THE CITY OF Waterloo

TRANSPORTATION MASTER PLAN 2020 UPDATE

VOLUME 3 – ROADS, TRANSIT AND FUTURE MOBILITY STRATEGY

TRANSPORTATION MASTER PLAN UPDATE
LOOKING AHEAD

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9 ROADS

9.1 Complete Streets

9.1.1 Philosophy

Complete Streets is a broad policy approach but is typically defined as streets for everyone, purposely designed and operated to allow for safe access for all users. The Complete Streets vision is one of leveraging the potential for streets to support a variety of uses and a more diverse mode-share with focus areas of safety, health, multi-mobility, transit, accessibility, sustainability, and equity. For the City, Complete Streets policies are aimed to achieve the goal of being "economically viable, sustainable, vibrant, walkable, bicycle friendly, age friendly, accessible, and diverse".

While it is a high-level idea, a Complete Streets policy should translate to implementation strategies that alter regular decision-making in planning, design, construction, operation, and maintenance. More specifically, the National Complete Streets Coalition, notes the approach is not a singular design element or prescription but context sensitive, not one special street project but a network approach, not a mandate for immediate retrofit but an incremental process with long term results, and finally, not a silver bullet but a strategy that requires actionable plans and resources.

The City's 2011 TMP incorporated an overarching Complete Streets Policy for all streets to be planned, designed, operated, and maintained to enable safe access for all users and to recognize the health, social, environmental, and economic benefits of a multi-modal network. The City of Waterloo was the second municipality in Canada to adopt a Complete Streets policy which was ultimately incorporated in the City's 2012 Official Plan. The City's current Complete Streets Policy:

- Incorporates Complete Streets into all transportation projects except where cyclists and pedestrians are prohibited by law, or there is a demonstrated absence of need, with exceptions provided and justified at the senior level;
- Integrates Complete Streets with a complementary Linked Greenways or Trail Corridors Policy to support active transportation in non-street corridors; and
- Examines complementary policies for implementation within the short term, such as end-of-trip facilities, an advisory committee, trail and sidewalk maintenance in winter, on-road bikeway and trail implementation process that recognizes importance of network, parking policies, and intersection and traffic control policies.

The policy identifies four major pillars for incorporating Complete Streets into all aspects of the City's responsibilities for streets. **Table 9.1** summarizes the pillars (planning and design, maintenance and operations, communications, and asset management) and specific action items.

Implementation strategies were also included in the policy, focusing on restructuring City procedures and budgetary models, rewriting City standards and guidelines, retraining staff, and creating a working group lead by a senior staff to oversee implementation, restructuring, and retraining.

TABLE 9.1: CITY OF WATERLOO COMPLETE STREETS POLICY

Category	Action Items
Planning and Design	▶ Planning of streets and street networks City-wide, in secondary plans and plans of subdivision ▶ Design of street networks, corridors, intersections, site-specific improvements, and traffic calming ▶ Design of new construction, reconstruction, retrofit, and resurfacing roadway projects
Maintenance and Operations	▶ Maintenance of pedestrian and cyclist access and mobility through construction zones and in traffic management plans ▶ Maintenance of streets for pedestrians and cyclist, including seasonal (debris, water, snow, and ice) and repair work (spot repairs, wear, deterioration, hazards)
Communications	▶ Public consultation and communications ▶ Advisory committee responsibilities and function ▶ Review of roadways within the City under Jurisdiction of MTO or Region ▶ Collaboration with Region on Transportation Demand Management initiatives
Asset Management	▶ Audits of streets and alternatives for pedestrian and cyclists ▶ Annual reviews of implementation of sidewalks, trails, and bikeway network ▶ Establishment of performance standards and data collection procedures and analysis to benchmark how well streets are serving all users ▶ Data collection procedures and analysis that benchmark and track how well streets are serving all users

Advancing a Complete Streets framework remains a key focus for the WTMP and is aligned with the overarching goal to achieve an equitable transportation system. The Complete Streets approach continues to evolve in response to new transport modes, on-demand mobility services, and rapid integration of technology. The way people interact with streets is changing and cities are facing new uncertainty with regards to managing new mobility services and user expectations for efficiency and convenience. In this context, street design is increasingly complex and raises questions for designers, policymakers, and the public on how to accommodate a growing list of modes and street uses while minimizing conflicts and achieving City goals.

Complete Streets 2.0 responds to this new reality, where the core principles remain the same, but the actions reflect a changing context for planning, design, maintenance, and operations. A variety of new ideas and design approaches are entering the transportation lexicon and being implemented in various jurisdictions. Key emerging ideas include:

- **Mobility hubs**, a method to aggregate a growing number of modes while supporting economic and social uses. The goal of a mobility hub is to maximize choice, minimize distance, reduce conflicts, and provide amenities through smart use of constrained spaces and with tools such as curbside management and targeted use of technology. Mobility hubs can look different, they can be linear along a block or in a concentrated site, but all recognize a diversity of users and prioritize inter-connection of modes.
- **Curbside management** is a growing topic as cities work to accommodate a variety of competing uses vying for space in the street. Policies and practices will need to evolve to balance transit access, bikeway access, pedestrian access, traffic flow, and ride-sharing pick-up and drop-off in a way that is seamless and integrated.
- **Parking** accommodation is a consistent issue in planning and design. The City's Official Plan outlines the requirement to balance community, motorist and active transportation user needs when providing parking. Newer parking strategies include providing streamlined access to space, reducing over-supply through planned contingency and overflow parking, and providing priority space for active and shared use mobility options. Parking management strategies are also incorporating technology to assist with navigation, payment, and dynamic pricing.
- **Micromobility** and **e-micromobility** offer opportunities to manage traffic congestion and contribute to economic development, but also presents challenges with regards to space allocation on sidewalks, bikeways, and trails. Cities will need tools for developing policies to manage micro-mobility while prioritizing safety and a vibrant public realm.

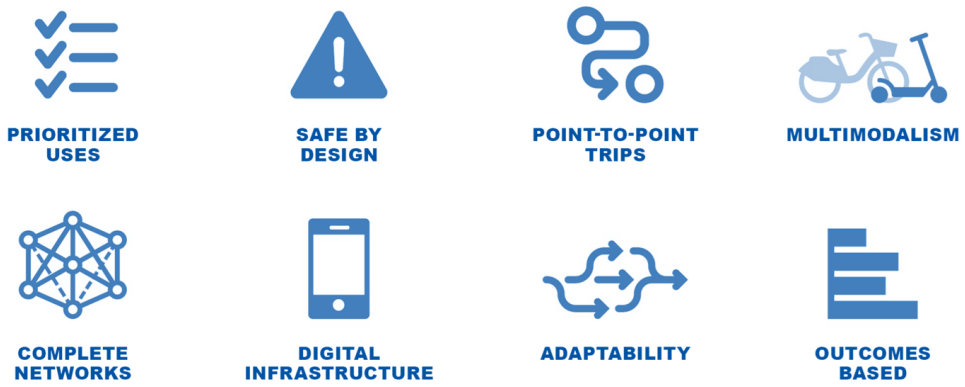
9.1.2 Recommended Policy Changes

An updated Complete Streets policy approach and corresponding set of tools will assist the City in achieving its defined vision. New tools and policy approaches should prioritize:

- Allocating space to serve specific objectives defined by mode and demand while managing safety;
- Measuring the right outcomes, for example where person-throughput is prioritized over vehicle-throughput;
- Using interim treatments and pilot projects/demonstration projects as alternatives to major capital projects to test ideas and move forward on implementation;
- Implementing mobility hubs through policies and permitting to support shared-mobility services, bike parking, drop-off zones; and
- Designing for flexibility and changing time of day or seasonal uses.

Figure 9.1 summarizes the principles of Complete Streets 2.0, which include prioritizing uses on the street, recognizing new modes, and incorporating flexibility. The City has already included some Complete Streets 2.0 principles, for example the provision of facilities such as parking, showers, and trip reduction incentives through the planning approvals process.

FIGURE 9.1: COMPLETE STREETS 2.0 PRINCIPLES



A comprehensive Complete Streets policy will identify and develop tools to address typical challenges that stall projects. Tools help with managing trade-offs and design decision-making particularly in constrained spaces. When properly created, processes and tools can be structured to ensure appropriate attention is paid to factors that may historically not receive due consideration, such as equity, green infrastructure, and street trees/urban forestry. The City should consider existing tools developed by comparable cites, including:

- City of London CDSM Toolkit;
- City of Kitchener Score Cards;
- City of Ottawa Multimodal Level of Service Framework; and
- City of Toronto Curb Radii Guidelines.

Furthermore, several municipalities have improved communication strategies to bring increased public engagement to Complete Streets implementation. Including additional communications tools corresponds directly to the communication pillar of the City's current Complete Streets Policy. Communications practices that can frame similar initiatives at the City include:

- City of London's Citizen's Guide to Complete Streets, which provides a concise overview of the processes and design elements that are covered in the City's Complete Streets Design Manual;
- City of Kitchener Community Guide to Complete Streets, a separate community document for the purposes of communicating with the public on Complete Streets; and
- City of Ottawa includes MMLOS results on public open house boards to communicate trade-offs and evaluation techniques when looking at various options.

To align future Complete Streets policies with best practice, the City should track defined metrics created by the National Complete Streets Coalition of Smart Growth America as summarized in **Table 9.2**.

Recommendation 32: Update the Complete Streets policy to incorporate Complete Streets 2.0 principles, new tools for implementation, improved communications practices, and defined metric tracking as detailed in Section 9.1.

9.1.3 Multi-Modal Level of Service

As the City moves forward with multimodal initiatives including updating its Complete Streets policy, expanding the cycling network, and upgrading the pedestrian realm, it will be important to consider a performance measurement that weighs the experience of all road users. An urban street is unique because its right-of-way is shared by multiple modes of travel, each using their assigned portion of the road allowance. To adequately evaluate the quality of service provided by the facility, one must consider the implications of facility design and operation on not only the auto driver, but also for the bus passenger, cyclist, and pedestrian.

Current planning tends to evaluate transportation system performance based primarily on motor vehicle traffic speed and delay. Performance measures for roadways are typically based on the practice of assessing "level of service" for motorized vehicles. Service levels and quality offered to pedestrians, cyclists and transit users on those roads is often not a consideration. Over the past decade, transportation researchers have started to develop tools to measure and compare the quality/level of service of non-auto modes of travel. Multimodal Level of Service (MMLOS) analysis aims to provide the necessary tools for assessing the performance of all travel modes, thus allowing the consideration of trade-offs between different road users.

TABLE 9.2: NATIONAL COMPLETE STREETS COALITION: ELEMENTS OF A COMPLETE STREETS POLICY

Element	Description of Model Policy and Metrics (Total 100 Points)
Vision and Intent	**Provides equitable vision for how and why communities want Complete Streets** Points are allocated for: a clear intent with strong "shall" or "must" language; an indicated need to create a complete, connected network; at least one motivation for pursuing Complete Streets including equity; and specification of at least four modes.
Diverse Users	**Benefits all users equitably, particularly vulnerable users** Points are allocated for: language to prioritize vulnerable and underserved groups and creation of accountable and measurable definition for priority groups.
Commitment in All Projects and Phases	**Applies to new, retrofit/reconstruction, maintenance, and ongoing projects** Points are allocated for: requirement for all new construction, retrofit, maintenance and ongoing operations to incorporate Complete Streets; and required accommodation of all modes during construction.
Clear, Accountable Expectations	**Makes any exceptions specific with a clear procedure that requires high-level approval and public notice** Points are allocated for: inclusion of 1-2 exceptions but no more; clear indication of responsibility for granting exceptions; and requirement for public notice of exception.
Jurisdiction	**Requires interagency coordination** Points are allocated for: requirement for compliance by private development projects; and intra-agency coordination.
Design	**Directs the use of the latest and best design criteria** Points are allocated for: adoption of specific, best state-of-the-practice design guidance or requires development/revision of guides; and sets specific time frame.
Land Use and Context Sensitivity	**Considers the surrounding community's current and expected land use and transportation needs** Points are allocated for: requirement for new or revised land use policies, plans, zoning ordinances, etc.; consideration of community context; and identifies need to mitigate unintended consequences.

