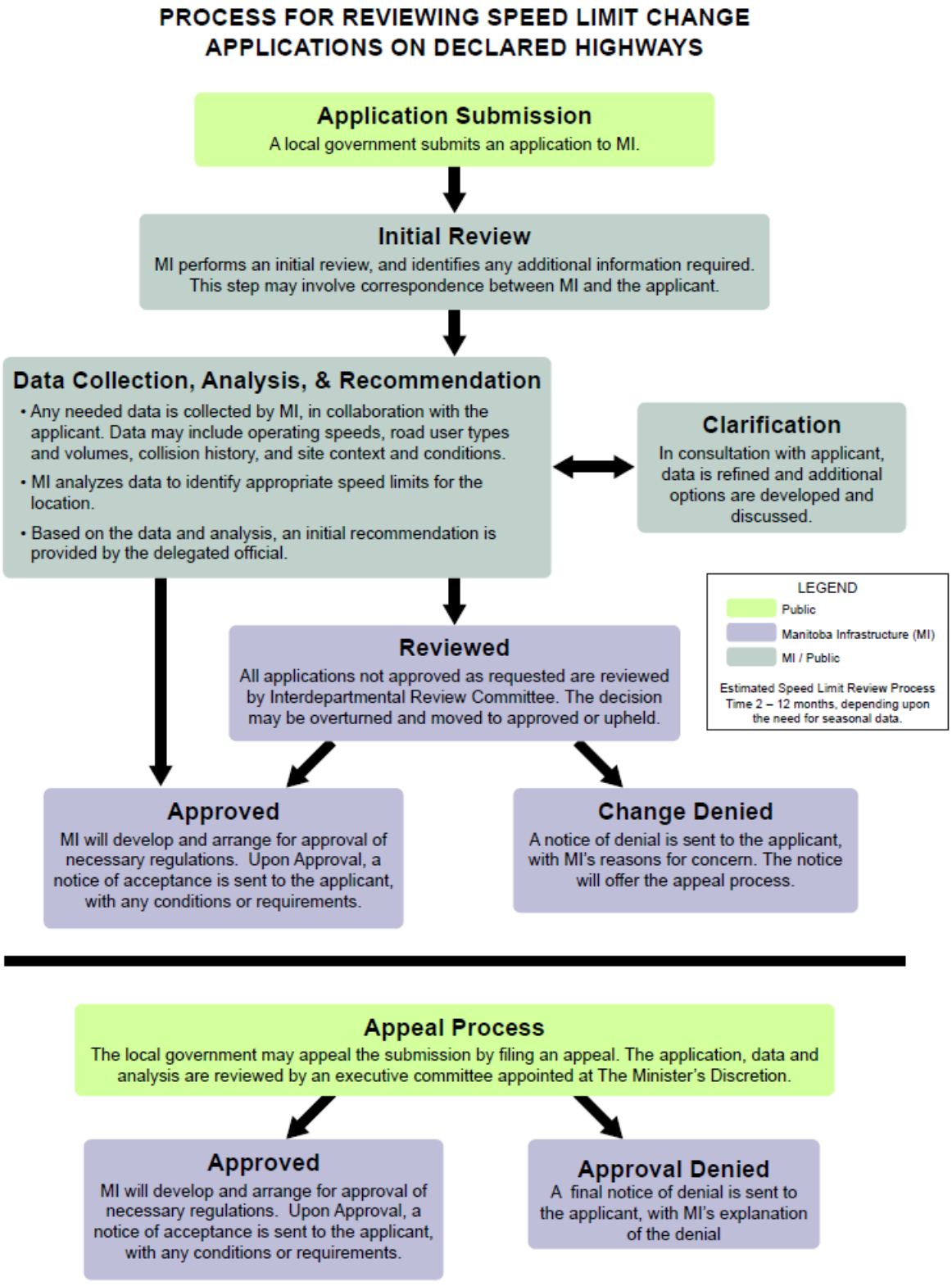

Figure 5: Process for Evaluating Speed Limit Change Requests on Provincial Highways

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APPENDIX A: SPEED MANAGEMENT

Speed management is a critical task that traffic authorities must undertake to balance the safety and mobility needs of all road users throughout the transportation network. This appendix provides important background information related to speed and safety, as well as an overview of important speed management principles that are not the primary focus of this guide.

