Attachment #1
EPW-020-24

Town of Whitchurch-Stouffville

Speed Management and Traffic Calming Report

FINAL REPORT

CIMA+ file number: Z0018233
03 December 2024 – Review 01

Town of Whitchurch-Stouffville

Speed Management and Traffic Calming Report

FINAL REPORT

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1. Introduction

CIMA has been retained by the Town of Whitchurch-Stouffville to update the Town's policy on speed management as it relates to the setting of posted speed limits and traffic calming. This report presents the following:

- **Section 1** - Speed management and traffic calming: purpose and definitions
- **Section 2** - Previous work completed by the Town and impetus for the development of this policy
- **Section 3** - Development of an approach to speed management through setting posted speeds
- **Section 4** - Traffic calming principles
- **Section 5** - Traffic calming location selection guidelines

1.1 Purpose

The purpose of the Town's Speed Management and Traffic Calming Report is to establish base posted speeds and define what traffic calming is and provide a general set of guidelines for Town staff to identify, evaluate, prioritize and implement traffic calming measures, where warranted, in the town of Whitchurch-Stouffville.

1.2 Definitions

Speed management involves providing a safe level of mobility for all affected road users by setting appropriate speed limits and reducing vehicle speeds through a suite of speed management strategies (engineering, education and enforcement), thereby reducing and/or mitigating the impact of speeding-related crashes.

Speed management can involve education measures such as road safety campaigns or enforcement measures such as police or automated speed enforcement. Engineering measures however involve changing the character of the roadway through traffic calming.

Traffic calming can be defined as the process involving the evaluation and subsequently, implementation of road safety measures to reduce speed and encourage safe driving behaviour for the benefit of all road users. A successful traffic calming program is one which will alter the street in such a way that motorists will drive slower, exercise caution, and bring the street back closer to its intended use while limiting the negative effects on emergency response agencies and operational costs.

Some examples of traffic calming measures include:

- Installation of special pavement markings and/or signage
- Changes to the roadways surface texture and/or colour
- Changes to the vertical and/or horizontal alignment of the roadway (may require road reconstruction)
- Changes to the travelled portion of the roadway through pavement and/or lane narrowing, such as vertical centre line treatment

It is important to note that not all the measures can be implemented on the evaluated roads as there are parameters that need to be taken into considerations (i.e., roadway geometry, road classification, operating speeds, etc.) before recommending the installation of the measure.

1.3 Role of Traffic Calming

As part of the Town's Traffic Calming Strategy, the evaluation and implementation of traffic calming becomes necessary when the amount of vehicular traffic, speed levels, and/or observed driver behaviour does not correspond with the type of road, the context of the surrounding areas, or the activities of other road users. The role and purpose of traffic calming in the Town of Whitchurch-Stouffville is to incorporate best practices in traffic calming with a local context that provides a more appropriate, efficient, flexible and systematic framework through which to address traffic safety issues relating to excessive speeding, traffic infiltration, and collision frequency.

Although the introduction of traffic calming measures can mitigate the negative effects of vehicle use, they can also have potentially negative effects on other modes of transportation, operations and maintenance activities conducted by the road authority, and emergency vehicle response times. As such, the Town's Traffic Calming Report should consider the following aspects:

- It supports decision-making process from the moment that a traffic related issue is identified to implementation of the selected measure
- It informs residents about the different elements composing the traffic calming toolbox and process
- It promotes a fair allocation of resources through an incremental implementation of required traffic calming measures

2. Background

In September of 2021, the Public Works Department presented to Council a Traffic Calming Strategy as part of the Town's first step to promote and implement their Safety Program. Through this strategy, the Town sought to reduce collisions by lowering posted speed limits and reducing operating speeds through the implementation of traffic calming measures.

To date, the Town has implemented numerous traffic calming measures such as traffic delineators, speed radar boards, enhanced pavement markings at crossings, among others. However, these have been implemented on a case-by-case basis without the support of a policy or toolbox. For this reason, Town Staff in conjunction with CIMA+ developed this report that aligns with the Town's transportation goals, Council's priorities and the principles of the Regional Vision Zero Program.

3. Speed Management

Speed management is included as part of this report given that one of the goals of implementing traffic calming is to reduce speeds on the Town's roads through the setting of speed limits throughout the community. Through the speed management report, the Town seeks to address concerns of undesirable speeds along identified corridors by consistently implementing a base speed limit depending on operating speeds observed as well as the type of road being evaluated.

3.1 Base Speed Limits

All roads in the Town of Whitchurch-Stouffville have a default speed limit of 40 km/h unless otherwise posted. To the discretion of the Town, higher speed limits may be set using the 2009 TAC *Guidelines for Establishing Posted Speed Limits*. The guidelines include a detailed step-by-step guide on assessing speed limits based on roadway geometry (presence of vertical and/or horizontal curves), lane widths, roadside hazards, pedestrian and cyclist exposure, intersection, access and interchange density, pavement condition and presence of on-street parking.

3.2 Network Review of Speed Limits

As a further step into assessing speed limits within the Town, it is recommended that the Town periodically review their road network to verify that the base speed limit is appropriate and to identify areas where operating speeds differ from the speed limit. Roads that may potentially warrant a higher posted speed would be higher volume collector roads, either in an urban or rural area. **Table 1** summarizes the recommended approach to be used for this assessment.

Table 1: Network Review of Speed Limits

Base Speed Limit	TAC Recommended Speed Limit	Operating (85th Percentile Speed)	Action
40 km/h	40 km/h	≤50 km/h	Maintain speed limit at 40 km/h
	40 km/h	>50 km/h	▪ Maintain speed limit at 40 km/h ▪ Investigate need for physical restrictions to roadway to reinforce posted speed (traffic calming) ▪ Investigate need for Automated Speed Enforcement
	50 km/h	≤50 km/h	Maintain speed limit at 40 km/h
	50 km/h	>50 km/h	▪ Review collision history and increased presence of vulnerable road users and posted speed on surrounding roads ▪ If no reported collisions and/or increased presence of vulnerable road users, increase posted speed to 50 km/h ▪ If reported collisions and/or increased presence of vulnerable road users, maintain speed limit at 40 km/h and investigate need for traffic calming measures and/or Automated Speed Enforcement

4. Traffic Calming Principles

There are several principles of traffic calming that are taken into consideration when investigating, selecting and implementing techniques suitable for local conditions. These principles involved a combination of local knowledge, technical expertise, consistency with other nearby implementations and sound engineering judgement. A brief description of the principles that the Town will follow when assessing for traffic calming is provided below:

- Identifying the actual problem to appropriately select the measure(s) to be implemented
- Quantifying the problem by understanding if it is an issue happening all day or at specific times by using data collection, observations and resident input
- Identifying the source of the problem to ensure that other measures are reviewed before implementing traffic calming measures, especially on collector or arterial roads
- Considering education and enforcement as a stand-alone measure or as a first step of an integrated solution
- Applying traffic calming measures on an area-wide basis rather than single locations
- Avoiding access restrictions to residents, transit operations and emergency services and considering all services and road users when developing traffic calming measures

- Using self-enforcing measures to minimize the need for police enforcement
- Monitoring implemented measures and reporting back to the community on results

4.1 Roadway Classification

One of the main goals of traffic calming is to restore streets to serve their intended function based on the role and classification of the street. The following section provides a summary of the traffic calming principles based on functional classification:

Local and Collector Roads

Their primary function of location streets is to provide access to adjacent properties. They are not intended to be used as through routes. On the other hand, the primary function of collector roads is to also provide access to adjacent properties in addition to collect and distribute traffic travelling in and out of the neighbourhoods[1]. On these types of roads, traffic calming is implemented to achieve the following:

- Reduce vehicle speeds
- Discourage shortcutting traffic
- Minimize conflicts between road users including motorists, cyclists, pedestrians and others
- Improve neighbourhood environment through the implementation of landscaping and design features that are considered traffic calming measures

Arterial Roads

The primary purpose of traffic calming on arterial roads is to reduce excessive vehicle speeds, alleviate conflicts between road users, and eliminate inappropriate driver behaviour. Measures that restrict or divert traffic or introduce significant vertical deflections into the street are inconsistent with the typical role and function of arterial roads and should not be implemented. There are a few arterial roads within the Town, however, these are Regional roads.