TABLE 9.2: NATIONAL COMPLETE STREETS COALITION: ELEMENTS OF A COMPLETE STREETS POLICY

Element	Description of Model Policy and Metrics (Total 100 Points)
Performance Measures	**Establishes performance standards that are specific, equitable, and public** Points are allocated for: specific performance measures under multiple categories; specific implementation processes; embedding equity measures; requirement to release results publicly; assignment of responsibility to specific agency or group.
Project Selection Criteria	**Provides specific criteria for funding prioritization for implementation** Points are allocated for: specific criteria to prioritize funding; and embedding equity.
Implementation Steps	**Includes next steps for implementation of the policy with specific time frames** Points are allocated for: revision of procedures, plans, regulations; requirement for workshops and staff training; assigns responsibility to new or existing committee with internal and external stakeholders; a strong community engagement plan.

Adopting the use of MMLOS is an integral part of a Complete Streets approach, one that recognizes all modes are important. It acknowledges that trade-offs are often required between each mode due to physical or financial constraints. MMLOS gives cities the tools to quantify those trade-offs and the ability to evaluate alternatives to plan for quality networks for each mode. Using a MMLOS framework, transportation planners can identify a corridor or intersection's level of service for vehicles, pedestrians, transit, and cyclists to objectively compare the trade-offs of various network alternatives. The application of an MMLOS approach is not intended to require an immediate retrofit for all streets to meet specified targets, rather, it provides a framework that can be applied to the City's existing procedures to assess the transportation impacts and mobility needs of all road users.

Unfortunately, no one set of measures has emerged as a preferred technique in the Ontario context. In the absence of definitive guidance, jurisdictions, such as the City of Ottawa, York Region, and City of Thunder Bay have developed their own MMLOS tools. The City should review current MMLOS guidelines and consider adapting the methods and targets to be applicable within the Waterloo context. The MMLOS framework should be applied whenever a level of service analysis is required, such as a transportation environmental assessment, operations and safety review or transportation impact analysis for a proposed development application.

Recommendation 33: Adopt a Multi-Modal Level of Service framework detailing the process, methodology and tools for assessing the performance of all travel modes, to be applied whenever a level of service analysis is required.

9.2 Vision Zero

9.2.1 Philosophy

Vision Zero is a strategy to eliminate traffic fatalities and severe injuries, while increasing safe, healthy, equitable mobility for all. Originating in Sweden in the late 1990's, Vision Zero is based on the philosophy that:

- No loss of life is acceptable;
- Traffic fatalities and serious injuries are preventable;
- People make mistakes so the road system and related policies should be designed to ensure those inevitable lapses do not result in severe injuries or fatalities; and
- Humans are physically vulnerable when involved in motor vehicle collisions.

Vision Zero starts with the ethical belief that everyone has the right to move safely in their communities. **Figure 9.2** summarizes how the concept deviates from the traditional view of road safety in two primary ways:

- System designers and policymakers share responsibility for ensuring safe travel with road users and are expected to improve the roadway environment, policies (such as speed management), and other related systems to lessen the severity of collisions; and
- Addressing this complex problem requires a multidisciplinary, collaborative approach, bringing together diverse stakeholders such as traffic planners and engineers, enforcement personnel, policymakers, and public health professionals.

FIGURE 9.2: NEW VISION FOR SAFETY
(Source: Vision Zero Network)

While not a new concept, Vision Zero requires a shift in how communities approach decisions, actions, and attitudes around safe mobility. The philosophy focuses on the policies and street designs with the greatest impact on safety. Different implementation approaches exist including:

- The **Safe Systems Approach**, which aims to create a road system that makes allowances for errors and minimizes their consequences, particularly the risk of death or serious injury, by targeting four elements:
  - Safe Speeds – Driving at an appropriate speed reduces the likelihood of a collision, diminishes injury severity if a crash does occur, and provides a safety buffer by giving motorists sufficient time to stop in an emergency;
  - Safe Roads – Roads can function to help manage speeds, reduce complexity, allow for human error, provide positive guidance to drivers, and reduce crash forces on people;
  - Safe Vehicles – Emerging technologies such as inflatable seat belts, centre air bags, crash avoidance systems, forward-collision warning, traffic sign recognition, adaptive headlights, lane-departure systems, intelligent speed assistance, fatigue-monitoring, and pedestrian detection can improve safety; and

- Safe Drivers – Educating drivers and enforcing the rules of the road can help reduce driver error, a contributing factor in many collisions.

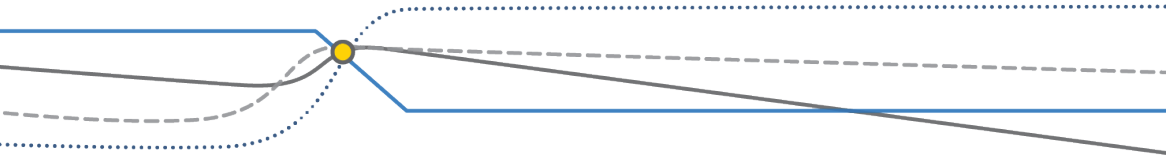
- The **"Es" of Traffic Safety**, which commonly provide the framework for Vision Zero planning in Canada. The most often used Es are "Engineering", "Enforcement", "Evaluation", "Education" and "Engagement". Sometimes additional "Es", such as "Equity", or different variations, like "Encouragement" rather than "Engagement", may be cited depending on the plan and purpose.
- A **Complete Streets Framework**, which emphasizes the design of streets for all ages, abilities, and modes of travel, including walking, cycling, transit, and others, consistent with objectives contained in the TMP.
- The **Public Health Approach**, which is preventative in nature and involves understanding the underlying determinants of health problems and developing effective strategies in response.

Communities making a Vision Zero commitment believe the status quo is unacceptable and systemic changes are needed to achieve meaningful progress in road safety. Committing to the vision requires:

- Building and sustaining leadership, collaboration, and accountability among a diverse group of stakeholders;
- Collecting, analyzing, and using data to understand trends and potential disproportionate impacts of traffic fatalities on certain populations;
- Prioritizing equity (all potential stakeholders) and community engagement in devising strategies and developing action plans; and
- Setting a timeline to achieve zero traffic deaths and serious injuries, which brings urgency and accountability and ensures transparency on progress and challenges.

Typical focus areas for Vision Zero initiatives include:

- Positioning road safety as a top priority in policymaking;
- Improving road infrastructure for all road users;
- Enhancing the safety of vulnerable road users;
- Increasing enforcement of laws to manage safe speeds and reduce impaired and distracted driving;
- Strictly regulating and testing vehicles;
- Leveraging innovative technology (red light cameras, automated speed enforcement); and
- Continuing leadership, collaboration, and accountability among all stakeholders.



Key activities to ensure Vision Zero becomes a reality include:

- Road infrastructure changes;
- Enhanced regulation and enforcement;
- Advocacy for policy change; and
- Raising public awareness and commitment to road safety.

Making a Vision Zero commitment requires time, effort, collaboration, and patience to achieve meaningful results, but is valued in communities that have moved in this direction.

Current City traffic safety programs are based on the same philosophy as Vision Zero to eliminate serious injuries and fatalities from motor vehicle collisions and offer the same breadth of perspective, in that the City incorporates education, enforcement, engineering, evaluation, and engagement in its initiatives. From a safety perspective, the City's road network appears to be performing better than others in Canada and even in Sweden based on research completed by the Region of Waterloo. But the City is always striving for improvement, particularly as there is a renewed emphasis on increasing mobility by active transportation and transit.

9.2.2 Recommended Action Plan

Fatalities and serious injuries are unacceptable outcomes of motor vehicle collisions. But formally committing to Vision Zero presents several important factors and potential consequences for the City to consider. Making this commitment would likely require considerable investment in infrastructure changes and/or electronic enforcement to compel drivers to further reduce vehicle speeds and comply with other traffic rules (e.g., stop sign and red light running). Experience has shown signs and markings alone have limited long term effect. On the other hand, physical measures can adversely impact emergency response (fire, ambulance, and police) and transit service delivery. As well, the design and operation of the road is only one factor contributing to traffic-related fatalities and serious injuries. Driver behaviour and the vehicle, factors largely outside the City's control, also play a critical role.

City Council has expressed a strong desire in committing to Vision Zero as evidenced by its stated objectives in the *City of Waterloo 2019-2022 Strategic Plan*. Consistent with this direction, the City should articulate a formal policy on road safety that pledges to Vision Zero and captures the key tenets of this strategy. This policy could read:

As a Vision Zero community, the City of Waterloo, with the support of its partners, aims to eliminate traffic-related fatalities and serious injuries on City roads using a Safe Systems Approach consistent with its Complete Streets Policy.

Along with adopting this policy, the City should develop a Road Safety Action Plan, consolidating its traffic safety-related initiatives into one comprehensive strategy with clear

objectives, stated outcomes, and required funding. The action plan should follow the Safe Systems Approach, implementing evidence-based measures for safe drivers, safe speeds, safe roads, and safe vehicles.

The City should also pursue new methods of identifying locations and trends with potential for safety improvement (consistent with the recommendations of Section 9.2.4) and implement proven countermeasures. Additionally, the City should consider trial applications of emerging countermeasures on a site-specific basis to evaluate their potential benefit in Waterloo. The availability of new technology, such as automated and connected vehicles, may also have a positive influence on the future of road safety.

Recommendation 34: Adopt a policy on road safety consistent with Vision Zero principles and develop a Road Safety Action Plan.

9.2.3 Residential Neighbourhood Speed Limits

Speed regulations aid motorists in selecting operating speeds that are safe for the prevailing conditions. The maximum safe speed at any location will vary as road geometry, traffic demands, and road environment change.

The selection of a posted speed limit for a specific location must take into consideration legislative regulations, public recognition and understanding, ease of implementation, capital and maintenance costs, and adherence to recognized engineering standards and practices. In Ontario, speed regulations are primarily defined in the *Highway Traffic Act* (HTA), which states "no person shall drive a motor vehicle at a rate of speed greater than 50 km/h on a highway within a local municipality or within a built-up area." This speed limit is commonly known as the Statutory Speed Limit.

Studies have shown that a reduction in vehicle operating speeds from 50 km/h to 40 km/h increases the chance of survival from 15% to 70% for a vulnerable road user struck by a vehicle. This rate is further increased to 90% for operating speeds of 30 km/h[1].

Consistent with this direction, the provincial government amended the HTA as part of the *Safer School Zones Act, 2017* to allow municipalities to designate an entire area with a posted speed limit lower than 50 km/h. Prior to this amendment, speed limit signs had to be posted for the complete length of each roadway with a reduced speed limit. But now, a municipality is only required to post the Gateway Speed Limit Signs shown in **Figure 9.3** at all entrance and exit points to the designated area. All streets that fall within the posted entry sign and exit sign are then designated with the same speed limit denoted on the gateway signs.

[1] City of Toronto. *Toronto Complete Streets Guidelines*. 2016. Figure 8-5.

FIGURE 9.3: GATEWAY SPEED LIMIT SIGNS

Area-wide speed limit reductions are not yet common in Ontario municipalities comparable to Waterloo although several are currently considering this approach. Even where a jurisdiction has taken this approach, analysis findings are not yet available, making it difficult to reliably assess the merit of implementing such measures in Waterloo. From the City's experience in reducing speed limits in school zones to 40 km/h, follow-up field surveys indicate speeds tend to diminish but remain above the posted limit. Sufficient data was not available to assess the sustained, long-term effects of these lower speed limits.

Consistent with its philosophy on Vision Zero, City Council has expressed a strong desire to realize lower vehicle speeds in the City, specifically for safety reasons on neighbourhood streets and especially around schools. But as previously noted, installing signs alone rarely achieves compliance with lower posted limits and sustained long-term change in vehicle operating speeds. For this reason, the City should develop a comprehensive Speed Management Program in concert with a policy of area-wide speed limits on neighbourhood streets and in school zones. Building on the City's current pilot in the Westvale, Eastbridge and Old Abbey neighbourhoods, the program should focus primarily on speed management for local and collector roads (class 4 and 5 roads) within residential communities. Most higher order roads in the City fall under the jurisdiction of the Region of Waterloo or Ministry of Transportation, with the few remaining arterial facilities under City control intended to facilitate the movement of large volumes of people and goods, including truck traffic, at higher speeds.