RELATIONSHIP BETWEEN SPEED LIMIT AND OPERATING SPEED

Requesting a change in the speed limit is a common solution that comes to mind for changing vehicular speeds on a roadway. Several studies have concluded that changes in mean operating speed do not match changes in posted speed limit. The actual change in mean operating speed is, on average, approximately 25 per cent of the change in the posted speed limit [11].

It is inappropriate to set a posted speed limit that is inconsistent with drivers' perceptions and then to rely on enforcement efforts to reduce operating speeds [7]. Most drivers select their speed based on perceptual messages provided by the roadway and its environment. For this reason, it is critical to design roads that are self-explaining. The posted speed limit should fit the drivers' expectations based on the road environment ahead. The simple act of reducing the speed limit will likely have very little impact, without ongoing visible enforcement or significant modifications to the design and appearance of the roadway [3].

RELATIONSHIP BETWEEN SPEED AND COLLISIONS

There is a strong correlation between collision severity and the vehicle speed at impact. Generally, as speed increases, so does injury severity. The rapid deceleration of the vehicle creates a large change in kinetic energy during a collision, which is absorbed by the vehicle occupants, potentially resulting in personal injuries. The direct relationship between speed and collision severity is even more pronounced in collisions involving pedestrians and cyclists. In the case of collisions with pedestrians, several studies report the risk of pedestrian fatality at 50 km/h being twice as high as the risk at 40 km/h and more than five times higher than the risk at 30 km/h [12] [13].

Unlike the straightforward relationship between speed and injury severity, the association between speed and collision frequency is more complex. Generally, studies have shown that collision rates increase with speed. However, some studies have found no correlation. Although there are many causes for collisions, in general, they can be mitigated where drivers have the time and space required to react to the event that may cause the collision. As speed increases, the distance covered during a driver's perception, reaction and braking time also increase. This

results in a greater distance to manoeuvre to avoid a collision at greater speeds and consequently can increase collision frequency [11].

RELATIONSHIP BETWEEN SPEED VARIANCE AND COLLISIONS

Speed variance is a measure of the difference in vehicle speeds from the mean operating speed. The Transportation Association of Canada (TAC) *Speed Management Guide* [3] states that as speed variance increases, collision risk also increases. Studies that have compared the crash rates between roads with a large speed variance to roads with a small speed variance mainly conclude that roads with a large speed variance have a higher crash risk [14] [15]. The rationale for this argument is that increased speed differentials increase the chances for interactions and conflicts (such as lane change and passing manoeuvres) between vehicles. As speed differential decreases, a more consistent traffic flow is developed, which improves driver certainty and roadway safety. Speed limits that are set relative to the expectations of drivers are expected to decrease speed variance.

GEOMETRIC DESIGN

Geometric design elements are the visible elements of the roadway itself, such as horizontal alignment, number and width of lanes, presence and type of median, sidewalks and cycling facilities. One of the principal methods of integrating speed management into the planning and design process for roads is better and more explicit consideration of speed during the design process.

The following documents provide guidance on geometric design:

- The **Geometric Design Guide for Canadian Roads** [16] provides design guidance for freeways, arterials, collectors and local roads in both urban and rural locations, as well as guidance for integrated pedestrian and bicycle design.
- The **Bikeway Traffic Control Guidelines for Canada** [17] outline the appropriate traffic control for the installation of signs and pavement markings on bikeways and offer diagrams of typical installations.

TRAFFIC CALMING

Traffic calming is the broad term used to describe the process and measures to address concerns about the behaviour and speeds of motor vehicle drivers. Traffic calming mostly uses physical tools, known as horizontal or vertical deflections, to reduce vehicle speed and traffic congestion.