[1] 2009 TAC Canadian Guide to Traffic Calming.

5. Traffic Calming Location Selection

The traffic calming review process will typically be initiated by resident request or proactively by Town staff. Residents with traffic related concerns will be asked to submit details of their concern using a standard form that will be developed by staff, made available on the Town website, and communicated to residents as part of a detailed communication plan. Appropriate information will be gathered through this process in order to proceed with detailed analysis, including a review against several screening criteria. **Figure 1** summarizes the process for traffic calming selection. Details on the process are provided in the following sections.

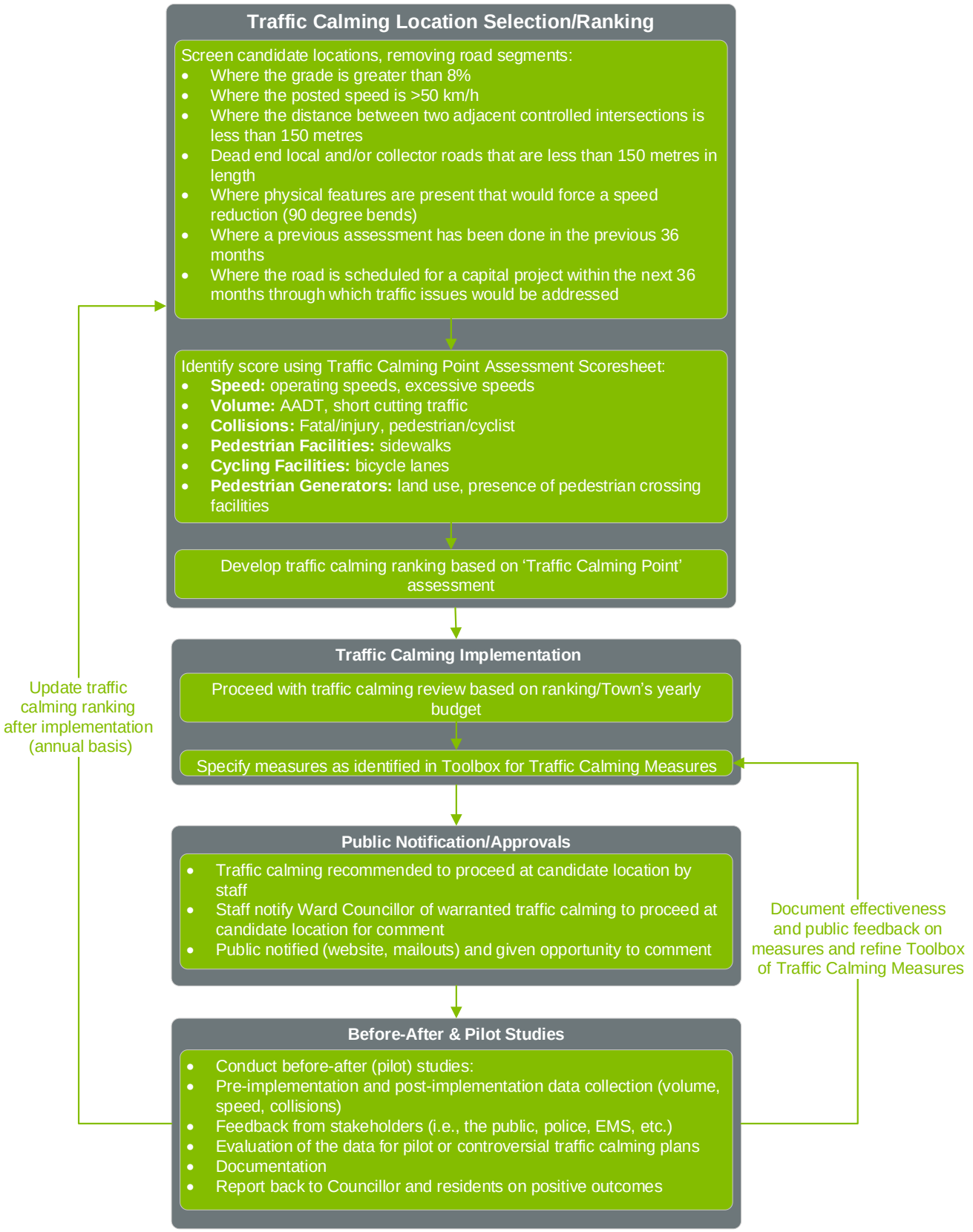


Figure 1: Traffic Calming Selection Process

5.1 Site-Specific Screening Criteria

Staff will review the location to determine if the roadway meets the criteria for implementing traffic calming measures.

The screening process sets requirements that should be met for a location to be eligible for traffic calming measures such as horizontal deflection, vertical deflection, roadway narrowing, pavement markings, traffic delineators, or enforcement. The screening criteria will also help identify whether a more complex issue exists that may need to be addressed using a different approach. Locations meeting any of the following pre-screening criteria will **not** be considered for traffic calming implementation:

- Grade > 8%: if the grade of the roadway is equal to or greater than the maximum threshold of 8%, safety considerations dictate that the location will not be considered for implementation of traffic calming measures.
- Posted speed limit > 50 km/h: if the posted speed limit is more than 50 km/h the location will not be considered a high priority for implementation of traffic calming measures.
- Block length < 150 m long: if the distance between consecutive controlled intersections along the requested route is shorter than 150 meters, the location will not be considered a high priority for implementation of traffic calming measures.
- Dead end roads < 150 m long: if the segment evaluated is a dead-end local or collector road that is less than 150 metres in length.
- 90-degree bend: if the segment evaluated has a geometry that would force a speed reduction such as 90- degree bends in the roadway
- Previous Evaluation: If the segment has had evaluations in the last 36 months.
- Planned Capital Project: location is currently scheduled for a capital project within the next 36months through which traffic issues would be addressed.

5.2 Location Scoring

Once the location being evaluated has passed the Pre-Screening Criteria, the next step is to score the location using a Traffic Calming Point Assessment Scoresheet. The determination of whether traffic calming will be required is based on the total number of points (score). The concerned road/location will not qualify for traffic calming if it scores below the minimum point threshold. The following list outlines criteria typically included in scoring locations on the need for traffic calming, and presents an example of the Traffic Calming scoresheet to be used by the Town of Whitchurch-Stouffville, adopted from the City of Hamilton (**Figure 2**):

- Traffic Speeds – points given for every selected amount of km/h the 85th percentile speed is above the speed limit.