Recommendation 35: Develop a comprehensive Speed Management Program focusing primarily on local and collector (class 4 and 5) roads within residential communities and assess the effectiveness of the program in achieving compliance with lower area-wide and school zone limits.

Recommendation 36: Based on Council's additional recommendation #6 to the April 19, 2021 Staff Report IPPW2021-037, that Council will adopt either of the following approaches as part of the Speed Management Program:

i) Adopt a uniform speed limit of 30 km/h for class 4 and 5 roads within residential areas; or

ii) Adopt a uniform speed limit of 40 km/h for class 4 and 5 roads within residential areas and 30 km/h on roads within school zones in residential areas.

9.2.4 Addressing Identified Collision Locations

As part of a broader strategy aligned with Vision Zero principles, the City should pursue a more formal data-driven, evidence-based decision-making process for its road safety program. A data-focussed program will help City Council, citizens and other interested parties better understand the nature, causes, and injury outcomes of collisions, providing context for the design of strategies and interventions that will reduce crashes and their adverse consequences.

The program should incorporate the two approaches to safety management, being the selection and treatment of sites based on:

- Site-specific collisions (collision-based); and
- Site-specific geometric and operational attributes known to increase collision risk (systemic).

The collision-based and systemic approaches are complementary and support a comprehensive approach to safety management, with their primary difference being the way in which the agency identifies issues and develops projects. The systemic approach is more preventative in nature, applying countermeasures to locations with features correlated with collisions but not necessarily having a history of crashes. This distinction is important because the types of collisions occurring on a system remain relatively consistent from year to year while their locations tend to fluctuate, particularly on lower volume roads. It is difficult to address these sites with the collision-based approach due to the low density of crashes and typical data limitations associated with local roads. The systemic approach helps to overcome these limitations by focusing on the underlying risk factors across the network as opposed to collision history at individual locations. While there are differences in application, both approaches focus on preventing future collisions and reducing fatalities and injuries.

This data-driven road safety management process will provide the City with valuable information for system planning, project planning, design and construction, and operations and maintenance of its road network. Safety evaluation develops the evidence-based information used in the process, which can be integrated into the overall project development process.

Recommendation 37: Adopt a formal data-driven, evidence-based decision-making process as part of the City's road safety program.

9.3 Roadway Classification and Design

9.3.1 Lane Widths

Decisions regarding lane configuration and widths represent a conscious allocation of space that has implications for the use and function of a roadway including vehicle types and modes, crossing distances, and parking availability. Altering lane widths can be a tool to effectively use a limited right-of-way while achieving Vision Zero and Complete Streets policy goals to prioritize safety for vulnerable users and design for all modes. This tool, coupled with an understanding of best practices and the relationship between lane widths, speed, capacity, and safety, can be used to design a street for all users, but also to fit its context within the overall road network.

The following summarizes the relationship between lane widths and speed, safety, and capacity in urban and suburban environments – where speeds are typically less than 70 km/h – such as the City of Waterloo.

- **Lane Width and Speed –** Narrower lane widths result in lower operating speeds. Lanes wider than 3.2 metres tend to encourage drivers to travel at higher speeds. Each additional 0.1 metre of lane width results in an increase in average travel speed of 1.5 km/h.

  Speed has a relationship with both safety and perceived safety. It is widely accepted speed is a key factor in collision severity, where higher operating speeds result in more severe crashes. Higher operating speeds result in reduced comfort for pedestrians and cyclists.

- **Lane Width and Safety** – Narrower lane widths have no negative impact on safety performance, where speeds are under 70 km/h. There is no evidence to suggest crash frequencies increase where urban and suburban arterial lane widths are reduced below 3.6 metres. Excessively wide lanes beyond 4.0 metres can have a detrimental impact to safety, as they may lead to confusion, improper lane use and may encourage unsafe passing manoeuvres.

- **Lane Width and Capacity** – Narrower lane widths have been found to have no negative impact on capacity, where speeds are under 70 km/h. However, on roadways with high speeds and low interruptions, reductions in lane widths can lead to reductions in capacity.

A review of best practice suggests the lane widths used in City standard cross-sections are overly wide. Wide lane widths encourage speeding, diminishes safety for pedestrian and cyclists, and result in longer pedestrian crossing distances at intersections. Wider than necessary lanes may also lead to higher spending on road construction and maintenance for the City, especially as efforts to incorporate more travel modes become more prominent. To be consistent with best practices and comparable cities, the City should consider narrowing lane width requirements and reducing roadway cross-sections in three ways:

- **Eliminate Centre Medians –** Centre medians may serve to manage access to the roadway, separate traffic flow, provide traffic calming through vertical elevation, and create

landscaping opportunities. The City also utilizes centre medians to provide separated mid-block crossings, where pedestrians have reduced exposure to the roadway and only mind traffic from one direction when crossing. Consider an alternative cross-section without a centre median where the context is appropriate with regards to land use, traffic, and other variables. This provides additional boulevard space for active transportation facilities and landscaping, plus reduces crossing distances for pedestrians at intersections.

- **Avoid Lanes wider than 3.5 Metres** – Lanes wider than 3.5 metres should not be used in any urban applications, as they promote faster speeds and consume an unnecessary amount of right-of-way. Eliminate general purpose vehicle lanes wider than 3.5 metres in urban conditions as they promote faster speeds and consume greater amounts of right-of-way. For existing roadway cross-sections, consider visual narrowing through pavement markings by:
  - Adding a longitudinal white stripe 0.3 metres from the curb or at the edge of the gutter when the vehicle lane is adjacent to the curb; and
  - Narrowing the vehicle lane and using the excess width to create a painted buffer between when the vehicle lane is adjacent to a bicycle lane.
- **Narrow Curb Lanes in Conjunction with Buffered Bicycle Lanes** – Where streets have separated bicycle lanes at the curbs, the buffer zone may be used as justification for narrower lanes because they provide distance for larger vehicles operating adjacent to them. Reduce lane widths on streets with separated bicycle lanes at the curbs. The buffer zone can provide additional width for larger vehicles. Narrow curb lanes with a buffer promote slower vehicle speeds and provide greater horizontal separation between vehicles and cyclists compared to a wide curb lane and a conventional bike lane. The buffer space may be painted and/or include features such as bollards or planters. **Figure 9.4** demonstrates that providing a 3.0-metre vehicle lane adjacent to a buffered or separated bicycle lane provides sufficient space for operation of a large vehicle, while promoting maximum horizontal separation between vehicles and cyclists.

Recommendation 38: Consider narrowing lane width requirements and reducing roadway cross-sections in three ways: remove centre medians, avoid lanes wider than 3.5 metres and narrow curb lanes in conjunction with buffered bicycle lanes.

Figure 9.5, Figure 9.6, and Figure 9.7 illustrate conceptual arterial, major collector, and minor collector roadways, respectively, demonstrating how to effectively use available space in the right-of-way. **Table 9.3** summarizes the cross-section components and required widths.

Recommendation 39: Update the City's standard cross-sections to incorporate the recommended lane widths, as well as effectively using the available space for pedestrians, cyclists, transit vehicles and private vehicles.