The primary purpose of traffic calming is to support the livability and vitality of residential and commercial areas through improvements in non-motorist safety, mobility and comfort. Traffic calming may also be used to encourage drivers to adopt a uniform speed without excessive acceleration or deceleration.

The following documents provide guidance on traffic calming plans and measures:

- The **Canadian Guide to Traffic Calming** [18] provides information and guidance related to the planning, design, installation, operation and maintenance of traffic calming measures on local, collector and arterial roads. The guide provides an understanding of the principles of traffic calming and the processes, tools and techniques to implement it properly.
- The **Speed Management Guide** [3] provides information and tools to facilitate safer Canadian roadways through speed management, with the focus on infrastructure methods of managing speeds.
- The **Traffic Calming ePrimer** [19] is a free, online resource available for public use. The ePrimer presents a thorough review of current traffic calming practices, by providing illustrations of various traffic calming measures and consideration for their appropriate application, including design specifics and their expected effects on speed.
- The **Speed Management ePrimer for Rural Transition Zones and Town Centers** [20] is a free, online resource available for public use. The ePrimer presents a review of speeding-related safety issues facing rural communities along with basic elements required for data collection, information processing and countermeasure selection by rural transportation professionals and community decision makers.

Traffic calming measures can be effective in reducing motor vehicle speeds, decreasing traffic volumes and alleviating conflicts between street users, depending on their location and intended purpose. However, they can also potentially have negative effects on the mobility of neighbourhood residents, transit operations, road maintenance activities and on emergency vehicle response times. In some cases, traffic calming will result in the unintended diversion of traffic to other streets, thus shifting the problem.

The objective and challenge for those implementing a traffic calming plan is to determine the best combination of measures that result in a net improvement (both real and perceived) in the quality of life and community safety, at a reasonable cost. Most Canadian experience and interest in traffic calming has been for local and collector streets in urban or rural town settings, where properly designed measures have generally proven effective and suitable for use. Traffic calming

is generally not suitable for major thoroughfares through communities and high-speed roadways in rural settings.

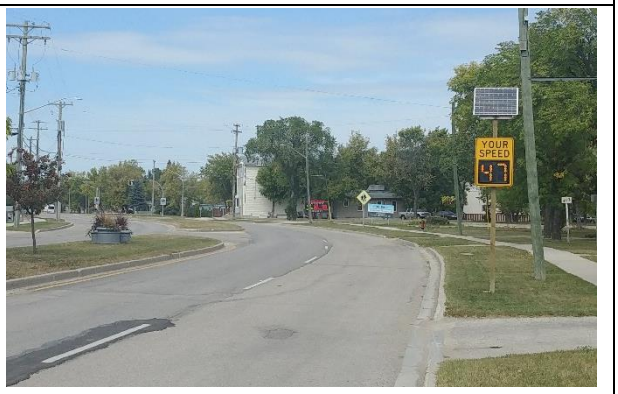
The following are examples of common traffic calming measures.

- A curb bulb out, which is a horizontal intrusion of the curb into the roadway, resulting in a narrowed section of the roadway.
- A raised median island, which is an elevated median constructed on the centerline of a two-way roadway to reduce the overall width of the adjacent travel lanes and require deflection of an otherwise straight travel path.
- Roundabouts, which are raised islands located in the centre of an intersection that motorists navigate around in a counter-clockwise direction. They also include median islands on all approaches to guide vehicles into the roundabout.
- A speed display device, which is an interactive sign that displays vehicle speeds as oncoming motorists approach.

Curb bulb out

Raised median

Roundabout



Speed display device

Figure 6: Example Traffic Calming Methods

APPENDIX B: SPOT SPEED STUDY METHODOLOGY

Spot speed studies are used to determine the operating speed characteristics of a traffic stream at a specific location. There are several methods to collect spot speed data including radar, automated equipment (e.g., traffic loops) and the manual stopwatch method. The data collector should be aware of the limitations and difficulties of the data collection method used.

