DILLON CONSULTING

City of Kingston

Williamsville Transportation Study

January 2024 - 23-6663

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City of Kingston
Henk Brilliams, P.Eng
Project Manager, Transportation Infrastructure
1211 John Counter Blvd
Kingston, ON K7L 2Z3

Williamsville Transportation Study Report - Draft

Dear Henk Brilliams:

Dillon Consulting Limited (Dillon) is pleased to provide you with an initial draft of the Williamsville Transportation Study Report. We trust that the report covers the topics request by the City in a way that is logical and presented in plain language.

Please let us know if you have any questions or concerns as we work towards preparation of a final report.

Sincerely,

DILLON CONSULTING LIMITED

Maria King, P.Eng.
Project Manager, Associate

cc: Ian Semple

Our file: 23-6663

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Executive Summary

Dillon Consulting Limited (Dillon) was retained by the City of Kingston (City) to conduct a transportation study of the Princess Street corridor, specifically within the Williamsville neighbourhood between Bath Road/Concession Street and Division Street. This study aims to support the planned growth of the Williamsville area and prioritize sustainable modes of transportation to mitigate potential traffic impacts. To this end, the study has been divided into three parts, which all relate to each other and support the overall vision for a sustainable and accessible Williamsville area.

Part one of the study focuses on Princess Street and the work which has been completed to date related to the traffic operations analysis, proposed cross-section alternatives, and previous engagement. The two shortlisted alternatives are the widened pedestrian realm and cycle lane alternatives. These alternatives most closely aligned with the priorities of the Williamsville area and it is recommended that these alternatives be presented to City council for further consideration. The responses received from the public engagement indicated that the public has a strong preference for keeping bike lanes on Princess Street.

Part two of the study relates to Neighbourhood Bikeways concepts for the surrounding Williamsville neighbourhood area. These bikeways were introduced as supportive infrastructure to enhance the cycling experience and provide additional signed connections to other cycling routes. Based on previous engagement, a list of preferred corridors was selected for neighbourhood bikeway treatments. These corridors were then further analyzed to determine which neighbourhood bikeway treatments would be most appropriate for them. Both advisory bike lanes and neighbourhood bikeways were selected as appropriate facilities for the area and sample renderings and designs were developed. MacDonnell Street, Alfred Street, Mack Street, and Park Street were selected as the key north-south and east-west corridors to prioritize. Additional studies should be conducted to explore the transition between these shared facilities and dedicated facilities at major intersections.

Part three of the study involves implementation of ‘green streets’ within the broader Williamsville area. These design concepts refer to streets that are intentionally designed to reduce impacts on the social and natural environments. These types of streets are

being considered for multiple local roads in the Williamsville area. The green street concepts included traffic calming measures, increased greenery, and reduced on-street parking. Public engagement revealed that the top priorities for green streets were tree plantings, wide sidewalks, and curb bump-outs. Participants ranked the "Green Heavy" alternative as the most preferred. It is recommended that the next steps for this part of the study are the identification of candidate sites within the Williamsville area and development of a prioritization plan for implementation.

It is recommended that the following additional steps are taken:

- Investigate opportunities to maximize accessibility of the short-listed alternative options presented for Princess Street and select a preferred design option.
- Develop an implementation plan and identify preferred traffic calming measures for the neighbourhood bikeways. Determine a timeline for implementing the proposed network with a focus on the priority corridors.
- Identify and screen candidate corridors for implementing the green streets concepts. Determine a preferred green-street design given the public feedback and preferred alternative.

1.0 Introduction

Dillon Consulting Limited (Dillon) was retained by the City of Kingston (City) to conduct a transportation study of the Princess Street corridor, specifically within the Williamsville neighbourhood between Bath Road/Concession Street and Division Street. Princess Street is identified in the Official Plan as an area for intensification in the City and as an important transportation corridor. Similarly, the Williamsville neighbourhood serves as a major destination and connection to Downtown Kingston, characterised by its high use and continued growth of active and sustainable modes of travel, including walking, cycling, and transit. More recently, the City has explored options for defining success in Williamsville, including aspirations for strategic and timely infill development to meet smart growth goals by updating the area secondary plan. As smart growth becomes more embedded in the principles and mandates of the City, there is an emphasis on ensuring the transportation network is refined to meet the changing needs of the community, primarily through a multimodal lens. This multimodal lens prioritizes active

and sustainable modes of travel throughout Williamsville, providing safer and more equitable access for all users.