- Traffic Volumes – points given based on the type of road being evaluated and the volumes travelling on that road.
- Collision History – points given at any location with collisions in the last 3 years or specified period, regardless of the contributing factors.
- Pedestrian Generators or Facilities – points per designated pedestrian crossing, park, or school in the area of interest, as well as presence of sidewalks.
- Bicycle Facilities or Routes – points where in the study area there is a presence of bicycle lanes, designated routes or trails, or multi-use trails.

Number	Feature	Range	Criteria	Total
Local ☐			Collector ☐	
Traffic Data				
1a	Speed	0 to 35	**5** points for every 2 km/h that the 85th percentile is greater than 7 km/h above the speed limit.	
1b	Excessive Speeds	0 to 5	**5** points if a minimum of 5% of daily traffic exceeds the posted speed limit by 15 – 20 km/h	
2	Volume	0 to 20	Local Roadways: **5** points for every 750 ADT (beyond 500) Collector Roadways: **5** points for every 2500 ADT (beyond 2000)	
3	Short-Cutting Traffic	0 to 15	**5** points if there is a presence of 25% or more short-cutting traffic, and an additional 5 points for every 10% increment above 25%	
4	Collisions	0 to 10	**2** points for every collision resulting in an injury/year over a three-year period **3** points for every collision involving a pedestrian or cyclist over a three-year period **5** points for every fatal collision over a three-year period	
Road Characteristics				
5	Pedestrian Facilities	0 to 10	**10** points for no sidewalks with evidence of pedestrian activity **5** points for sidewalks on only one side **0** points for sidewalks on both sides	
6	Cycling Facilities	0 to 5	**5** points for no dedicated cycling facilities (shared use) **3** points if cycling lanes are provided **0** points if cycle tracks are provided	
7	Pedestrian Generators	0 to 15	**5** points for each pedestrian generator such as trails, schools, playgrounds, community centres, libraries, retail centres, etc. on the street segment (no dedicated pedestrian crossing facilities provided)	
			Total	
Note: In Section 1a, points are awarded beginning at 38 km/h on a 30 km/h roadway, 48 km/h on a 40 km/h roadway and 58 km/h on a 50 km/h roadway.				
Does the location meet the minimum requirements?				
Local roadway = minimum 40 points			**YES** ☐	**NO** ☐
Collector roadway – minimum 57 points			**YES** ☐	**NO** ☐

Figure 2: Whitchurch-Stouffville Traffic Calming Scoresheet (Adopted from City of Hamilton)

The development of a customized scoresheet involves having a large amount of data for multiple road segments within the Town and identifying risk factors based on collision history, speed data, AADT, land use and road characteristics data. While the development of a tailored scoresheet is completed, the Town will be using an adopted scoresheet (**Figure 2**) to assess for traffic calming. A traffic calming ranking will then be created using the scores obtained for each road/segment being evaluated. This will provide Town Staff with a priority list for implementation purposes.

Traffic calming ranking should be reviewed on an annual basis using the most recent data collected.

5.3 Treatment Selection

Appendix A provides a detailed description of the traffic calming measure toolbox that Town Staff will use for selecting treatments for locations where traffic calming is warranted.

The selection of the measure is based on the applicability of these measures on the type of road being evaluated. This includes road classification (local or collector, urban or rural), speed limits, cross-sections, maintenance requirements, impacts to emergency services and environment. For example, some measures are only recommended to be implemented on two-lane cross-sections (one lane per direction) rather than on roads with a four-lane cross-section (two lanes per direction). This applicability is based on research completed by other jurisdictions through monitoring on the effectiveness of these measures.

The list of measures presented below was selected based on what the Town has currently implemented up to date in conjunction with best practices on neighbouring municipalities and regions. Detailed descriptions, including implementation considerations and estimates are provided in **Appendix A**.

- Pavement Markings
  - Full-Lane Transverse Bars
  - On-Road 'Signs' Pavement Markings
  - Peripheral Transverse Bars
- Roadway Narrowing
  - On-street parking
  - Lane Narrowing
  - Road Diet
  - Curb Extension
  - Traffic Delineators
- Surface Treatments
  - Textured Crosswalk

  - Textured Pavement
  - Transverse Rumble Strips
- Education and Enforcement
  - Automated Speed Enforcement (ASE)
  - Red Light Cameras (RLC)
  - Radar Speed Signs
- Horizontal Deflection
  - Traffic Circle/Roundabout
- Vertical Deflection
  - Raised Crosswalk
  - Speed Cushion
- Intersection Treatments
  - Tiger Tails
  - Reflective Strip on STOP signposts
  - Left-side STOP sign
  - Left-turn Traffic Calming

5.4 Public Notification

Prior to planning for the implementation of the selected measures, Town Staff should provide notifications to the residents in the immediate area where the traffic calming will be implemented of the proposed work. Notifications can be provided using the Town's website, mailout or through hosting in-person information sessions. The selected method of communication will be at the discretion of Town Staff. Once the public notifications have been given, the Town will provide a set period for residents to provide feedback on the proposed work. Town Staff will incorporate the feedback received and adjust, whenever possible, the proposed work.

5.5 Implementation

Implementation of the measures will be completed based on the Town's yearly budget. As mentioned before, locations will be implemented based on the priority ranking developed earlier in the process. Implementations will be planned for the non-winter months and will be completed depending on the weather and availability of staff. Larger projects will be added to draft capital and/or operating budgets for Council consideration.

5.6 Monitoring and Evaluation

Following implementation of the traffic calming measures, staff will monitor their effectiveness, refine the installation, if required, and remove measures no longer serving their intended purpose. Evaluation of the effectiveness of the implemented measures will be completed by collecting before and after data that includes traffic volumes, speed and collision data.

A

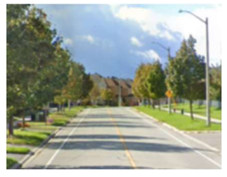
Appendix A
Traffic Calming Toolbox

Appendix A – Traffic Calming Toolbox

Type	Countermeasure	Description & Purposes	Advantages	Disadvantages	Applicability	Implementation Considerations	Cost	Cost Reference
Pavement Markings	Full-Lane Transverse Bars 	Full-lane transverse bars are a series of parallel pavement markings which extend across the majority of the travelled lane width. The series of markings may be placed closer together with distance to create the illusion that a vehicle's speed is increasing to alert the driver of the need to reduce speed.	> Vehicle Speeds: Reduction in 85th percentile speed between 5 and 15 km/h > Environment: No increase in noise > Other: - Can be implemented rapidly - No impact to emergency vehicles, snow plowing, street sweeping, and police enforcement - No adverse effect on vehicle operations	> Maintenance: - Pavement markings will require regular maintenance; increased costs if placed in the wheel path of vehicles - May be less effective in winter months due to snow/ice cover > Other: Pavement markings are not visible from significant distances upstream	> Road Classification: All roadways - Freeway off-ramps; approaches to intersection and bridges; deficient horizontal curves > Traffic Conditions: All traffic volumes > Roadway: Primarily rural cross-section; can be considered in urban areas	> Speed reduction enhanced if used in conjunction with rumble strips, but speed variability tended to increase > It is unknown if the effect on speeds can be sustained over time	> Low - Pavement markings are low cost, with the initial cost to lay markings and cost of subsequent maintenance - Durable markings have higher initial cost, but require much less regular maintenance, which avoids the traffic impacts of lane closures while repainting the transverse bars	TAC CITE - Traffic Calming Guide
Pavement Markings	On-Road 'Signs' Pavement Markings 	On-road 'sign' pavement markings provide information that would typically be shown to drivers through signage but are painted on the	> Vehicle Speeds: Reduction between 6 and 14 km/h	> Maintenance: - Pavement markings will require regular maintenance - May be less effective in	> Road Classification: Local, collector and arterial streets	> Refer to provincial legislation and guidelines, if available, to ensure standards for traffic control devices are met	$200 to $500 each	Based on information from other municipalities