Considerations in collecting and analyzing speed data are:

- When the purpose of the study is to observe general operating speed characteristics, the study is typically conducted when traffic is free flowing.
- The study should be conducted under ideal weather (not raining or snowing) and road surface conditions (road surface should not be wet or snow covered).
- The data collector should not be too obvious, so drivers do not vary their normal driving behavior.
- In a platoon of vehicles, only the speed of the first vehicle is typically recorded. The other vehicles are likely not travelling at a self-selected speed.
- The study location should not be too close to major intersections or traffic signals.
- Vehicles involved in, or affected by, passing or turning manoeuvres are typically not recorded.
- Vehicle speeds in both directions of travel can generally be grouped together for analysis. In some instances, it may be beneficial to analyze each direction separately, if there are large discrepancies in vehicle speeds by direction.
- It is common to observe a sample size of 100 vehicles. This sample size generally yields between a one and 4 km/h error in the 85^{th} percentile speed (assuming a standard deviation of 8 km/h and 95 per cent level of confidence). Achieving a sample size of 100 vehicles on low-volume roads can be difficult. On these roads, a minimum sample duration of two hours can be applied (for practical purposes), even if 100 vehicles have not been recorded.

The following pages show an example of a completed spot speed study data collection form and an analysis form. Blank spot speed study and analysis forms are also provided for use.

Example Spot Speed Study Form

Location Description: Town X, on Main Street, 150 metres east of Queen Street intersection

Study Characteristics

Date:	September 20, 2018	Start Time:	14:00
Observer:	First name, Last name	End Time:	15:30

Roadway Characteristics:

Number of lanes:	2	Posted Speed Limit:	70

Speed range (km/h)	Observed Speeds (direction 1) Northbound	Observed Speeds (direction 2) Southbound
< 20		
20 – 24		
25 – 29		
30 – 34		
35 – 39		
40 – 44		
45 – 49		
50 – 54	1	2
55 – 59	4	4
60 – 64	9	8
65 – 69	8	7
70 – 74	8	9
75 - 79	5	7
80 – 84	2	2
85 – 89		2
90 – 94		1
95 – 99		
100 - 104		
105 – 109		
110 – 114		
115 – 120		
120 - 124		
≥ 125		

Example Spot Speed Analysis Form

Speed range (km/h)	Observations (direction 1)	Observations (direction 2)	Total (both directions)	Cumulative Frequency	Cumulative Per cent
< 20					
20 – 24					
25 – 29					
30 – 34					
35 – 39					
40 – 44					
45 – 49					
50 – 54	1	2	3	3	3%
55 – 59	4	4	8	11	11%
60 – 64	9	10	19	30	30%
65 – 69	10	12	22	52	52%
70 – 74	13	16	29	81	81%
75 - 79	5	7	12	93	93%
80 – 84	2	2	4	97	97%
85 – 89		2	2	99	99%
90 – 94		1	1	100	100%
95 – 99					
100 - 104					
105 – 109					
110 – 114					
115 – 120					
120 - 124					
≥ 125					
Total	44	56	100		

85th percentile:	76 km/h
15 km/h pace:	60 – 74 km/h
Per cent in pace:	70%

(See calculations on following page)

Example Spot Speed Analysis Calculations

85th Percentile Speed. The 85th percentile speed is the speed at or below 85 per cent of the measured speeds. Using the sample study from the previous page, calculate the 85th percentile as follows:

$$85^{th}\text{ percentile} = \frac{85 - P_{min}}{P_{max} - P_{min}} * (S_{max} - S_{min}) + S_{min}$$

Where: P_{max} = the high end of the cumulative per cent just greater than 85 per cent
P_{min} = the high end of the cumulative per cent just less than 85 per cent
S_{max} = the high end of the speed range containing the 85th percentile
S_{min} = the low end of the speed range containing the 85th percentile

$$85^{th}\text{ percentile} = \frac{85 - 81}{93 - 81} * (79 - 75) + 75 = 76$$

15 km/h pace. The 15 km/h pace is the 15 km/h range of speeds that encompasses the greatest percentage of measured speeds in a spot speed study. Using the example study from the previous page, the 15 km/h pace is the range of 60 km/h – 74 km/h.