1.1 Scope

One of the overarching transportation goals for Williamsville is supporting growth in walking, cycling, and transit mode share as they relate to the significant development and evolution of character the area is experiencing. The scope of this transportation study has three main parts that support Kingston in creating an implementation strategy that is well-suited to accommodate priority transit and active transportation in Williamsville. Part One looks at multi-mobility options along the Princess Street corridor between Bath Road/Concession Street and Division Street. This includes exploring alternative design solutions that emphasize shifting mode share in favour of transit and active transportation. While the intention is not to eliminate vehicular use along Princess Street, there is a great need to explore ways to minimize auto-dependency. The redesign of Princess Street will provide a strong foundation for establishing a more comprehensive multimodal network within Williamsville. Part Two explores implementation of a more comprehensive cycling network throughout the Williamsville neighbourhood, accomplished through the principles of "Green Streets", which are explored in Part Three of this report. The goal of Parts Two and Three is to determine the most feasible approach to increase the desirability of cycling at all ability levels. This includes layering concepts such as Neighbourhood Bikeways and Advisory Bike Lanes on top of the facilities already proposed through the City's Active Transportation Master Plan. The outcomes of Parts Two and Three will complement the redevelopment of Princess Street by improving transportation options and implementing design changes that encourage reduced auto dependency.

1.2 Background

The 2012 *Williamsville Main Street Study* was originally completed to examine existing land uses and redevelopment potential in the Williamsville area. It provided recommendations about transportation, servicing, and cultural heritage in the area. The *Study* was approved by City Council on February 21, 2012 and included a provision for cycling infrastructure on Princess Street.

As per the direction of City Council, an updated Williamsville Main Street Study began in 2019 and included the *Williamsville Transportation Plan Operational Needs Assessment*. On December 1, 2020 City Council passed amendments to implement the update to the Williamsville Main Street Study including adopting the conclusions from the Operational Needs Assessment. This resulted in an update to the Official Plan and Zoning By-law for the Williamsville Main Street Secondary Plan. Further direction was given to undertake a more detailed second phase to develop a design concept for the Princess Street corridor.

In the 2020 transportation study, the City confirmed that Princess Street is theoretically capable of accommodating additional growth and related transportation demand, inclusive of walking, cycling, and transit use. The physical constraints of the Princess Street right-of-way (ROW) could, however, limit the street's actual ability to meet the demands of all modes. This means that it may not be feasible for Princess Street to simultaneously serve as a transit priority corridor, cycling spine route, pedestrian-friendly corridor, and a primary vehicular connection to the Downtown core.

The current study is an extension of the *Williamsville Transportation Plan Operational Needs Assessment Study* completed in 2020 and explores how all modes can be accommodated on Princess Street, and within Williamsville as a whole. This study and report have been prepared in three parts:

- Part 1: Princess Street Study,
- Part 2: Neighbourhood Bikeways, and
- Part 3: Green Streets Concepts.

2.0 Existing Policy Context

The City of Kingston is the largest municipality in southeastern Ontario, with considerable opportunity to continue to grow. To promote growth, while simultaneously meeting the community's unique and evolving needs, the City of Kingston requires policy frameworks that guide its development into the future.

The following section speaks to the policies in several overarching planning documents and guidelines that are related to sustainable transportation and community development. The policies are augmented by the City's studies and guidelines, which guide towards establishing more inclusive and accessible rights-of-way that promote compatibility between mobility and land use.

2.1 City of Kingston Official Plan

The City of Kingston Official Plan (OP), consolidated in December 2022, provides direction on how the City will grow to the year 2036. The OP outlines goals, objectives, and policies that manage and direct the physical changes of the City and its effect on the social, economic, built, and natural environments. The policies that are contained in the OP guide how development will evolve over the prescribed planning horizon and how initiatives must be adapted to support the forecasted growth.

The OP's Vision strives to attain sustainability of development to become the most sustainable municipality in Canada. To successfully achieve this Vision, the OP details a set of policies that are focused on implementing green infrastructure, managing growth through sustainable planning principles, and promoting compact development within the Urban Boundary. All of these will reduce the need for automobile-dependent travel. The OP recognizes:

- The importance of intensification and redevelopment along major corridors, continuing to grow within the City's existing urban boundary.
- The need to utilize existing City infrastructure more efficiently to address climate change resiliency, including mitigation and adaptation strategies.
- The need to carry out expansion of the transportation system in a systematic and timely fashion to maximize use of facilities and minimize associated costs and disruption.