Type	Countermeasure	Description & Purposes	Advantages	Disadvantages	Applicability	Implementation Considerations	Cost	Cost Reference
		roadway to provide a larger image, and one that is directly in the driver's line of sight. Some examples could be speed limit, 'SLOW', 'Stop ahead, etc.	> Environment: No increase in noise > Other: - Can be implemented rapidly - No impact to emergency vehicles, snow plowing, street sweeping, and police enforcement - No adverse effect on vehicle operations	winter months due to snow/ice cover	> Traffic Conditions: All traffic volumes > Roadway: Urban and rural cross-section > Advance of hazards/curves > Entrance treatment to urban and rural communities	> If there is no provincial guidance for placement, speed limit on-road 'sign' pavement markings should be placed in the same location as speed limit signs to reinforce regulatory environment > May be used as part of gateways to alert drivers that they are entering a rural community		
Pavement Markings	Peripheral Transverse Bars 	Peripheral transverse bars are a series of parallel pavement markings along the edge of the travelled lane widths. The series of markings may be placed closer together with distance to create the illusion that a vehicle's speed is increasing. This is done to alert the driver's awareness of the need to reduce speed. Peripheral	> Vehicle Speeds: Reduction in 85th percentile speed up to 8 km/h > Environment: No Increase in noise > Other: - Can be implemented rapidly	> Maintenance: - Pavement markings will require maintenance but not as frequently compared to full-lane transverse bars - May be less effective in winter months due to snow/ice cover	> Road Classification: All roadways > Traffic Conditions: All traffic volumes > Roadway: Primarily rural cross-section; can be considered in urban areas - Preferred where edge and centerlines are provided	> Enhanced effect on speeds when used with speed display boards > Effect on speeds may be reduced over time > Avoid overuse so visual effect of the treatment is not jeopardized (restrict use to known accident locations or situations requiring traffic to significantly reduce speed)	> Low - Pavement markings are low cost, with the initial cost to lay markings and cost of subsequent maintenance - Durable markings have higher initial cost, but require much	TAC CITE - Traffic Calming Guide

Type	Countermeasure	Description & Purposes	Advantages	Disadvantages	Applicability	Implementation Considerations	Cost	Cost Reference
		transverse bars are similar to full-lane transverse bars but require less maintenance of pavement markings.	- No impact to emergency vehicles, snow plowing, street sweeping, and police enforcement - No adverse effect on vehicle operations	> Other: Pavement markings are not visible from significant distances upstream	> Freeway off-ramps, bridge approaches, approach to an intersection, deficient horizontal curves		less regular maintenance, which avoids the traffic impacts of lane closures while repainting	
Roadway Narrowing	On-street parking 	On-street parking is the reduction of the roadway width available for vehicle movement by allowing motor vehicles to park adjacent and parallel to the curb. Angled parking is not appropriate as a traffic calming measure, due to the increased potential for conflicts. The effect of using on-street parking to narrow the effective roadway space is to reduce vehicle speeds and to reduce possible short-cutting or through traffic.	> Conflicts: Parked vehicles provide a buffer between traffic and pedestrians on sidewalks > Environment: Traffic noise may be reduced due to a reduction in traffic volumes or speeds > Other: No effect on resident access and police enforcement	> Active Transportation and Transit: - On-street parking may reduce mutual visibility for pedestrians crossing the roadway - Requires a minimum width to allow for safe passing of cyclists around opened car doors > Maintenance: Parked vehicles may obstruct street sweeping and snow removal	> Road Classification: Local and collector streets; urban commercial streets > Traffic Conditions: All traffic volumes > Roadway: Urban cross-section – curb and gutter > May be used in combination with speed humps, curb extensions, etc. > Due to varying jurisdictional guidelines and regulations, on-street parking should not be implemented if it results in substandard roadway widths which conflict	> Narrower roadway widths may not be appropriate in municipalities with significant snowfall, or for streets with relatively high two-way traffic volumes (use with caution on roads > 10,000 veh/day) > Required Pavement Width: 2.0m to 2.5m Where transit routes operate, remaining lane width should be a minimum of 3.1 m, preferably 3.3 m.	Cost per 1 km (one side): $2,000	Based on information from other municipalities

Type	Countermeasure	Description & Purposes	Advantages	Disadvantages	Applicability	Implementation Considerations	Cost	Cost Reference
				operations, unless parking restrictions are applied for these operations > Other: - Parked vehicles may obstruct driveways, or reduce visibility for motorists entering the roadway from driveways - Could increase rear-end or sideswipe collisions	with lane width, transit or emergency services requirements > Locations to Avoid: Driveways, areas with limited sight distance, bus zones, designated school zones, unfenced playgrounds, and poorly illuminated streets			
Roadway Narrowing	Lane Narrowing 	Lane narrowing is the process of reducing lane widths using pavement markings (for example, centreline, urban shoulders, bicycle lanes). The intention is for drivers to perceive the roadway to be less comfortable at higher speeds due to the narrowing of the lanes	> Vehicle Speeds: Reduction in 85th percentile speed up to 10km/h > Conflicts: If lanes are physically narrowed and space is not	> Active Transportation and Transit: Cyclists can feel squeezed closer to vehicles if no bicycle lanes are provided > Maintenance: - Pavement markings	> Road Classification: Local and collector streets > Traffic Conditions: All traffic volumes > Roadway: Urban cross-section; typically applied on two- and four-lane roadways	> Physical lane narrowing tends to provide better results than simple pavement markings, which have minimal effect > Low cost when implemented using pavement markings only, however, studies show this is less effective than narrowing roadways using physical measures as	Cost per 1 km: - Centreline: $6,000 - Urban shoulder (one side): $6,000 - Conventional bike lane (one side): $7,000 - Buffered bike lane (one side): $20,000	Based on information from other municipalities

Type	Countermeasure	Description & Purposes	Advantages	Disadvantages	Applicability	Implementation Considerations	Cost	Cost Reference
		and ultimately reduce operating speeds.	allocated to other modes, the reduced crossing distance at pedestrian crossings may reduce pedestrian-vehicle conflicts > Other: - Can be implemented rapidly if using pavement markings and no physical change is required - Space can be allocated for urban amenities and activities such as bicycle lanes - No effect on emergency vehicles, resident access, snow plowing, street sweeping, and	require regular maintenance - Pavement markings may be less effective in winter months due to snow/ice cover > Other: Reduced separation between oncoming vehicles		speeds did not appear to be affected > Ensure consistency in application to avoid driver confusion > Required Pavement Width: - Urban shoulder (one side): 1.2m to 2.0m - Conventional bike lane (one side): 1.5m to 1.8m - Buffered bike lane (one side): 1.8m to 2.8m Where transit routes operate, remaining lane width should be a minimum of 3.1 m, preferably 3.3 m.	Note: For pavement marking installation on a short road segment (i.e., less than 500m), instead of estimating the cost based on the unit price, a minimum cost of $3,000 is expected.	