Speed range (km/h)	Observations (direction 1)	Observations (direction 2)	Total (both directions)	Cumulative Frequency	Cumulative Per cent
55 – 59	4	4	8	11	11%
60 – 64	9	10	19	30	30%
65 – 69	10	12	22	52	52%
70 – 74	13	16	29	81	81%
75 - 79	5	7	12	93	93%

Per cent in pace. The per cent in pace is the percentage of measured speeds that fall within the 15 km/h pace. Using the sample study from the previous page, calculate the per cent in pace as follows:

$$\text{Per cent in pace} = \frac{\text{sum of total vehicles in 15 km/h pace}}{\text{total sample size}} = \frac{19+22+29}{100} = 70$$

Spot Speed Study Form

Location Description:	

Study Characteristics

Date:	Start Time:
Observer:	End Time:

Roadway Characteristics:

Number of lanes:	Posted Speed Limit:

Speed range (km/h)	**Observed Speeds (direction 1)**	**Observed Speeds (direction 2)**
< 20		
20 – 24		
25 – 29		
30 – 34		
35 – 39		
40 – 44		
45 – 49		
50 – 54		
55 – 59		
60 – 64		
65 – 69		
70 – 74		
75 - 79		
80 – 84		
85 – 89		
90 – 94		
95 – 99		
100 - 104		
105 – 109		
110 – 114		
115 – 120		
120 - 124		
≥ 125		

Spot Speed Analysis Form

Speed range (km/h)	Observations (direction 1)	Observations (direction 2)	Total (both directions)	Cumulative Frequency	Cumulative Per cent
< 20					
20 – 24					
25 – 29					
30 – 34					
35 – 39					
40 – 44					
45 – 49					
50 – 54					
55 – 59					
60 – 64					
65 – 69					
70 – 74					
75 - 79					
80 – 84					
85 – 89					
90 – 94					
95 – 99					
100 - 104					
105 – 109					
110 – 114					
115 – 120					
120 - 124					
≥ 125					
Total					

85th percentile:	
15 km/h pace:	
Per cent in pace:	

APPENDIX C: PRELIMINARY SPEED LIMIT ANALYSIS OUTLINE

The following identifies key components of the Preliminary Speed Limit Analysis:

I. Study Background

Describe why the speed limit analysis is being undertaken.

II. Study Area Description

Field Investigation – Describe the characteristics of the roadway, such as the number of lanes, roadway width, presence of roadside hazards, presence of pedestrians or cyclists, number of access points, roadway surface type and traffic volumes.

Existing Speed Limits – Identify the locations of existing speed limits in the immediate vicinity of the study area and label these in map form.

III. Speed Limit Analysis and Discussion

Operating Speed – Determine the operating speed characteristics, based on the observed 85^{th} percentile speed, 15 km/h pace, and per cent in pace.

Describe the results of the preliminary speed limit analysis and any additional information considered.

IV. Recommendation

State the recommendations based on the preliminary speed limit analysis.

Provide a map identifying the recommendations.

V. Implementation

Describe the next steps as to how the traffic authority will implement the recommendations (if changes are being recommended).

APPENDIX D: PRELIMINARY SPEED LIMIT ANALYSIS EXAMPLE 1

SUBJECT: Preliminary Speed Limit Analysis – Main Street, near Town X

This memorandum details the findings and recommendations of the preliminary speed limit analysis conducted on Main Street near Town X.

Background

The Town of X have requested that a new speed limit of 70 km/h be implemented on Main Street on the approach to Town X. Local stakeholders have concerns regarding the increased development over the last several years, which they believe has resulted in increased total vehicle traffic, increased truck traffic, and increased safety concerns.

Study Area Description

The existing speed limits and extent of the requested area for the new 70 km/h speed limit are illustrated in Figure 1. Currently the existing speed limit on Main Street is 90 km/h.