FIGURE 9.4: NARROW CURB LANES WITH BUFFERED BIKE LANES

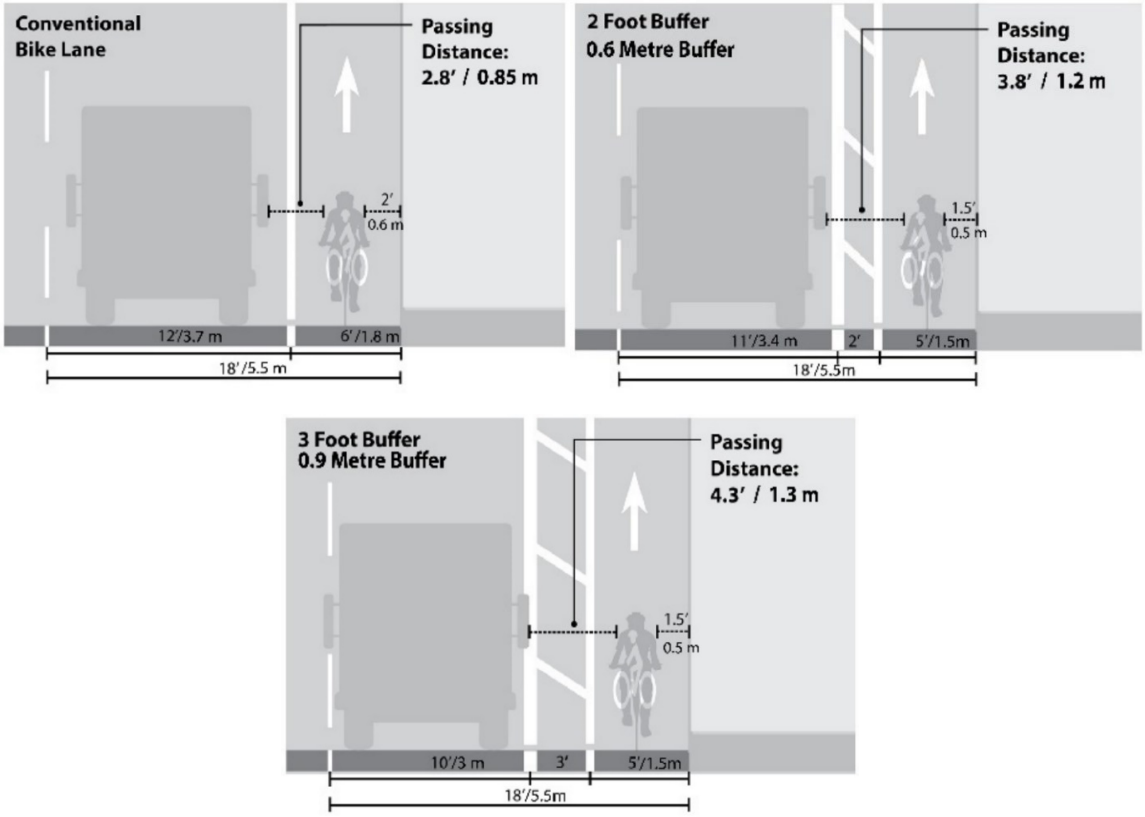


FIGURE 9.5: ARTERIAL ROAD CONCEPTUAL CROSS-SECTION

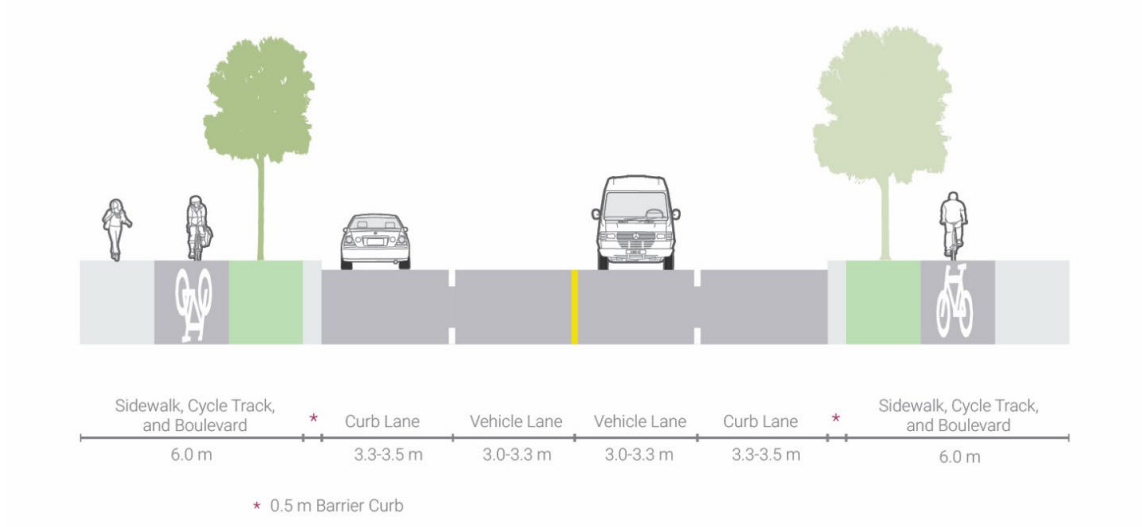


FIGURE 9.6: MAJOR COLLECTOR ROAD CONCEPTUAL CROSS-SECTION

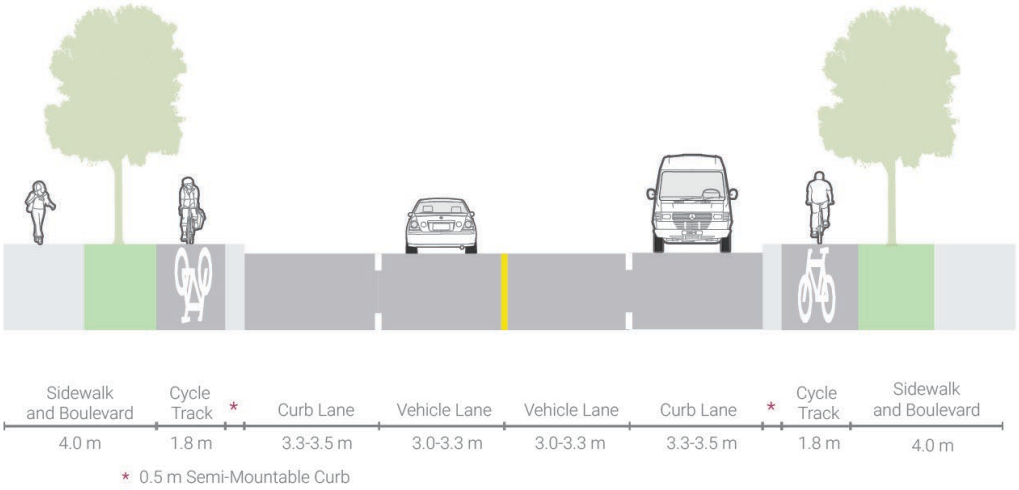


FIGURE 9.7: MINOR COLLECTOR ROAD CONCEPTUAL CROSS-SECTION

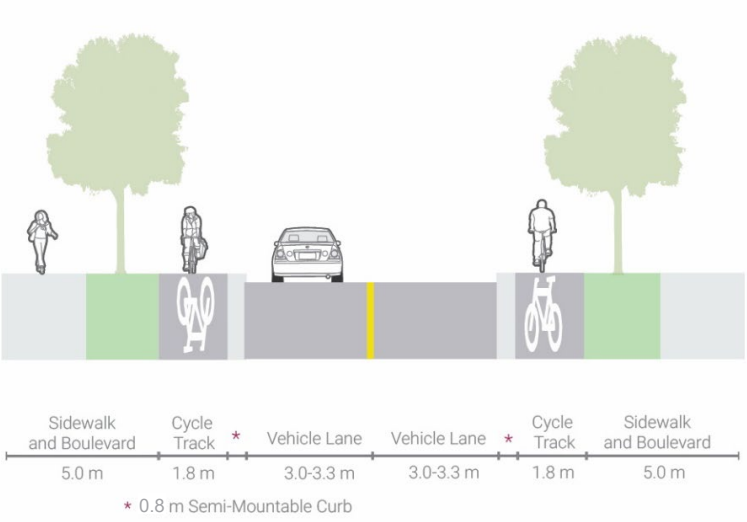


TABLE 9.3: CROSS-SECTION COMPONENTS AND REQUIRED RIGHT-OF-WAY

Road Classification	Sidewalk and Boulevard	Cycle Track	Curb	Vehicle Curb Lane	Vehicle Inside Lane
Arterial	6.0 m	With sidewalk and boulevard	0.5 m barrier	3.3 – 3.5 m	3.0 – 3.3 m
Major Collector	4.0 m	1.8 m	0.5 m semi-mountable	3.3 – 3.5 m	3.0 – 3.3 m
Minor Collector	5.0 m	1.8 m	0.8 m semi-mountable	3.0 – 3.3 m	Not provided

9.3.2 Roadway Classification

A street network performs most efficiently and effectively from both traffic operations and road safety perspectives if roads are planned, designed, operated, and maintained to serve their intended purposes. This includes travel for all modes and the safety and convenience of all road users.

In keeping with this philosophy, a road classification system designates streets into different groups or classes according to the type of service (or function) each category is intended to provide. The 2011 TMP established a new road classification system for the City based on a people movement focus. The system remains relevant and is proposed to be carried forward as part of the WTMP with no changes to the existing road classifications and characteristics/criteria.

A new **Woonerf** classification is proposed based on the recommendations of the *Northdale Land Use and Community Improvement Plan Study – Urban Design and Built Form Guidelines*. A woonerf (Dutch for living garden), or shared street, integrates uses within the right-of-way removing the boundaries established in typical separated roadways between vehicles, cyclists, and pedestrians. Woonerfs are not intended to act as through streets and are expected to only serve adjacent uses. The intention is to integrate (not segregate) roadway users, and thereby increase safety by slowing down vehicular traffic. Larch Street in the Northdale neighbourhood is proposed as a Woonerf at this time. Other roads may be considered in the future.

With the addition of the Woonerf category to the existing designations, the classification system will comprise the following eight types of roads (in order from mobility to access):

- Provincial Highway (Ministry of Transportation responsibility)
- Regional Road (Region of Waterloo responsibility)

- City Arterial
- Major Collector
- Minor Collector
- Local
- Woonerf *(new classification)*
- Laneway (not shown on map due to scale)

Table 9.4 details the various characteristics/criteria that apply to each of the City's road classifications, describing the role of each category in the overall roadway network.

Map 9.1 shows the proposed classifications for the City of Waterloo road network based on the recommended road classification system detailed in **Table 9.4**. The figure identifies (in yellow highlight) the roads proposed for reclassification from their current designation shown on *Schedule 'E' – Road Classification System* of the City's Official Plan (Revision Date February 2018). The remaining roads would retain their current classifications per Schedule 'E'. **Table 9.5** summarizes the proposed changes, listing the specific roads/limits and their current (Official Plan) and proposed classifications (the ID column cross-references the road sections to **Map 9.1**).

The proposed Woonerf road category and reclassifications of specific streets noted in **Table 9.5** would be incorporated into the City of Waterloo Official Plan by amendment or through an Official Plan update.

Recommendation 40: Incorporate the proposed road classification criteria and road classification changes summarized in **Table 9.4**, **Map 9.1** and **Table 9.5**, into the City of Waterloo Official Plan.