Type	Countermeasure	Description & Purposes	Advantages	Disadvantages	Applicability	Implementation Considerations	Cost	Cost Reference
			police enforcement					
Roadway Narrowing	Road Diet 	where the number of travelled lanes and/or the effective width of the road is reduced in order to allocate the reclaimed space for other uses, such as wider sidewalks, turning lanes, bus lanes, pedestrian refuge islands, bike lanes, parking, etc. Typically, a Road Diet involves converting an existing four-lane, undivided roadway segment to a three-lane segment consisting of two through lanes, a centre two-way left-turn lane, and two bicycle lanes. However, other conversions are possible, such as 4-lane to 5-lane, 2-lane to 3-lane, 3-lane to 3-lane, and 5-lane to 3-lane.	> Vehicle Speeds: Reduction between 5 and 12 km/h > Conflicts: Reduction of 25% in the number of collisions per kilometre (collision density) and of 18% in the collision rate (controlled for volume)	> Emergency Response: May affect emergency vehicle response times due to added congestion, however vehicle can bypass congestion and there is a space for vehicles to pull to side of the road	> Road Classification: Most appropriate for four-lane collector and arterial roads > Traffic Conditions: Moderate traffic volumes (subject to before/after capacity analysis) > Roadway: Urban cross-section – curb and gutter	> Effective for widening sidewalks, adding bicycle lanes, and creating friendly streets for pedestrians and transit users > Preferred to be combined with other traffic calming devices and “complete street” elements > Refer to FHWA Road Diet Informational Guide for safety, operational, and quality of life considerations from research and practice, as well as guidance for decision-making process and post-implementation evaluation	> Variable depending on the extent and scope of the project - Lower if just pavement markings, signs, and potential adjustment of signals at intersections - Cost can be reduced if implemented at the same time as a repaving project or road repairs	TAC CITE - Traffic Calming Guide
Roadway Narrowing	Curb Extension	A curb extension (also known as neckdown, choker, curb bulb, or	> Vehicle Speeds: Reduction	> Active Transportation and	> Road Classification: Local	> The effectiveness of a curb extension can be increased when used in	$13,000 per pair	Costs for Pedestrian and Bicyclist

Type	Countermeasure	Description & Purposes	Advantages	Disadvantages	Applicability	Implementation Considerations	Cost	Cost Reference
		bulb-out) is a horizontal intrusion of the curb into the roadway resulting in a narrow section of roadway. The curb is extended on one or both sides of the roadway to reduce its width to as a little as 6.0 m for two-lane, two-way traffic. In urban environments, it is possible to implement curb extensions by removing existing parking spaces. The purpose of a curb extension is to reduce vehicle speeds, reduce crossing distance for pedestrians, increase visibility of pedestrians, and prevent parking close to an intersection.	between 2 and 8 km/h > Conflicts: - Reduced pedestrian crossing distance at intersections may reduce pedestrian-vehicle conflicts - Better mutual visibility between pedestrians and motorists if crosswalks are installed between curb extensions > Environment: Landscaped curb extensions, can improve the appearance of a street > Other: - No effect on resident access, snow	Transit: - Not compatible with bicycle lanes - Can be hazardous for drivers and cyclists if not designed and maintained properly - Cyclists can feel squeezed closer to vehicles as motorists attempt to overtake them at the narrowing points > Parking: Potential loss of on-street parking > Maintenance: Increased snow removal cost and snow plow damage to grass, trees and	and collector streets; urban arterial streets > Traffic Conditions: All traffic volumes > Roadway: Urban cross-section – curb and gutter	combination with other traffic calming measures (speed humps, raised crosswalks, raised intersections, textured crosswalks, curb radius reductions, raised median islands) > Used often with on-street parking to create bays and increase pedestrian visibility at crossings - Keeps road narrow when parked vehicles are not present - On urban arterial streets, applicability may not be recommended if the arterial street has a parking lane that can be needed to carry occasional traffic volume increases (e.g., Emergency Detour Route (EDR), evacuation route, ceremonial route, flexibility of flow management during road repair, etc.) > Drainage system adjustments may be		Infrastructure Improvements

Type	Countermeasure	Description & Purposes	Advantages	Disadvantages	Applicability	Implementation Considerations	Cost	Cost Reference
			plowing, street sweeping, and police enforcement - Can provide additional storage for snow, however, height of windrow should not negatively impact pedestrian visibility	curb extensions > Other: - Long trucks, buses and other large vehicles may need to cross into oncoming travel lanes to negotiate turns at intersections with curb extensions - Between snow removals in winter environments, the roadway's effective width can be significantly reduced		required where curb extensions are needed > Should be marked with signs or other objects to be visible to motorists and plow operators > Sight lines should be respected if there is landscaping > Required Pavement Width: 2.0m to 2.5m Where transit routes operate, remaining lane width should be a minimum of 3.1 m, preferably 3.3 m.		
Roadway Narrowing	Traffic Delineators 	The use of vertical treatments such as flexible post-mounted delineators or raised pavement markers to create a centre median. This could be used to give drivers a perception of lane narrowing and create a sense of constriction.	>Vehicle Speeds: Reduction in 85th percentile speed up to 5 km/h >Conflicts: Separation of traffic has the potential to	> Maintenance: - May require regular maintenance with collection of debris around posts and repeated impacts from vehicles	> Road Classification: Local and collector streets > Traffic Conditions: All traffic volumes > Roadway: Urban or rural cross-section; two-lane roadways in	> Typically, are between 45 and 90 cm tall, spaced 30m to 50m apart > May also be installed at the start and end of a speed reduction zone (e.g., a School Zone) along with other traffic	$125 per bollard	Cost for Flexible Bollards from Oxford County Trails Master Plan (factored up from $100 to 2022 cost of $125)

Type	Countermeasure	Description & Purposes	Advantages	Disadvantages	Applicability	Implementation Considerations	Cost	Cost Reference
		Flexible post-mounted delineators are similar in appearance to bollards. They are commonly used in work zones, high-occupancy vehicle (HOV) lanes, and on-ramp exits to direct vehicles or prevent particular movements.	reduce collisions >Other: Collapsible design is able to withstand impact with a vehicle	- Permanent installation may cause difficulty of snow removal > Other: - In rural areas, wider vehicles or farm equipment may have difficulty passing if post-mounted delineators excessively narrow the roadway - May cause confusion as measure can be perceived as temporary or as an indication of a construction zone	order to achieve lane narrowing > Locations to Avoid: Where it may block driveways or cross streets > Separation of conflicting movements when barriers are too costly or impractical	calming measures (e.g., speed cushions, raised islands, bump outs/curb extensions) to increase the visibility of traffic calming measures and create "gateway-like" features > May also be installed within a speed reduction zone between other traffic calming measures Where transit routes operate, remaining lane width should be a minimum of 3.1 m, preferably 3.3 m.		
Surface Treatments	Textured Crosswalk 	A sidewalk extension is a sidewalk continued across a local street intersection at the level of the roadway. Textured/patterned elements that contrast the roadway can be	> Conflicts: - Extension of sidewalk and textured surface reinforces pedestrian priority and may reduce	> Active Transportation and Transit: - May result in a false sense of pedestrian security, if not accompanied by pedestrian	> Road Classification: Local, collector and arterial streets; urban commercial streets > Traffic Conditions: All traffic volumes, with consideration of	> May be used in combination with other measures, such as raised intersection or curb radius reduction	> Low – Medium - Cost varies depending on width of roadway, labour and material costs	TAC CITE - Traffic Calming Guide