Figure 1: Existing and Requested Speed Limits

Analysis and Discussion

Two spot speed studies were completed on Wednesday November 28, 2018. The following terms are used to define the vehicle operating speed characteristics:

- *85th percentile speed.* The speed at which 85 percent of the measured speeds in a spot speed study are at or below.
- *15 km/h pace.* The 15 km/h range of speeds that encompasses the greatest percentage of measured speeds in a spot speed study.
- *Percent in pace.* The percentage of speeds that fall within the 15 km/h pace.

Table 1 provides a summary of the observed vehicle speeds.

Table 1: Vehicle Operating Speed Data

ID	Speed study location	Posted speed limit (km/h)	85th percentile speed (km/h)	15 km/h pace	Percent in pace (%)
1	150 m east of Queen St	90	76	60 – 74	70
2	500 m east of Queen St	90	78	65 – 79	72

The study area and the speed study collection sites are not part of a transition zone between a rural high-speed highway and a much lower speed limit. Therefore, it is not necessary to discuss special considerations for transition zones.

The percent in pace at both study locations sites was well above 60 percent, and motorists are generally fairly consistent in their speed.

The ideal posted speed limit based on the 85th percentile speeds is 70 or 80 km/h.

Recommendation

The requested speed limit of 70 km/h is supported by speed data collected at the study area. It is recommended that a new speed limit of 70 km/h be implemented on Main Street beginning at Queen Street and continuing easterly for a distance of 700 m. This is illustrated in Figure 2.

Figure 2: Recommended Speed Limits

Implementation

The traffic authority will develop and arrange for the approval of necessary supporting regulations. When regulations are approved and registered a notice of acceptance will be sent to the applicant. Once regulations are in place, the traffic authority will install required signs.

APPENDIX D: PRELIMINARY SPEED LIMIT ANALYSIS EXAMPLE 2

SUBJECT: Preliminary Speed Limit Analysis – Kings Highway at Town Y

This memorandum details the findings and recommendations of the preliminary speed limit analysis conducted on Kings Highway at the western limits of Town Y.

Background

The Town of Y have requested that the existing 50 km/h speed limit be extended approximately 700 metres westerly and the existing 70 km/h speed limit correspondingly be shifted 700 metres westerly. Local stakeholders have concerns regarding speeds through town and speeds at the approaches to businesses on the outskirts of town.

Study Area Description

The existing speed limits and extent of the requested area for the extended 50 km/h speed limits and shifted 70 km/h speed limit are illustrated in Figure 1.