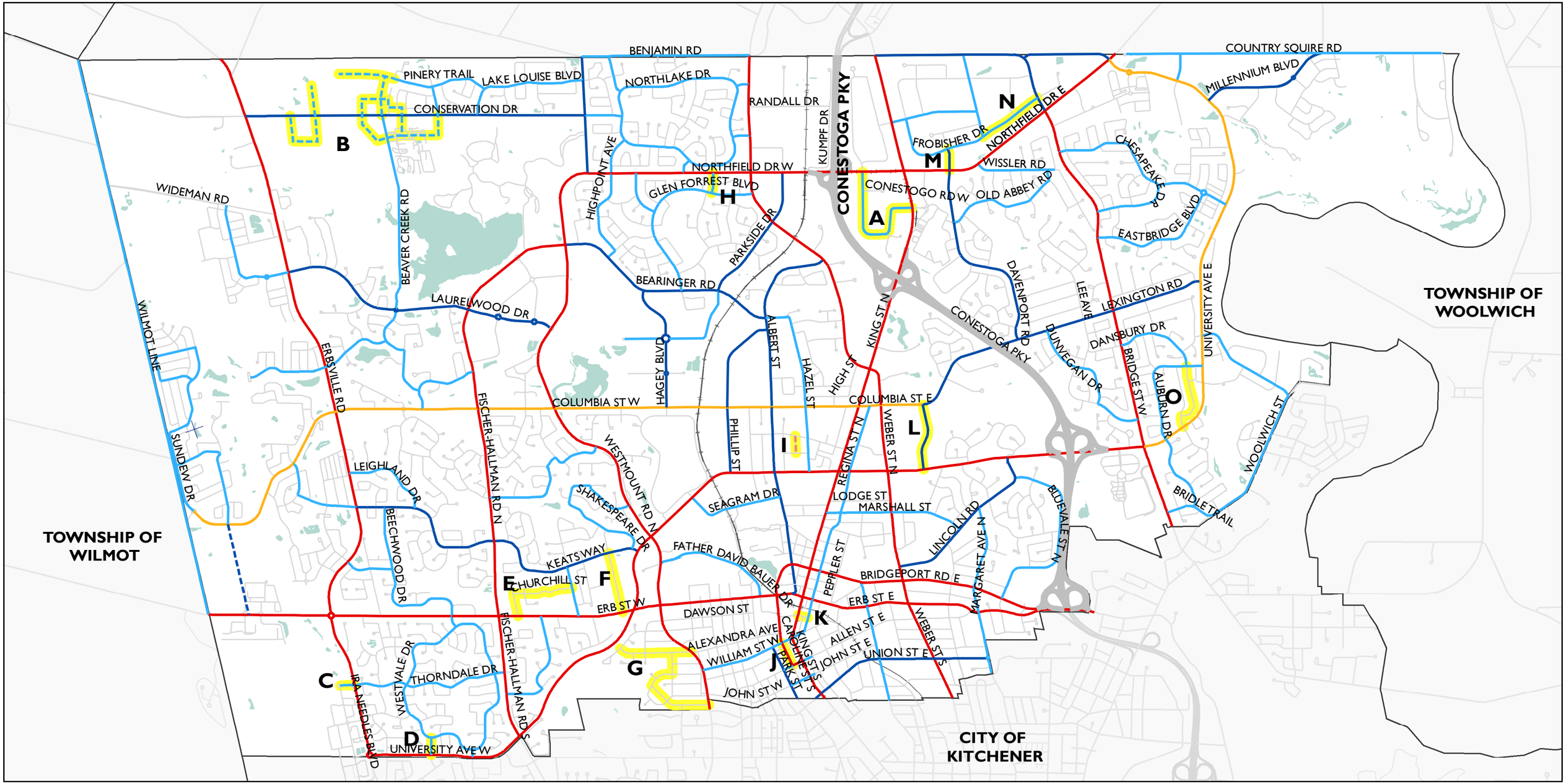
TABLE 9.4: CITY OF WATERLOO ROAD CLASSIFICATION CRITERIA

Road Classification Characteristics	Road Classification					
	City Arterial	Major Collector	Minor Collector	Local	Woonerf	Laneways
ROW Width	30 – 35 m	20 – 30 m	18 – 20 m	16 – 18 m	10 – 13 m	6 m
Pavement Width	11 – 18 m	11 – 15 m	8 – 11 m	8 – 9 m	< 7 m	6 m
Vehicle Types	All Types, Truck Route	Residential: Passenger and Service Vehicles Industrial/Commercial: All Types	Residential: Passenger and Service Vehicles Industrial/Commercial: All Types	Residential: Passenger and Service Vehicles Industrial/Commercial: All Types	Residential: Passenger and Service Vehicles Industrial/Commercial: Restricted	Residential: Passenger and Service Vehicles Industrial/Commercial: Restricted
Innovation Potential	Opportunities for innovation to enhance person-carrying capacity and transit efficiency	Opportunities for innovation to accommodate non-motorized travel and reduce impacts of vehicular modes	Opportunities for innovation to accommodate non-motorized travel and reduce impacts of vehicular modes	Opportunities for innovation to develop safe and pedestrian friendly streets	Opportunities for innovation to develop safe and pedestrian oriented streets	Opportunities for innovations in the street orientation of buildings and to remove residential on-street parking
Streetscape Features	Opportunities for Basic and Enhanced Streetscape Features involving Furniture, Lighting, Trees and Landscaping	Opportunities for Basic and Enhanced Streetscape Features involving Furniture, Lighting, Trees and Landscaping	Opportunities for Primarily Basic Streetscape Features involving Boulevard Landscaping and Sidewalks	Opportunities for Primarily Basic Streetscape Features involving Boulevard Landscaping and Sidewalks	Opportunities for Basic and Enhanced Streetscape Features involving Furniture, Lighting, Trees and Landscaping	Limited to streetlighting and drainage opportunities in Laneways
Existing/Planned Adjacent Lane Use	Medium/High-Density Mixed-Use Development and Major Traffic Attractions	Mixed Land Uses in Range of Low/Medium Density	Primarily Low/Medium Density Development in Residential Neighbourhoods and Employment Areas	Primarily Low Density Residential Neighbourhoods and Employment Areas	Medium/High Density Mixed-Use and Residential Neighbourhoods	Low Density Residential Neighbourhood with Frontages on Public Street
User Volume (Typical Motorized Traffic AADT)	12,000 – 30,000	< 12,000	< 5,000	< 2,000	Local Access Only	Local Access Only
User Volume (Pedestrian)	High	High	Medium	Low	High	Local Access Only with No Sidewalks
Design Speed*	50 km/h	50 km/h	30 – 50 km/h	30 – 40 km/h	30 km/h Maximum	30 km/h Maximum
On-Street Parking Provisions	Generally Restricted	Generally Restricted	Permitted on One or Both Sides	Permitted on One or Both Sides	Permitted in Demarcated Spaces	Parking Generally Restricted on a Laneway
Land Service/Access	Primary Function is People and Goods Movement with Access Controls	Property Access and People and Goods Movement of Equal Importance	Property Access and People and Goods Movement of Equal Importance	Primary Function is to Access Individual Properties	Primary Function is to Access Individual Properties	Primary Function is to Access Parking Garages/Areas Located at Rear of Houses
Transit Service	Supports all Conventional and Rapid Transit Service	Conventional Transit Allowed	Conventional Transit Allowed	Generally Restricted	Restricted	Restricted
Pedestrian Facilities	Sidewalks on Both Sides	Sidewalks on Both Sides	Sidewalks on Both Sides	Sidewalks on Both Sides	Accommodate Safely Within Road Right-of-Way	No Sidewalks
Cyclist Facilities	Dedicated On-Road Facilities and Off-Road Facilities Where Appropriate	Generally Dedicated On-Road Facilities and Off-Road Facilities Where Appropriate	Generally Dedicated On-Road Facilities and Off-Road Facilities Where Appropriate	Accommodate Safely Within Road Right-of-Way	Accommodate Safely Within Woonerf Right-of-Way	Accommodate Safely Within Laneway Right-of-Way

TABLE 9.4: CITY OF WATERLOO ROAD CLASSIFICATION CRITERIA

Road Classification Characteristics	Road Classification					
	City Arterial	**Major Collector**	**Minor Collector**	**Local**	**Woonerf**	**Laneways**
Commercial Vehicle Access	Generally Allowed – May Be Subject to Time Restrictions	Permitted in Employment Areas or as Specified in Truck Route Bylaw	Permitted in Employment Areas or as Specified in Truck Route Bylaw	Not Permitted Except as Allowed in Employment Areas or Specified in Truck Route Bylaw	Not Permitted Except as Required by Adjacent Land Use	Not Permitted Except as Required by Adjacent Land Use
Maximum Intersection Separation	400 m	200 m	60 m	60 m	N/A	N/A
Maximum Intersection Pedestrian Crossing	400 m	200 m	60 m	60 m	N/A	N/A
Maximum Driveway Spacing	Generally Restricted			One Driveway per lot	N/A	N/A

* Design speed for streets or sections of streets with lower posted speed limits, e.g. school zones, will be designed to the posted speed.



Map 9.1

PROPOSED ROAD CLASSIFICATION

Map Version: 11/13/2020

Road Classifications

- Provincial Highway
- Regional Arterial
- City Arterial
- Major Collector
- Future Major Collector
- Minor Collector
- Future Minor Collector
- Future Woonerf
- Local Street

TMP Recommendation

- Recommended for Classification Change

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TABLE 9.5: PROPOSED ROAD CLASSIFICATION CHANGES

ID	Street Name	Limits	Current Classification	Proposed Classification
G	Alexandra Avenue	Lourdes Street to Westmount Road South	Minor Collector	Local
J	Allen Street West	Caroline Street West to King Street South	Minor Collector	Regional Arterial
B	Beaver Creek Meadows District Plan	Not Applicable	Not Applicable	Proposed Minor Collector
J	Caroline Street South	Allen Street West to Erb Street West	Major Collector	Regional Arterial
E	Churchill Street	Erb Street West to Amos Avenue	Minor Collector	Local
A	Conestogo Road	Northfield Drive West to King Street North	Local	Minor Collector
O	Dansbury Drive	Pastern Trail to Auburn Drive	Minor Collector	Local
M	Davenport Road	Northfield Drive East to Frobisher Drive	Minor Collector	Major Collector
G	Empire Street	Stanley Drive to Alexandra Avenue	Minor Collector	Local
G	Forsyth Drive	Stanley Drive to City Limit	Minor Collector	Local
N	Frobisher Drive	McMurray Road to Bridge Street West	Local	Minor Collector
I	Larch Street	Balsam Street to Hickory Street West	Local	Woonerf
L	Marsland Drive	University Avenue East to Columbia Street East	Local	Major Collector
F	McDougall Road	Erb Street West to Keats Way	Minor Collector	Local
H	Northgate Avenue	Glen Forest Boulevard to Northfield Drive West	Local	Minor Collector
O	Pastern Trail	University Avenue East to Dansbury Drive	Minor Collector	Local
D	Portsmouth Gate	University Avenue West to Westvale Drive	Local	Minor Collector

TABLE 9.5: PROPOSED ROAD CLASSIFICATION CHANGES

ID	Street Name	Limits	Current Classification	Proposed Classification
G	Stanley Drive	Forsyth Drive to Empire Street	Minor Collector	Local
C	Thorndale Drive	The Boardwalk to Ira Needles Boulevard	Not Applicable	Minor Collector
K	Willis Way	King Street South to Regina Street South	Minor Collector	Local

9.4 Proposed Road Works

9.4.1 Philosophy

As population and employment growth transpired, the City historically responded to the increasing transportation demand through the construction of road widenings. Now, the City is reaching a state of maturity where there are not many options left for road widening that do not have major environmental and community impacts. The City's focus is a sustainable transportation system with an increased emphasis on moving people and managing travel to reduce reliance on the automobile in favour of transit and more active forms of movement. Through conversations with Council and the public, it became evident that road widening will not be the primary method to accommodate transportation growth moving forward. Therefore, the WTMP does not include an extensive road expansion program. Instead, the program focuses on:

- Completing corridor expansion projects identified in the 2011 TMP, 2019 DC Background Study and development plans but pursue no new city initiatives;
- Working with the Region of Waterloo to implement the 2018 RTMP road projects; and
- Undertaking select intersection expansion projects.

However, the City may still choose to widen a road right-of-way and/or pavement width for active transportation facilities, infrastructure needs or streetscaping.

Additionally, the WTMP anticipated a review and application of the Region of Waterloo Travel Demand Forecasting Model (the Model) to help identify any City roads that would experience future capacity pressures due to forecasted growth in population and employment. The Model forecasts transportation trip-making by mode and trip purpose across the Region based on population and employment forecasts generated by the Region to project future travel demands. These forecasts ultimately translate into person trips by various travel modes on the transportation network as people move to, from and within the Region of Waterloo.

Prior to commencing the modelling task, the Project Team reviewed key inputs and assumptions used in the Model for consistency and suitability in the City's context. Through this review, discrepancies between the Regional population and employment forecasts used in the Model and what the City is observing in terms of actual growth were noted. The discrepancies raise questions around the reliability of the forecasts and their ability to inform the WTMP and the capital program. From a financial and asset management perspective, the capital and operating costs to widen roads and upgrade intersections can be significant. Given the potential impact, decisions related to road widenings and intersection capacity enhancements should be based on data in which staff has greater confidence in.

A further task of the WTMP update was to use the Model to analyze existing and projected traffic conditions to help establish modal shift targets and corporate targets for reducing Carbon Dioxide (CO2) emissions. The above noted discrepancies would also make the setting of such targets questionable and potentially unusable.

Given the above factors, the Project Team concluded the modelling task should not be completed as part of the WTMP and should be deferred and carried out as a separate future project once the Regional Official Plan is updated. The new plan will provide updated population and employment forecasts for the City, which can then be applied in the Model. The analysis, targets for modal shift and CO2 reduction, can then be completed with confidence.

Recommendation 41: Commence the transportation modelling work and other technical analyses, including targets for modal shift and CO2 reduction and intersection capacity enhancements upon completion of the Region of Waterloo Official Plan update, targeted fall of 2022.

9.4.2 Network Capacity

Enhancing the capacity of a road typically involves adding travel lanes and/or bike lanes, installing transit improvements such as transit priority signals or queue jump lanes, restricting cross-street and/or driveway access and optimizing traffic controls. It can also involve structural roadway extensions and additions to enhance overall road network capacity. "Road expansions" refer to projects involving extensions of existing roads, new road corridors, and road widenings that involve additional vehicle travel lanes.

In addition to enhancing roadway capacity in appropriate corridors and at deficient intersections, a Complete Transportation Strategy also includes opportunities to adjust road capacity to better accommodate all transportation modes and improve the streetscape environment. In some cases, this can be done by reducing the number of motorized vehicle travel lanes on a road section, called "road reconfiguration", to accommodate other transportation infrastructure such as cycling facilities, enhanced pedestrian space, or dedicated transit lanes.

Table 9.6 details the roadway capacity projects identified in the 2011 TMP and the 2019 DC Background Study. The three City projects have an estimated total capital cost $18.2 million.

The 2018 RTMP recommends 11 roadway capacity projects including widenings, extensions, and road reconfigurations within the City of Waterloo to 2041 and beyond. **Table 9.7** details the recommendations. Indicative costs for each project were not provided as part of the 2018 RTMP.

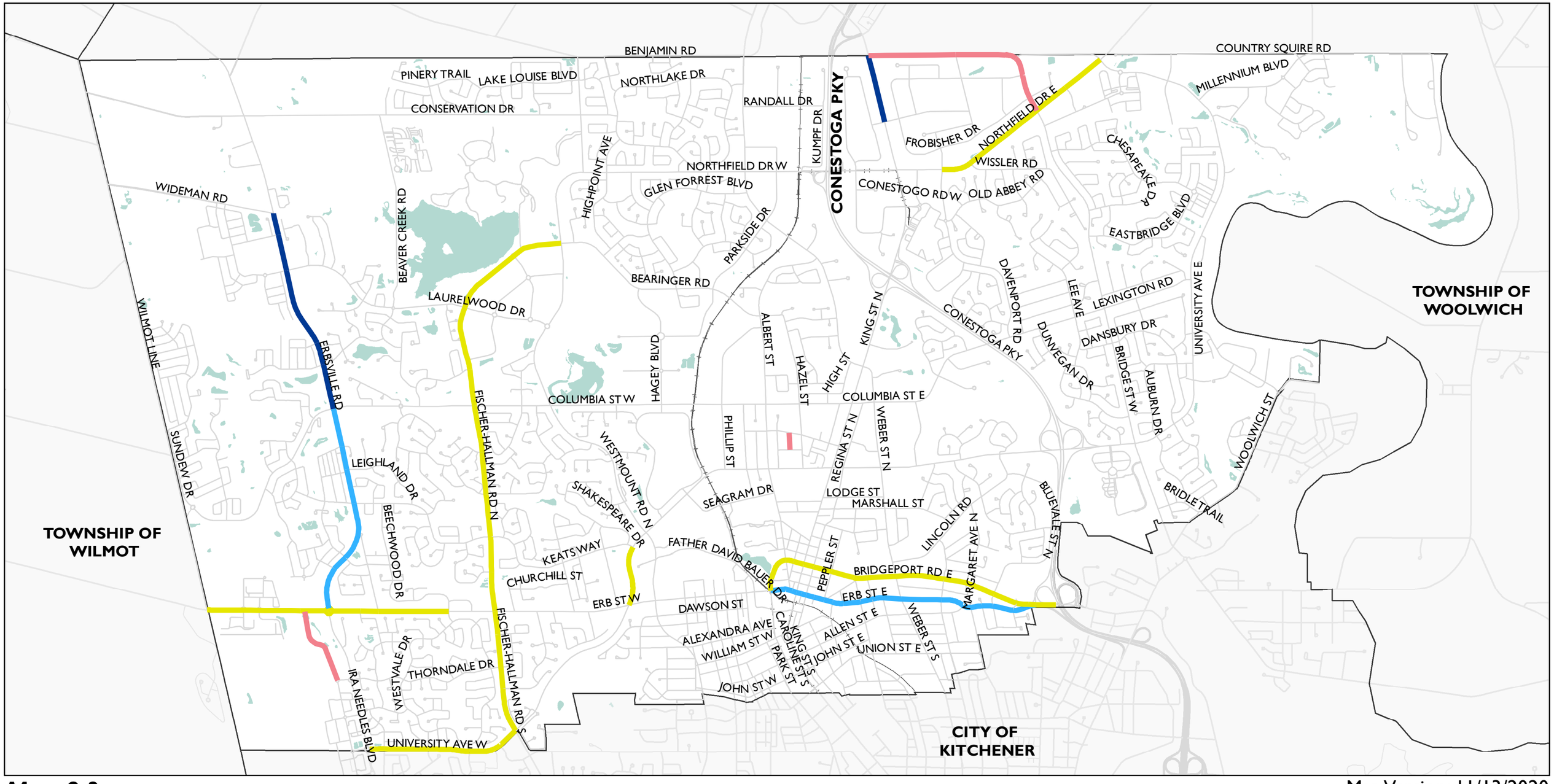
Map 9.2 shows the planned roadway capacity enhancements in the City of Waterloo to 2041 and beyond.