Type	Countermeasure	Description & Purposes	Advantages	Disadvantages	Applicability	Implementation Considerations	Cost	Cost Reference
		incorporated into the sidewalk extension. The purpose of a sidewalk extension is to visually enhance a pedestrian crossing location so drivers become more aware of its presence. It is not intended to indicate whether drivers or pedestrians are required to yield (traffic must comply with local or provincial regulations governing the type of pedestrian crossing system being enhanced by the sidewalk extension / textured crosswalk). With a sidewalk extension/textured crosswalk the continuation of the surface and enhanced visual/tactile identification of the crosswalk area emphasizes pedestrian priority.	pedestrian-vehicle conflict - Visually-impaired pedestrians are better able to differentiate between the sidewalk and the travelled portion of the street if crosswalk is appropriately textured and detectable > Environment: Textured treatment enhances appearance of street, particularly when combined with other landscaping techniques > Other: No effect on resident access, on-street parking	right-of-way legislation - Textured surfaces may create traction and/or stability problems for seniors, the disabled, and wheelchairs > Maintenance: - Asphalt and textured pavement will settle differently and requires ongoing maintenance to repair uneven transition between surfaces - Textured surfaces may increase street sweeping time if texturing incorporates deep grooves, and some dust and debris may remain in the grooves	buses and heavy vehicles on truck routes > Roadway: Urban cross-section – curb and gutter; sidewalks exist along street			

Type	Countermeasure	Description & Purposes	Advantages	Disadvantages	Applicability	Implementation Considerations	Cost	Cost Reference
			and police enforcement	- Less effective in winter conditions due to snow/ice cover > Other: Rough or pronounced texturing may create additional noise from vehicle wheels				
Surface Treatments	Textured Pavement 	Textured pavement is roadway pavement that incorporates a textured and/or patterned surface which contrasts other adjacent roadways in the surrounding area. The difference in texture alerts drivers of the potential need to reduce speed.	> Environment: Textured treatment may improve aesthetics and enhance the character of the street, particularly when combined with other landscaping techniques	> Active Transportation and Transit: Can be difficult for cyclists and pedestrians to negotiate > Maintenance: - Requires regular maintenance - Textured surfaces may increase street sweeping time if texturing incorporates deep grooves, and some dust and debris may	> Road Classification: Local and collector streets > Traffic Conditions: All traffic volumes, with consideration of buses and heavy vehicles on truck routes > Roadway: Urban cross-section	> Stamped concrete and asphalt concrete are generally preferred over brick when a textured surface is desired > Brick or unit pavers are discouraged because of potential problems related to maintenance, pedestrians, bicycles and accessibility requirements	> Low – Medium o Roadway surface treatments, such as use of different textures or incorporating dyes into the roadway or shoulder pavement, are more expensive depending on width of roadway, labour and material costs	TAC CITE - Traffic Calming Guide

Type	Countermeasure	Description & Purposes	Advantages	Disadvantages	Applicability	Implementation Considerations	Cost	Cost Reference
				remain in the grooves - Less effective in winter conditions due to snow/ice cover > Other: Rough or pronounced texturing may create additional noise from vehicle wheels				
Surface Treatments	Transverse Rumble Strips 	Transverse rumble strips are raised buttons, bars or grooves closely spaced at regular intervals on the roadway that create both noise and vibration in a moving vehicle. The purpose of a rumble strip is to alert motorists to a traffic control device which is associated with unusual or changing conditions ahead. Rumble strips are sometimes incorrectly used in a standalone mode as a	> Vehicle Speeds: Reduction in 85th percentile speed between 3 and 8 km/h > Other: - Milled rumble strips typically require little to no maintenance. Rumble strips have no effect on resident access, on-street parking, street sweeping	> Active Transportation and Transit: Negative impact on cyclists and should not be used in areas with high volumes of cyclists > Maintenance: - Raised rumble strips or buttons have a negative effect on snow plowing operations	> Road Classification: Local, collector and arterial streets > Traffic Conditions: All traffic volumes > Roadway: Urban and rural cross-section; usually two traffic lanes (one each direction) > Locations to Avoid: Within 200 m radius of residential areas	> Rumble strips are intended for changing conditions ahead and should not be incorrectly used as a stand-alone speed control device > Use only when standard warning or regulatory signing has been shown to be ineffective > Most commonly used on approaches to Stop signs, often in situations where visibility of Stop signs are limited	> Low - Maintenance costs can vary depending on type of application (raised, buttons or milled) and traffic volume - Cost varies depending on materials used for strip, width of roadway and labour costs	TAC CITE - Traffic Calming Guide

Type	Countermeasure	Description & Purposes	Advantages	Disadvantages	Applicability	Implementation Considerations	Cost	Cost Reference
		speed control device. With rumble strips, motorists are alerted by minor vertical deflection of vehicle wheels, and audible warning created as vehicle wheels pass over.	and police enforcement	> Other: - Increased noise levels by 3 to 4 dB in the immediate vicinity - May detract from appearance of street				
Education and Enforcement	Automated Speed Enforcement (ASE) 	Automated Speed Enforcement involves permanently installed radar cameras that photograph vehicles operating exceeding the speed limit without the presence of police officers. Legal provision is required.	> Vehicle Speeds: - Reduction in average speed between 8 and 14 km/h within enforced area, which is close to the point of installation - As long as thresholds are low enough and depending on the penalties (financial and/or demerit points), program effects should be effective in the longer term > Conflicts:	> Enforcement: - Motorists may adapt by taking alternate routes or speeding up after passing cameras > Other: - Little evidence of crash reduction impacts on the rest of the roadway network when too few devices are installed - Possible disfavour from local residents/community	> Road Classification: All roadways > Traffic Conditions: All traffic volumes > Roadway: Urban and rural cross-section > Areas with a history of speed related severe collisions	> Engineering solutions should be sought before implementing camera programs	> High - Requires capital cost plus significant on-going costs to manage and operate processing centre to review and issue citations, prosecute and operate court sessions, and follow-up on scofflaws	TAC CITE - Traffic Calming Guide

Type	Countermeasure	Description & Purposes	Advantages	Disadvantages	Applicability	Implementation Considerations	Cost	Cost Reference
			- Substantial reduction in speed related collisions; injury crash reductions in the range of 20 to 48% at conspicuous, fixed camera sites - More noticeable and may achieve more rapid site-specific speed and crash reductions at high crash locations					
Education and Enforcement	Red Light Cameras (RLC) 	Red light Cameras are automated enforcement of signal violation at intersections. They reduce intentional red light running behaviours	> Conflicts: Red light cameras can reduce collisions by 30% > Other: Red light cameras can reduce aggressive driving by 21%	> Enforcement: - Motorists may adapt by taking alternate routes > Other: - Frequency of rear-end collisions might increase - Possible disfavour from local residents/ community	> Road Classification: All roadways > Traffic Conditions: All traffic volumes > Roadway: Urban and rural cross-section > Areas with a history of intersection related severe collisions	> Engineering solutions should be sought before implementing camera programs	$100,000 per camera	York Region website