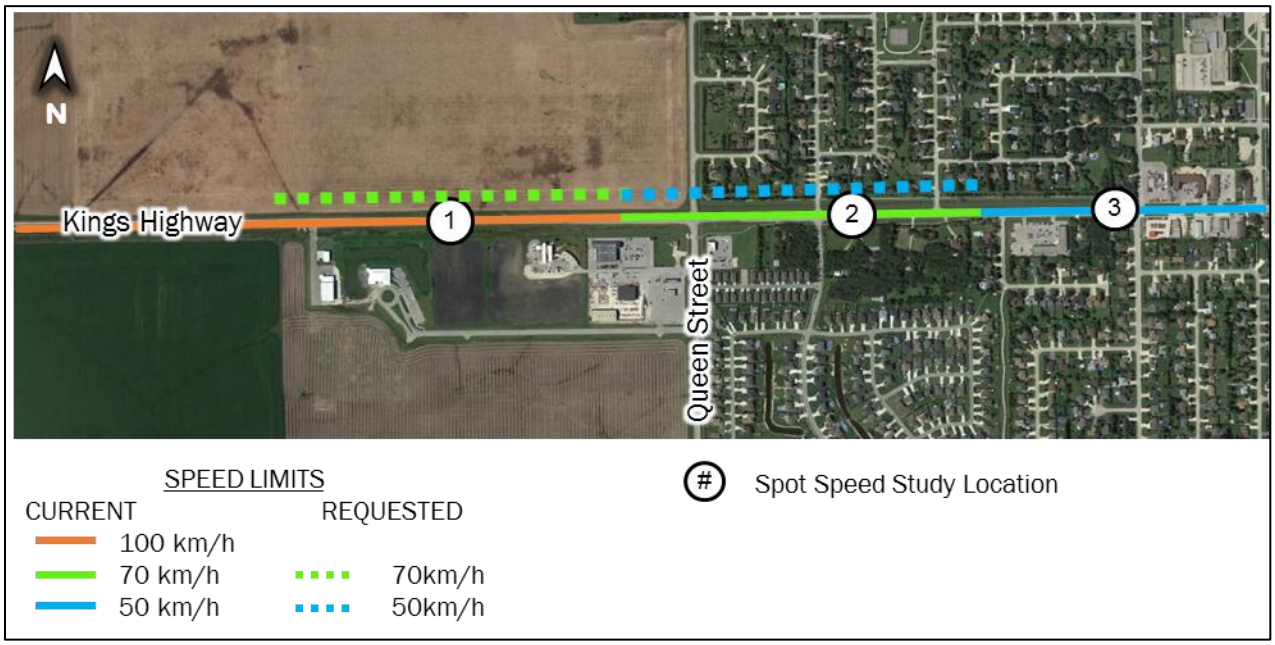


Figure 1: Existing and Requested Speed Limits

Analysis and Discussion

Two spot speed studies were completed on Wednesday November 28, 2018. The following terms are used to define the vehicle operating speed characteristics:

- *85th percentile speed.* The speed at which 85 percent of the measured speeds in a spot speed study are at or below.
- *15 km/h pace.* The 15 km/h range of speeds that encompasses the greatest percentage of measured speeds in a spot speed study.
- *Percent in pace.* The percentage of speeds that fall within the 15 km/h pace.

Table 1 provides a summary of the observed vehicle speeds.

Table 1: Vehicle Operating Speed Data

ID	Speed study location	Posted speed limit (km/h)	85th percentile speed (km/h)	15 km/h pace	Percent in pace (%)
1	500 m west of Queen St	100	99	85 – 99	66
2	400 m east of Queen St	70	72	55 – 69	74
3	900 m east of Queen St	50	54	40 – 54	82

The primary request is the extension of the 50 km/h speed limit westerly for a distance of 700 metres. The 50 km/h speed limit is not part of a transition zone between a rural high-speed highway and a much lower speed limit. Therefore, it is not necessary to discuss special considerations for transition zones.

At study location 1 the current posted speed limit is 100 km/h and the request is to reduce the speed limit to 70 km/h through this area. The percent in pace is 66, which is somewhat low, this is likely because motorists are accelerating/decelerating at slightly different rates on their approach/departure to Town Y. The 85th percentile speed is 99 km/h, which corresponds to an ideal posted speed limit of 90 or 100 km/h.

At study location 2 the current posted speed limit is 70 km/h and the request is to reduce the speed limit to 50 km/h through this area. The percent in pace is 74, which indicates that drivers are perceiving the roadway function and physical characteristics in a fairly consistent manner. The 85th percentile speed is 72 km/h, which corresponds to an ideal posted speed limit of 70 or 80 km/h.

Speed data was also collected at study location 3 to determine if motorists were adjusting their speeds to the 50 km/h limit as they continued into town. The percent in pace is 82, which indicates that drivers are perceiving the roadway function and physical characteristics in a very consistent manner. The 85th percentile speed is 54, which supports the current posted speed limit of 50 km/h.

Recommendation

The requested extension of the 50 km/h speed limit westerly for a distance of 700 metres and the corresponding shift of the existing 70 km/h speed limit westerly are not supported by the current vehicle operating speeds.

It is recommended that the requested speed limit changes not be approved and that no changes occur to the current speed limits. It is generally inappropriate to set a speed limit that is inconsistent with drivers' perceptions. Speed limits that are significantly different than operating speeds can contribute to greater speed dispersion and increased risk of collisions.

If there are continued concerns with the existing posted speeds and operating speeds, an engineering speed limit study is required to identify the ideal target speeds for the roadway. The engineering speed limit study will also identify engineering design or traffic calming tools that may be implemented to better align the operating speeds with the target speeds.