TABLE 9.6: RECOMMENDED ROAD PROJECTS

Street	Type	Limits	Timing	Cost (millions)
2011 TMP Projects				
Bridge Street	Widening	King Street North to Northfield Drive	2021-2031	$13.3
2019 Development Charges Background Study Projects				
Ira Needles Boulevard By-pass	Extension	The Boardwalk to Erb Street West	2020	$4.1
Larch Street	Woonerf	Balsam Street to Hickory Street West	2020	$1.8

TABLE 9.7: RECOMMENDED ROAD PROJECTS IN THE CITY OF WATERLOO IN 2018 REGION OF WATERLOO TMP

No.	Street	Type	Limits
2019 – 2031 Projects			
3	Northfield Drive East	Widening	Davenport Road to Bridge Street (completed in 2019) Bridge Street to University Avenue
9	Fischer-Hallman Road/ Bearinger Road	Extension	Columbia Street to Westmount Road
11	Erb Street West	Widening	Gateway Drive/Beechwood Drive to Wilmot Line
12	University Avenue West	Widening	Keats Way to Erb Street (completed in 2019)
14	University Avenue West	Widening	Ira Needles Boulevard to Fischer-Hallman Road South
16	Fischer-Hallman Road	Widening for Transit Lanes	Highway 7/8 to Columbia Street
A	Bridgeport Road/Caroline Street North	Road Reconfiguration	Highway 85 to Erb Street West
2031 – 2041 Projects			
10	Erbsville Road	Widening	Erb Street to Columbia Street
B	Erb Street West	Road Reconfiguration	Caroline Street to Highway 85
Projects Beyond 2041			
73	King Street North	Widening	Northland Road to Bridge Street West
74	Erbsville Road	Widening	Columbia Street West to Wideman Road



Map 9.2

RECOMMENDED ROAD PROJECTS

Map Version: 11/13/2020

Project Responsibility and Timeline

- City - 2020-2031
- Region - 2020-2031
- Region - 2031-2041
- Region - 2041+

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10 TRANSIT AND FUTURE MOBILITY

10.1 Supporting Transit

Grand River Transit (GRT) provides scheduled (fixed route), on-demand, and specialized (for qualified individuals) bus and Light Rail Transit (LRT) transit services within the City, offering connections within Waterloo and to the rest of the Region and beyond. Additionally, GO Transit operates a bus route with stops in the City, and train service to nearby Kitchener, linking to the broader inter-regional transportation network. Subsection 5.2.1 and 5.2.2 of Volume 1 describe existing transit services in further detail.

Providing efficient and effective transit service is key to offering individuals mobility choices and serving a broader segment of the community, especially people who choose not to drive, are unable to drive or do not have access to an automobile because of age, income and/or physical disability. Universal access to reliable public transportation is also needed to create the types of compact and complete communities envisioned by provincial policy and municipal land use plans. The demand for and reliance on these services continues to expand as Waterloo grows and its population ages, placing additional pressure on existing systems to meet needs.

Section 6.1.4 of the City's Official Plan details objectives for public transit in Waterloo. The plan states the *City supports the wide use of public transit as a preferred form of travel. Rapid transit will assist in facilitating the City's growth through intensification and can be supported as a means of reducing traffic congestion, parking demands, air pollution and energy consumption while providing opportunities to improve community livability and quality of life. To that end, the City will plan for:*

- *Neighbourhoods, sites and buildings that are designed to facilitate transit and enable it to be well connected with other modes of travel, making it a desirable travel option;*
- *Compact urban form that supports transit usage; and*
- *The provision and maintenance of infrastructure such as the sidewalk and bicycle system, to support the transit system, in conjunction with the Region of Waterloo.*

Section 6.5.2 of the Official Plan further details how the City intends to support the use and accessibility of public transit in Waterloo with respect to transit-oriented development, integrating transit with other travel modes and supporting a comprehensive and well-designed transit network.

With the growth and change experienced in the Region of Waterloo over the last few decades and the emergence of activity centres across the Region, the demand for more frequent inter-municipal transit service has grown. Residents attending public open houses and forwarding comments during the study expressed their excitement for the ION LRT, improved transit connections between municipalities and greater service frequency.

While the City is not responsible for service delivery, the municipality can continue to help facilitate and promote transit through actions such as:

- Encouraging transit-supportive development through Official Plan policy, Zoning By-law regulations and site plan control;
- Creating safe and accessible active transportation connections to and from transit stops by developing the pedestrian and cycling networks detailed in Volume 2 of the WTMP;
- Rehabilitating and upgrading roads used for transit routes to enhance the operational efficiency of buses;
- Providing real-time transit information at locations such as the community centres and municipal offices.

In anticipation of needs beyond the 2018 RTMP horizon year of 2041, the 2018 RTMP identifies several road and rail corridors for potential future transit service which are subject to further review and refinement prior to implementation. Within the City, the Erb Street West – University Avenue West – King Street North (from Ira Needles Boulevard to Conestoga Mall) corridor should be protected for potential ION Stage 3 rapid transit. This initiative would build on the existing ION LRT (Stages 1 and 2) service to provide east-west connections in Waterloo. While potential future transit service on this corridor is beyond the horizon of the WTMP, the City should continue to monitor the status of ION Stage 3.

Recommendation 42: Advocate for the continuation and expansion of GRT and GO Transit services to and within Waterloo with the Region of Waterloo and Metrolinx, respectively.

Recommendation 43: Facilitate and promote transit within the City through actions such as supportive land use, active transportation connections, road improvements, and real-time transit information.

10.2 Shared and Micro Mobility

Shared mobility is defined as "the shared use of a motor vehicle, bicycle, or other low-speed transportation mode" that "enables users to obtain short-term access to transportation on an as-needed basis, rather than requiring ownership". The first carsharing and bikesharing programs in North America launched in 1994, with other shared mobility services expanding rapidly since that time.

Interest in shared mobility has grown tremendously in recent years with technological, socio-demographic, and behavioural changes and as society seeks more sustainable alternatives to the private automobile. This evolution in mobility can be traced to the emergence of the sharing economy. Defined as a peer-to-peer activity of acquiring, providing, or sharing access to goods and services, the modern sharing economy is typically facilitated by a community-based online digital platform. The rapid advancement of technology, particularly in smartphones and mobile

applications, has contributed to this evolution, with real-time information about where, when, and how to access or connect between different travel modes now readily available.

Through the sharing economy rose mobility on demand (MOD) and mobility as a service (MaaS):

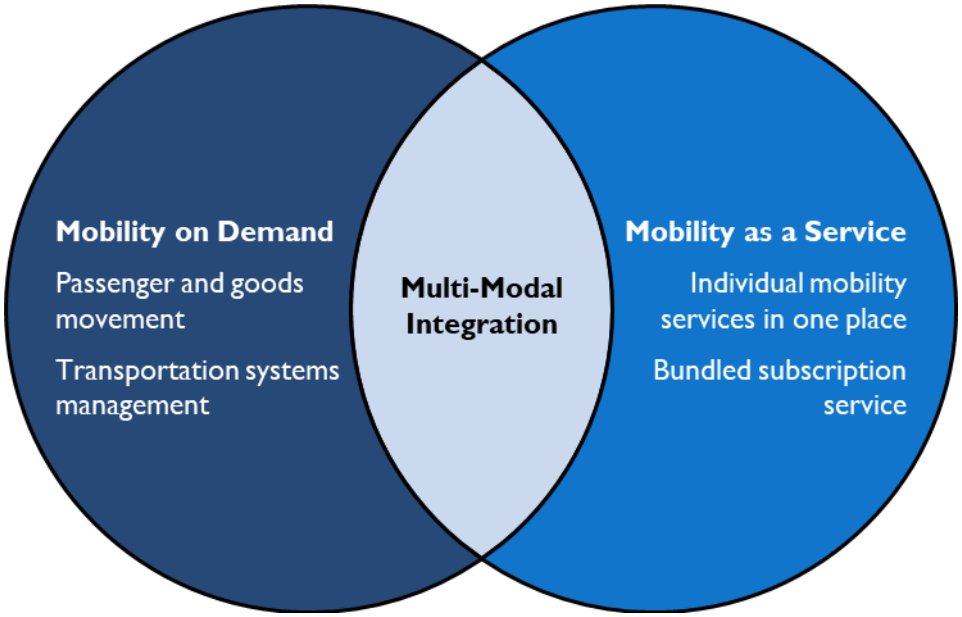
- MOD is based on the principle that different transportation modes have different economic values due to cost, trip time, wait time, number of connections/transfers, convenience, etc. MOD services allow users to access mobility, goods, and delivery services on demand creating an accessible multi-modal network. Four main MOD business models have evolved, being:
  - Business to Consumer (B2C)
  - Business to Government (B2G)
  - Business to Business (B2B)
  - Peer to Peer (P2P)

  Through supportive public policies, commonly involving rights-of-way, grants and direct subsidies, municipalities can influence the success and growth of MOD.
- MaaS is a platform that offers integrated transportation through subscription services. The platform is typically a mobile based app that contains all available transportation mode service information and payment in one convenient location. The idea is that the freedom and convenience to choose the most appropriate form and combination of travel for every trip alleviates the need to privately own a vehicle.

Figure 10.1 compares the concepts, illustrating the relationship between MOD and MaaS. In general terms, MOD is often referred to as how people or goods move from point A to point B, and which mode(s) are selected based on time, cost, and convenience. It emphasizes the commodification of passenger mobility, goods delivery, and transportation systems management. The term MaaS is typically used when discussing the software applications people use to make travel decisions and the data used to study that travel. It primarily emphasizes passenger mobility allowing travelers to seamlessly plan, book, and pay for a multimodal trip on a pay-as-you-go and/or subscription basis. The concepts are similar because they both involve integration of transportation modes through fares, a digital interface, and physical mobility options.

FIGURE 10.1: RELATING MOBILITY ON DEMAND AND MOBILITY AS A SERVICE

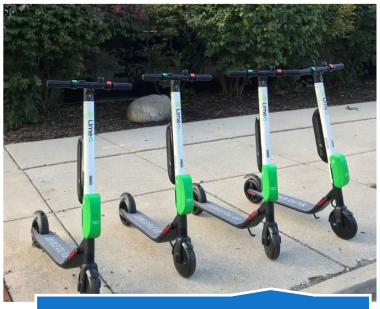
(Source: ITE Journal, Susan Shaheen and Adam Cohen, 2020)



New technologies and ideas in shared mobility continue to grow. In the broad sense, most forms can be categorized as either a transportation network company (TNC) or mobility service provider (MSP). Both rely on a smartphone application to connect individual users with a travel mode. **Figure 10.2** illustrates current examples of shared mobility options.