Type	Countermeasure	Description & Purposes	Advantages	Disadvantages	Applicability	Implementation Considerations	Cost	Cost Reference
Education and Enforcement	Radar Speed Signs 	A speed display device is an interactive sign that displays vehicle speeds as oncoming motorists approach. Vehicle speed is captured using radar and can trigger the display board to show when vehicles approach at predetermined unsafe speeds. Can be used upstream of manned speed enforcement.	> Vehicle Speeds: Reduction in 85th percentile speed between 3 and 14 km/h > Conflicts: Reduction in speed related collisions > Other: - Portable units can be relocated and deployed immediately at different locations - Less expensive than police enforcement when considering long-term use	> Enforcement: - Drivers may become immune to devices if there is no further perception of enforcement - Motorists may speed up to see how fast they can go - May be less effective or less accurate on multi-lane roads, or heavily trafficked roads > Maintenance: Requires regular maintenance and a source of power	> Road Classification: All roadways > Traffic conditions: All traffic volumes > Roadway: Urban and rural cross-section > Generally used at the beginning of regulatory school zones, upstream of high speed signalized intersections, and upstream of deficient horizontal curves	> Speed display devices can be used as curve advisory systems > Speed displays can be used on a weather-related basis > If used in conjunction with manned enforcement downstream on some occasions, can be very effective and may decrease complaints about manned enforcement as well	$5,000.00 each if mounted on existing pole $7,500 each if additional pole is required	Based on information from other municipalities
Horizontal Deflection	Traffic Circle/ Roundabout 	A traffic circle/traffic button/mini-roundabout is an island located at the centre of an intersection, which requires vehicles to travel through the	>Vehicle Speeds: Reduction in 85th percentile speed up to 14km/h	> Emergency Response: Delay between 1.3 and 10.7 seconds for emergency vehicle response times	> Road Classification: Local and collector street intersections > Traffic Conditions: - Posted speed limit ≤ 50 km/h	> Preferred with textured crosswalks and most effective when used in series > Sight lines should be respected if there is landscaping	Average $85,500.00 each	Costs for Pedestrian and Bicyclist Infrastructure Improvements

Type	Countermeasure	Description & Purposes	Advantages	Disadvantages	Applicability	Implementation Considerations	Cost	Cost Reference
		intersection in a counter-clockwise direction around the island. Mini-roundabouts are designed in accordance with full-size roundabout design principles presenting splitter islands and deflection of vehicles on all approaches, except that they have a smaller diameter and traversable islands. A traffic circle is typically smaller than a mini-roundabout and does not have splitter islands on the approaches. A traffic button is similar to a traffic circle, however, the former is typically made of coloured asphalt while the latter is landscaped. The turning radius for left-turning trucks, buses, or emergency vehicles may require a diameter which would be larger than the intersection space	>Traffic volumes: Reduction of up to 20% >Conflicts: Collision rate reductions of approximately 30% compared to signalized intersections >Environment: - Traffic noise reduction of 3 dBA due to lower speeds (benefits may be offset by increased noise due to braking and accelerating) - Environmental benefit through reduced delay, fuel consumption, and vehicle emissions - When landscaped, can improve	> Active Transportation and Transit: May force vehicles into crosswalk area increasing potential for pedestrian-vehicle conflicts > Parking: May require removal of some on-street parking in vicinity of traffic circle > Maintenance: “Minor” effects on winter maintenance by increasing snow plowing time > Other: - Restricted access for trucks and longer school buses	- < 1500 vehicles per day; Use with caution for low-volume collectors with 1500 to 5000 vehicles per day > Roadway: Urban cross-section – curb and gutter; rural cross-section; maximum two traffic lanes (one each direction) > Locations to Avoid: - Designated emergency access routes and transit routes - Intersections with high pedestrian volumes - Intersections where collector street traffic volumes are significantly higher than the intersecting street	> Mini roundabouts are often more suitable for collector roads, and traffic circles are more suitable for local roads		

Type	Countermeasure	Description & Purposes	Advantages	Disadvantages	Applicability	Implementation Considerations	Cost	Cost Reference
		commonly available. Consequently, vehicles may turn in left in front of the traffic circle or mount the centre raised island rather than travelling around it. Yield traffic control is recommended.	the appearance of a street >Other: No effect on resident access, street sweeping, and police enforcement	- Traffic may be diverted to parallel streets without traffic calming measures				
Vertical Deflection	Raised Crosswalk 	A raised crosswalk is a marked pedestrian crosswalk at an intersection or mid-block location constructed at a higher elevation than the adjacent roadway. The purpose of a raised crosswalk is to reduce vehicle speeds, improve pedestrian visibility, and reduce pedestrian–vehicle conflicts.	> Vehicle Speeds: Reduction in 85th percentile speed from 5 km/h to 13 km/h > Traffic volumes: Reduction of up to 26%, and increase of up to 7% on neighbouring streets > Conflicts: - 53% of drivers yielding to pedestrians compared to 13% before	> Emergency Response: Impacts and delays to emergency vehicles; Fire vehicles – 3.8 seconds' delay per raised crosswalk > Active Transportation and Transit: - May result in a false sense of pedestrian security - Visually-impaired pedestrians may have difficulty differentiating between the	> Road Classification: - Local and collector streets; commercial collector streets > Traffic Conditions: Posted speed limit ≤ 50km/h; all traffic volumes > Roadway: Urban cross-section – curb and gutter > School zones > Locations to Avoid: - Designated emergency access routes - Small turning radius curves and other areas with limited sight distance,	> Not recommended unless there is an existing marked crosswalk > Not recommended in limited right-of-way > There must be a sidewalk on at least one side of the road and landing areas on each end of the raised crosswalk > May cause discomfort for transit users > Consistent configuration throughout a community is desirable to facilitate safe use by those with mental impairment > Snow removal personnel may require special training in raised crosswalk areas	$8,000.00 each	Costs for Pedestrian and Bicyclist Infrastructure Improvements

Type	Countermeasure	Description & Purposes	Advantages	Disadvantages	Applicability	Implementation Considerations	Cost	Cost Reference
			- Pedestrian crossing area better defined; vehicles are forced to slow through pedestrian conflict zone > Environment: Traffic noise may be reduced due to lower speeds (benefits may be offset by increased noise due to braking and accelerating) > Other: - No effect on bicycles riding at moderate speeds - No effect on resident access, street sweeping (small amount of debris may remain at edges of raised	curb and the travelled portion of the street (can be mitigated with appropriate design elements for accessibility requirements such as tactile walking surface indicators) - Some cyclists may experience loss of control at speeds over 40 km/h - May slightly affect transit routes; a series of vertical deflection measures may increase travel time > Maintenance: - Snow clearing time may be increased - Raised crosswalks interfere with	intersections, and driveways - Transit routes where articulated buses are used due to potential decoupling - Bus stops – locate at least 25 m in advance to minimize potential stability problems - Traffic signals – locate at least 75 m distance from traffic signals so that the crosswalk is not within the decision or braking zones - Grades over 8%	> Raised crosswalks with gentle approach and exit gradients, flush leading edges and smooth surfaces pose a less significant hazard to cyclists		

Type	Countermeasure	Description & Purposes	Advantages	Disadvantages	Applicability	Implementation Considerations	Cost	Cost Reference
			crosswalk), and police enforcement - Pedestrians using assistive devices are able to cross more easily and with increased comfort due to no accumulation of rain or snow at the bottom of the curb	pavement overlays > Other: - Catch basins may be required to provide drainage depending on location of raised crosswalk and site specific conditions - If catch basins become blocked, ponding may occur on uphill edge of crosswalk - Increased traffic noise levels due to braking and accelerating - Increased gas consumption and emission levels if there are significant variations in speed,				