FIGURE 10.2: EXAMPLES OF SHARED MOBILITY

Bike Share



E-Scooter Share

Ride Share

The most prominent forms of shared mobility currently, and those with the highest potential applicability in Waterloo, include:

- **Car Sharing** – A service that provides members with access to an automobile for intervals of (typically) less than a day, alleviating the need for users to privately own a vehicle. Two primary models exist:
  - *Fleet operations*, where a company supplies and maintains a fleet of vehicles in pre-positioned locations (i.e. pick-up and drop-off at same location) or "floating" within a defined boundary (i.e. pick-up and drop-off at different locations). Current examples include Enterprise, Zipcar and Communauto; and
  - *Peer-to-peer operations*, where individuals share their personal vehicles directly with other carshare subscribers. Turo is a current example.
- **Bike Sharing** – A service that offers short-term bike rentals, usually for periods of an hour or less. The rental period can range from a single ride, to several days, to an annual membership. Two main models exist:
  - *Docked systems*, where bicycles are rented from an automated station (locked "docking stations" or "docks") and returned to a station belonging to the same system. Bike Share Toronto and BIXI Montreal are current examples; and
  - *Dockless system*, where self-locking and free-floating bicycles are rented and returned anywhere within a specified zone. Although not prevalent in Canada currently, examples in the United States include Lime, Jump and Bird.
- **Electric Kick-Style Scooter (E-Scooter) Sharing** – A service in which electric motorized scooters (also referred to as e-scooters) are rented for short-term use. E-scooters are typically "dockless", like the bike sharing service. Although not prevalent in Canada currently, examples in the United States include Lime, Jump and Bird.

  In fall 2018 and spring/summer 2019, the City participated in the first Canadian e-scooter pilot program. The pilot area included the David Johnston Research and Technology Park ("R&T Park") and extended slightly into the Idea Quarter district and along the Laurel Trail to the Uptown Promenade. The Provincial Government has since launched a pilot program on January 1, 2020 to permit e-scooters on Ontario roads. For the pilot, the province has set out the broad rules and requirements for e-scooters. Municipalities must then pass by-laws to allow their use and determine where they can operate most safely in each unique environment.
- **Ride Sharing, Ride Hailing and Ride Sourcing** – A service that involves adding passengers to a private trip in which the driver and travellers share a common destination. Traditional forms of ride sharing services include carpooling and vanpooling. Today, transportation network companies such as Uber and Lyft are examples of ride hailing services although their "pool" functions are akin to ride sharing. A ride sourcing service, like Poparide, that allows individuals to coordinate shared rides through an online app.

  There may be a role for ride sharing, ride hailing and ride sourcing platforms to serve longer distance, intermunicipal trips not accommodated by transit or local taxis.

- **Shuttles** – A service that relies on small buses or vans to provide public mobility within a defined area. A form of "microtransit", two common models exist:
  - *Circulating shuttles*, which carry passengers for short trips along a fixed route to/from specific destinations and designated locations such as transit stops, offices, stopping, and community facilities; and
  - *Demand-responsive shuttles*, which transport passengers, often door to door, in vehicles that alter their routes based on demand rather than following a fixed timetable.

  Like ride sharing, shuttles could play a limited role serving trips not met by transit or other modes.

Shared mobility services can be successful in addressing the transportation challenges of communities like Waterloo, providing a viable solution to the "first and last mile dilemma" and offering mobility options for individuals without automobiles. These services can complement the transit system and offer efficient, cost-effective options to single-occupant vehicle travel, thereby reducing the volume of short distance auto trips.

Municipalities typically use by-laws, policies, and guidelines to influence the availability, viability, and delivery of shared mobility services. The most common matters addressed through municipal direction include the allocation of public rights-of-way spaces (e.g., parking, curb space), development and zoning regulations, insurance, and for-hire vehicle regulations (e.g., licensing), and taxation and fees.

Before deciding on the type of service(s) to pursue and/or permit, the City should pursue a Shared Mobility Strategy for the community. The strategy should identify the specific transportation needs to be addressed and articulate a case for the service(s) that best suits requirements. Tools such as surveys, pilot projects and incentives could be used as part of the study to gauge local interest level. The study should also engage a cross-section of local stakeholders and potential partners to ensure broad support for the initiative and ultimately facilitate implementation.

The Shared Mobility Strategy should consider the merit of introducing/piloting an "EcoMobility" hub(s) in the City, possibly in the Uptown area or near the university and college campuses. These hubs serve as one-stop service points for multimodal systems and typically feature a range of shared mobility services including bike share, ride share, and car share facilities. **Figure 10.3** illustrates the concept.

FIGURE 10.3: ECOMOBILITY HUB CONCEPT
(Source: Multi Mobility, Sophia von Berg, 2014)

An opportunity may exist to leverage the planned transit plaza at the University of Waterloo Station for a type of EcoMobility hub. The plaza will increase bus access to the interior of campus, allow GRT routes to connect directly to the new ION light rail station, and provide access to new developments on Phillip Street. It could also provide the base for shared mobility services with easy access to the Laurel Trail for cyclists and pedestrians and connections to business and services along University Avenue.

The Shared Mobility Strategy should reflect the following guiding principles:

- Shared mobility impacts everyone, not just users, due to its impacts on the transportation network and the environment;
- Providing clear and consistent definitions can help reduce confusion about the different service models;
- Public-private partnerships can enhance shared mobility options;
- The public should be informed and involved in the planning process;
- Collecting data and reporting findings help build understanding of the impacts of shared mobility and enhance performance;
- Shared mobility should be incorporated into transportation planning;
- Social, interregional, and intergenerational equity needs to be encouraged to the extent possible; and
- Shared mobility developments should be tracked, and sound policies developed for managing rights-of-way and public-private partnerships.

Recommendation 44: Develop a Shared Mobility Strategy for the City in collaboration with the Region, local stakeholders, and potential partners. The strategy should consider the merit of introducing/piloting an of an Ecomobility Hub, as well as assess the potential for a Mobility as a Service (MaaS) system.

Recommendation 45: Facilitate and promote shared mobility within the City through the introduction or modification of by-laws, policies, and guidelines pertaining to the allocation of public rights-of-ways, development and zoning regulations, insurance and for-hire vehicle regulations, and taxation and fees.

10.3 Automated, Connected and Electric Vehicles

Over the past decade, the automotive industry has experienced considerable change due to innovation and rapidly evolving technology, some of which impacts local governments. Potentially transformative automobile technologies likely to have significant effects on municipal land use and transportation in the coming 10 to 30 years include:

- **Automated Vehicles (AVs)**, which have at least some aspect of a safety-critical control function (e.g., steering, throttle, or braking) occur without direct driver input. There are six levels of vehicle automation, starting from Level 0: No Automation to Level 5: Full Automation (or Autonomous), as defined by the Society of Automated Engineers (SAE) International;
- **Connected Vehicles (CVs)**, which rely on different wireless communication technologies to communicate with the driver, other cars on the road (vehicle-to-vehicle [V2V]), roadway infrastructure (vehicle-to-infrastructure [V2I]), and the "Cloud" [V2C], and
- **Electric Vehicles (EVs)**, which use one or more electric or traction motors for propulsion. An EV may be powered through a collector system by electricity from off-vehicle sources, or may be self-contained with a battery, solar panels, or an electric generator to convert fuel to electricity.

Automated, connected, and electric (ACE) vehicles, as illustrated in **Figure 10.4**, offer promise to improve transportation system safety and efficiency in communities. From a positive perspective, they have the potential to:

- Reduce collisions, traffic congestion and emissions;
- Improve mobility and equity, particularly for youth, seniors, and individuals with disabilities; and
- Lessen the need for roadway expansion and on-site parking.

At the same time, if not deployed and managed properly, these technologies could lead to more traffic, inequitable access to mobility, and adverse environmental impacts.

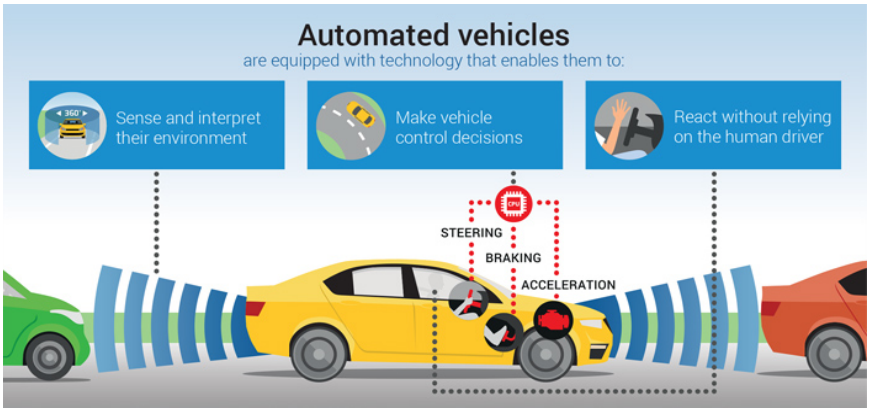
The future of ACE vehicles, especially AVs and CVs (collectively referred to as CAVs), could be highly disruptive, for better or worse. Gaining a better understanding of the likely outcome is complex and difficult to fully grasp at this time given:

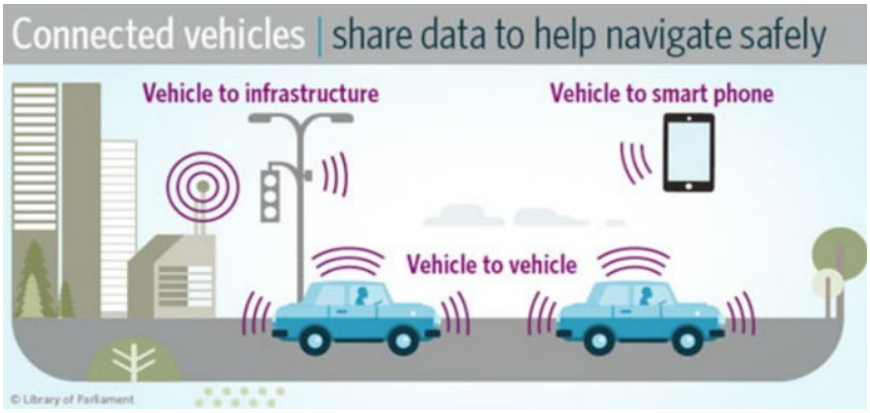
- CAVs may have a broad range of economic and social impacts, many of which extend beyond transportation and are unknown or dependent on further information;
- The potential effects of widespread CAV use are both positive and negative;
- Timelines for the arrival of CAVs are uncertain; and
- The impacts of accommodating CAVs on existing transportation infrastructure (e.g., signs, pavement markings, lane drops) are not well understood, especially implications for design and standards.

Capitalizing on opportunities and effectively addressing risks will require governments to prepare carefully. On this basis, the City should develop an action plan identifying the tasks required to prepare the City for the introduction of automated, connected, and electric vehicles. The *Automated and Connected Vehicles Policy Framework for Canada* sets out the following six guiding principles for initiatives and policies related to introducing CAVs on public roads:

- *Prioritize safety* – While there is pressure to adapt quickly to emerging technologies, safety is a top priority for testing and deploying these vehicles;
- *Exchange information to ensure CAVs are safe and secure* – Data needs to be shared with governments and law enforcement while protecting privacy;
- *Align CAV policies and regulations* – A common, coordinated approach within Canada (and outside the country) is essential;
- *Raise public awareness of the capabilities and limitations of CAVs* – Governments, as well as industry, will play an important role in education and outreach;
- *Prepare proactively for the deployment of CAVs on public roads* – All levels of government must ready themselves for the potential safety, mobility, and land use planning implications of these technologies; and
- *Collaborate continually with those involved in the CAV sector* – A culture of cooperation and collaboration will be essential to successful implementation.

Overall, the framework recommends that municipalities advocate and accommodate testing of CAVs and start adapting infrastructure to support their deployment. The City should consider taking this step in preparing the action plan.