Type	Countermeasure	Description & Purposes	Advantages	Disadvantages	Applicability	Implementation Considerations	Cost	Cost Reference
				especially if there are multiple devices within close proximity on the same street - Pavement markings and signing could detract from the appearance of a street - Traffic may be diverted to parallel streets without traffic calming measures				
Vertical Deflection	Speed Cushion 	A raised area on a road, similar to a speed hump, but does not cover the entire width of the road. The width is designed to allow a large vehicle, such as a bus, to “straddle” the cushion, while light vehicles will have at least one side of the vehicle deflected upward. Speed cushions are intended to produce sufficient	> Vehicle Speeds: Reduction in 85th percentile speed up to 8km/h > Traffic Volumes: Reduction of approximately 30% > Environment: Traffic noise may be	> Emergency Response: May slightly affect emergency vehicle response times but not as much as speed humps or speed tables > Active Transportation and Transit: May slightly affect transit	> Road Classification: Local and collector streets > Traffic Conditions: Posted speed limit ≤ 50 km/h; all traffic volumes > Roadway: Urban cross-section – curb and gutter > Locations to Avoid:	> Allows greater access for transit and emergency services compared to other traffic calming devices could be considered as an alternative to speed humps on emergency routes > Speed humps are more effective in reducing speeds > Snow removal personnel may require special	$6,000 each location (assumed based on cost for speed bump)	Costs for Pedestrian and Bicyclist Infrastructure Improvements

Type	Countermeasure	Description & Purposes	Advantages	Disadvantages	Applicability	Implementation Considerations	Cost	Cost Reference
		discomfort to limit passenger vehicle travel speeds yet allow the driver to maintain vehicle control, while allowing larger vehicles such as buses and emergency vehicles to pass without difficulty.	reduced due to lower speeds (benefits may be offset by increased noise due to braking and accelerating) > Other: - No effect on bicycles riding at moderate speeds - No effect on resident access, street sweeping (small amount of debris may remain at edges of speed cushion), and police enforcement	routes; a series of vertical deflection measures may increase travel time > Maintenance: Negative effects on snow plowing/ removal; plow operators must use caution to avoid damaging speed cushion surface > Other: - More difficult to construct compared to speed humps requiring more precise hand work - Increased traffic noise levels due to braking and accelerating - Increased gas consumption and emission levels if there	- Small turning radius curves and other areas with limited sight distance, intersections, and driveways - Traffic signals – locate at least 75 m distance from traffic signals so that the speed cushion is not within the decision or braking zones - Grades over 8%	training in removing snow from speed cushion areas > A series of speed cushions is more effective than a single installation; spacing can range from 60 m to 250 m depending on the desired 85th percentile speed > Installation of WA-50 Speed Hump sign is considered mandatory > Speed cushions are not to be implemented together with raised median island		

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				are significant variations in speed, especially if there are multiple devices within close proximity on the same street - Pavement markings and signing could detract from the appearance of a street - Traffic may be diverted to parallel streets without traffic calming measures				
Intersection Treatments	Tiger Tails  	Tiger tails are alternating stripes placed below a stop sign to capture the driver's attention. They are generally more frequently used at All-way Stop Controlled intersections when compared to Minor Road Stop Controlled intersections.	> Vehicle Speeds: Changes in vehicle speeds require further study > Compliance Rates: Changes in compliance rates require further study	> Other: - Lack of research as to its effectiveness In Ontario.	> Road Classification: Local and collector streets > Roadway: Urban and rural cross-sections > Should be used on all approaches of all all-way stop control intersections or as needed in rural areas	> The Tiger Tail sign is not an officially recognized sign and is not approved for use in the Ontario Traffic Manual (O.T.M.). There are no official guidelines for its use, and no studies have been completed to show the sign effectiveness for addressing stop sign compliance issues in Ontario.	All way stop control intersection: Approximate average cost is $230 per intersection Non all way stop control intersection (between 1-2 leg(s) are stop	City of Oshawa's Tiger Tail Signage on Stop Sign Posts Report - #CO-23-17

Type	Countermeasure	Description & Purposes	Advantages	Disadvantages	Applicability	Implementation Considerations	Cost	Cost Reference
			> Other: - Beneficial under low-light conditions - Improved visibility in rural areas with stop signs at the end of long stretches of roadway.		> May be paired with left-side stop signs.		controlled): Approximate average cost is $160 per intersection.	
Intersection Treatments	Left-side STOP sign 	Left-side STOP signs are a second set of signage at a stop controlled approach meant to increase the driver's visibility of the stop sign. They are generally used at where horizontal curves impair the sight of All-Way Stop Control intersections.	>Collisions: may reduce collision where 'disobeyed traffic control' was reported as the apparent driver action >Other: Improved visibility of stop sign, particularly on intersections downstream of a horizontal curve.	> Maintenance: May require extra maintenance.	> Road Classification: Local and collector streets > Roadway: Urban and rural > Should be used in all school crossing guard locations > Intersections downstream of horizontal curves to the right, where the right-side sign may not be as visible/ conspicuous and may benefit from a left-side sign. > May be used on all-way stop control intersections as needed. > May be paired with tiger tails.	> For two-way roadways, if collision records show an unusually high proportion (or over-representation) of failure to stop collisions at the STOP sign on an intersection approach, a supplementary STOP sign on the left-hand side of the roadway or in the median may be installed. However, practitioners are reminded that overuse of traffic control devices tends to lessen their effectiveness. > On approaches where the roadway environment makes the regular STOP signs less conspicuous (e.g., horizontal/vertical roadway alignment, presence of trees or other objects obstructing		

Type	Countermeasure	Description & Purposes	Advantages	Disadvantages	Applicability	Implementation Considerations	Cost	Cost Reference
						sightlines) and an existing STOP AHEAD sign has not been proved to be effective.		
Intersection Treatments	Left-turn Traffic Calming 	Rubber speed bumps are placed before and after the crosswalk on the centre line of an intersection. These additions “harden” the centerline and encourage drivers to approach the crosswalk at a sharper angle instead of cutting across intersections diagonally, resulting in slower turning speeds and better visibility of people walking and cycling.	> Vehicle Speeds: Decrease let-turn speeds by 10-20% > Conflicts: 70% reduction in conflicts with left-turns	> Other: - May need to be removed for snow clearing. - Although mountable, it may impact larger vehicles, forcing them to track over the speed bump.	> Roadway: Urban, used mainly in arterial-arterial or arterial-major collector intersections	> Other: In winter months, snow may cover the speed bumps and make it difficult for vehicles to see and drive around them. Yellow plastic posts may help.		
Intersection Treatments	Retroreflective Strips On Stop Sign Posts 	Addition of retroreflective strips on stop sign posts may be beneficial when additional attention needs to be drawn to a stop sign. This may be particularly true at night.	-Low cost. -Can be added to existing sign post.	> Maintenance: May require extra maintenance.	> Roadway: Used mainly in rural intersections.	According to the MUTCD, retroreflective strips should be at least two inches in width and placed the full length of the support from the sign to within two feet above the edge of the roadway. The color should match the background color of the sign.	$50 per strip	Vendor website