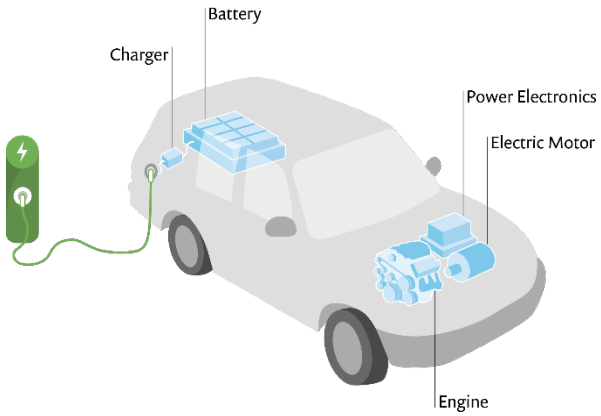


FIGURE 10.4: AUTOMATED, CONNECTED AND ELECTRIC (ACE) VEHICLES
(Source: https://www.autonomousvehicleinternational.com/news/business/eu-auto-makers-publish-automated-driving-checklist.html#prettyPhoto/0/
https://startupheretoronto.com/partners/mentor-works/connected-vehicles-innovative-technology-driving-market/
https://www.kindpng.com/downpng/hhomibb_transparent-electric-car-png-city-car-png-download/)

Consistent with the principles, the role and responsibilities for municipalities in the introduction of ACE vehicles can include:

- Enacting and enforcing traffic and parking bylaws;
- Facilitating trials and deployment on municipal roads (In 2016, the province launched a ten-year pilot program allowing the testing of AVs on Ontario roads);
- Adapting and implementing infrastructure, like signs and pavement markings, to support deployment;
- Implementing curb management strategies to organize operation and designate areas for vehicle dwelling;
- Implementing or modifying policies pertaining to the supply and management of on-street, municipal lot, and private, off-street parking;
- Developing strategies to repurpose infrastructure and land no longer required for parking;
- Managing and regulating passenger transportation impacted by deployment (including public transit, taxis, and shared mobility services);
- Creating and managing new logistics, regulations, and revenue structures for traffic and parking control;
- Engaging, educating, and raising awareness with the public; and
- Establishing funding streams for related initiatives.

The installation of EV charging stations in municipal parking lots and on-street is another action being taken by municipalities to support ACE vehicle use. By helping to make electric vehicles more convenient, municipalities hope to encourage greater use of this environmentally friendly alternative to lower their overall carbon footprint. In some communities, municipalities are partnering with private companies (such as Tesla) to implement the stations. At present, Waterloo has several EV charging stations including installations at City Hall and several City-owned parking facilities.

Recommendation 46: Develop an action plan identifying the tasks required to prepare the City for the introduction of automated, connected, and electric vehicles, which include changes to by-laws, policies, and guidelines pertaining to testing, infrastructure design, parking, curb management, traffic control, vehicles, and other items.

Recommendation 47: Pursuant to the action plan, permit the testing and deployment of automated and connected vehicles on City roads.

Recommendation 48: Continue to develop and implement an electric vehicle charging station program. Explore potential partnership opportunities to develop the network.

Recommendation 49: (Continue to) transition the City's fleet of vehicles towards electric and low carbon fuels.

10.4 Parking and Curb Space Management

Parking is an integral element of the community transportation system. An appropriate balance of supply and demand for parking is necessary to support business viability and maintain residential neighbourhood integrity. Management of the supply, location, and price of parking can also be an effective way to influence travel behaviour and encourage walking, cycling, and transit use. The following subsections address the key parking-related issues facing the City.

10.4.1 Parking Reform

Existing policies and practices have required or encouraged building large quantities of parking spaces which are expensive, take up space, encourage car ownership and more driving, and make communities less equitable. Parking reform discourages the building of excess parking supply and encourages more efficient and sustainable management of existing spaces (usually by pricing parking).

Revising and removing parking requirements can trigger a cascade of benefits: shorter commutes, less traffic, a healthier economy, a cleaner environment, and more affordable housing. The following policies can help discourage excess supply:

- Eliminating minimum parking requirements;
- Creating maximum parking entitlements;
- Using impact fees for new parking stalls;
- Restricting new surface lots and impermeable surfaces; and
- Allowing (or mandating) shared parking where land uses are compatible and complementary to permit sharing of parking stalls.

Other policies can help encourage better use of existing parking supply, including:

- Applying performance pricing for public on-street (and municipal garage) parking;
- Requiring mandatory parking cash-out for employer-paid parking;
- Implementing peak-hour commuter parking surcharges; and
- Unbundling the cost of parking from building leases and sales.

Parking reforms can generate revenue in the form of fees and taxes. This revenue should be invested in ways that are visibly beneficial and/or advance City goals and values, beginning with offsetting the operating and maintenance costs of parking facilities.

From time to time, the City reviews and refines its parking-related by-laws to address changes in legislation and the evolving needs of the community. In 2018, the City updated the Zoning

By-law parking policies. Future reviews should explore parking reform including policies to discourage excess supply and encourage better use of existing spaces. Additionally, as policies and the use of parking changes, there may be land available from unused or underutilized parking that could be repurposed for other uses such as development intensification, new transportation facilities, and/or community spaces. The City should explore planning strategies for the potential repurposing of unneeded transportation infrastructure, parking lots, and roadside parking spaces.

Recommendation 50: Continue to explore car parking reform, including reviewing and refining the City's Zoning By-law policies to discourage excess supply and encourage better use of existing spaces.

Recommendation 51: Explore planning strategies for the eventual repurposing of unneeded transportation infrastructure, parking lots, and roadside parking spaces.

10.4.2 Uptown Waterloo Parking

For the Uptown area, the City should continue to apply the guiding principles and recommendations from the **2008 Uptown Waterloo Parking Strategy** summarized as follows:

- Maintain an appropriate supply of affordable, secure, convenient, and appealing shared public parking that is accessible to all segments of the community;
- Enhance the attractiveness of Uptown Waterloo by utilizing progressive urban design principles that support compact urban development, walk ability, safety, security, and visual appeal;
- Encourage and support sustainable economic development in the urban core by engaging the private sector in partnerships for the provision of strategically located municipal parking structures;
- Provide facilities and programs that support public transit, taxis, ride sharing, cycling, and walking by demonstrating Transportation Demand Management leadership;
- Operate as a financially self-sustaining parking enterprise to effectively deliver services that support good urban design, economic development, and transportation demand management; and
- Engage the community in consultation to support decision making and operate with transparency by regularly communicating with Community stakeholders.

The City should continue monitoring the Uptown Parking Strategy to ensure the measures remain effective over time. If the underlying assumptions were to change (e.g., sale of significant land parcel used for parking), the City should consider updating the strategy to ensure the

recommended parking management practices, including pricing and fine structure, reflect prevailing conditions and continue to achieve objectives.

The City should also continue to explore opportunities to leverage emerging technologies, like parking sensors, digital message signs, and software applications, to enhance the management and operation of its Uptown Waterloo parking system. The cost of this technology is becoming less prohibitive to municipalities like Waterloo and can be used to:

- Dynamically adjust pricing based on occupancy (which helps to optimize parking usage);
- Provide real-time information to users (which helps to minimize the time spent searching for parking and its environmental consequences);
- Simplify revenue collection (which could help to increase revenue); and
- Improve utilization of available parking resources (which could defer or alleviate the need for expansion).

Recommendation 52: Monitor the need to update the Uptown Waterloo Parking Strategy.

Recommendation 53: Continue to explore opportunities to leverage emerging parking management technologies.

10.4.3 Curb Space Management

Use of the curbside (defined as the shared transitional space between the roadway and the sidewalk) has traditionally been driven by adjacent land use, with parking and loading regulations based principally on the immediately adjoining buildings. Municipalities have tended to develop regulations to control this space in a piecemeal fashion, often in response to property and business owner requests and with a focus on private vehicles. This practice, which invariably assumes the automobile is the primary mode of transportation, does not optimize this valuable and flexible public space for its highest and best use.

With the growth in active travel, evolution of shared mobility, rise in e-commerce goods delivery, and prospects of CAV, demand for access to the curbside is beginning to escalate. The curb space is becoming a primary location for cycling, picking-up/dropping-off passengers, and loading/unloading goods, competing with its traditional use for vehicle parking and bus stops. As a result, it is becoming more important to manage the curb space effectively and purposely determine the optimal allocation for different uses.

Curb space management is fundamentally about creating an organization scheme that improves mobility and safety for all via the prioritized and optimized allocation of space to different uses. Managing curb space effectively involves aligning regulations and operations to clear policy goals

to achieve universal access, sustainable ecosystems, resilient economies, and a safe, reliable, and equitable transportation system.

As the transportation system in Waterloo continues to develop and evolve in response to the above-noted emerging trends, its likely demands on the curb space will grow. In anticipation, the City should develop a Curb Space Management Strategy in collaboration with other stakeholders, like the Region and local businesses, to detail the tools and tactics necessary to effectively control the curbside in a manner that supports mobility and access for people and goods consistent with the objectives of the WTMP. The strategy should include a high-level policy approach to guide future decision making around issues that impact curbside allocation, as well as an implementation plan. This includes:

- Defining the essential functions and uses of the public right-of-way in Waterloo;
- Developing a toolkit of curbside treatment options;
- Detailing the curbside management evaluation process and decision framework;
- Summarizing the performance measures and monitoring program; and
- Providing an implementation plan the City can undertake to improve how curbside space is managed.

Recommendation 54: Develop a Curb Space Management Strategy for the City in collaboration with the Region, local stakeholders, and potential partners.

10.5 Smart Cities and Big Data

The rapid rise of urbanization has, in recent years, coincided with a massive growth in connected devices (or things that talk to the internet). With this steady expansion of the Internet of Things (IoT), there is significant opportunity for Canadian municipalities to empower their communities through information and communications technology (ICT) and connectivity. By employing this connectivity, cities can leverage investments in technology to support smarter, healthier, and more equitable and sustainable communities.

While there is no consensus definition, a "smart city" is generally one that improves overall quality of life for people at home, work, and play using data and connected technology integrated throughout the built environment. Technology is used to provide opportunities for economic development and enhance urban services, resource conservation and cost effectiveness. These solutions are built on a foundation of high-speed broadband and open data with policies for data inclusion and data privacy.

"Big data" is commonly considered a critical component of a smart city. For public agencies, data becomes "big" when the data cannot be conveniently analyzed by traditional statistical methods or common software tools. From a transportation perspective, big data is commonly

used for identifying trends with spatial (location-based) precision (e.g., road safety analysis) and improving municipal service delivery (e.g., public transit routing).

Transportation and mobility are typically integral components and a key benefactor of a smart city initiative. Better connected transportation systems offer some of the greatest potential to drastically enhance efficiencies within a city. Intelligent traffic signals that optimize traffic flow, parking management systems that capitalize on additional revenue streams, and public transit apps that allow riders to track bus locations are a few examples of smart city technologies that allow municipalities to better serve citizens.

Transportation in a smart city should not be driven by competition between different travel modes, each of which aims to dominate the market. A successful system will combine and integrate multiple modes to offer passengers the best mobility solution.

As noted above, the City should continue to proactively monitor and research emerging technologies through its strategic planning, including regular updates to the TMP. This will ensure the City:

- Maintains an understanding of emerging transportation technologies and trends and is not caught off guard when something new appears;
- Is aware of what it controls, the tools available to influence the technology or trend, and the responsibilities of other levels of government and industry. This allows the City to understand what influence it has over the technology and its adoption locally;
- Knows what other jurisdictions are doing in regard to regulating or promoting the technology or trend, so it can understand where it fits in relation to other jurisdictions and what innovative policies and practices it could utilize to influence the technology or trend;
- Can effectively assess the future impact of the technology or trends on the long-term vision articulated in its strategic policy documents;
- Develops an understanding of how future technologies and trends may impact City finances and steps it can take to be financially resilient; and
- Understands the potential impacts of the various technologies.

Recommendation 55: Consider developing a Smart City Strategy for the City in collaboration with the Region, local stakeholders, and potential partners.

Recommendation 56: Facilitate and promote Waterloo as a Smart City through the introduction or modification of by-laws, policies and guidelines, continued monitoring and research of emerging transportation technologies and impacts, collaboration with government, universities and private industry, public education campaigns, staff attendance at conferences and exploring funding opportunities.