- The importance of implementing an integrated and diverse transportation system through land use patterns and a multi-modal network that supports walking, cycling, and transit, fostering sustainable community development.

More specific to the role of transportation planning, the OP acknowledges the important role long-term transportation planning plays in readying the City for future travel needs, while meeting its goals for fostering sustainability. To this end, the **City's OP has included policies that are supportive of transit, active transportation, and pedestrian-friendly facilities that will increase usage, safety, and access for all.** Part of the OP's strategic direction is to reduce reliance on the automobile by satisfying travel demand through the efficient use of existing infrastructure, providing facilities and services that prioritize walking, cycling and transit as universal modes.

2.2 City of Kingston Official Plan - Princess Street Corridor Specific Policy Area (2022)

The Princess Street Corridor Specific Policy Area is a detailed policy directive that provides a cohesive plan for future development along the Princess Street Corridor. It includes consideration for principles such as sustainability, active transportation, and economic development. The Specific Policy Area extends from Ontario Street to Midland Avenue, including the Williamsville Main Street Study, which extends between the westerly limits of the Central Business District at Division Street and the Bath Road/Concession Street Intersection. The Williamsville Main Street policies focus on development in a pedestrian-oriented form that will provide support for the Princess Street transit corridors and more sustainable means of growth. **The primary vision for the Williamsville Main Street is to establish a corridor that is vibrant and active, inclusive of improved, pedestrian-oriented streetscape.** Additionally, the Williamsville Main Street policies denotes a set of directives for Green Streets. Policy 10E.1.43 states that "Green streets are defined as tree-lined corridors that establish important visual links and enhance active transportation connections between areas within and surrounding the Williamsville Main Street." This policy directive is directly linked to Part 3 of this report, where the City explores options for green street treatments along specific streets within the broader Williamsville area.

2.3 City of Kingston Transportation Master Plan (2015)

The City of Kingston Transportation Master Plan (TMP) provides the long-term direction for the development of transportation networks, supporting policies, programs, and services for the next 20 years. The TMP, originally received by Council in 2015, intended to support the City of Kingston with achieving its Official Plan and overall strategic vision of sustainability. **It established mode share goals, based on afternoon peak period travel, for the purposes of identifying policies, programs, and initiatives that put the City on the trajectory of change.** Council ultimately adopted aspirational mode share goals for the TMP to reduce reliance on the automobile and instead support mobility needs through sustainable modes of travel. The mode share goals are as follows:

- Active Transportation (Walking and Cycling): 20%
- Transit: 15%
- Auto: 65%

These mode share goals are increased for the Williamsville neighbourhood to further prioritize active transportation and transit as follows:

- Active Transportation (Walking and Cycling): 50%
- Transit: 15%
- Auto: 35%

The mode share goals noted above are critical to the design and operation of Princess Street. They serve as rationale for why potential trade-offs may be required if the City is to meet its objectives and strategic policy directions highlighted in both the Official Plan and the policies adopted specifically for Williamsville.

2.4 City of Kingston Active Transportation Master Plan (2018)

The City's Active Transportation Master Plan (ATMP) is a strategic document that builds upon the Official Plan and further develops the active transportation elements included at a high level in the TMP. The goal of the ATMP is to achieve the long-term city-wide active transportation mode share target of 20%. It encompasses a series of tools and strategies that are specific to neighbourhood transportation planning, including: traffic calming, expanded pedestrian crossings, cycle routes, and neighbourhood programs. The Williamsville neighbourhood falls within "Area K" of Kingston's Transportation

Focus Area in the ATMP. **Through the ATMP, it was identified that a more detailed multi-modal transportation study is required to guide future decision-making and support the City with identifying improved conditions and facilities for pedestrians, cyclists, and transit users.**

3.0 Part 1: Princess Street Study

Part 1, the Princess Street Study, reviews the operational needs and design options of the Princess Street Corridor in Williamsville, aiming to support the growth and intensification projected along the Corridor. This Princess Street Study is a continuation of the *Williamsville Transportation Plan Operational Needs Analysis (2020)* and the *Princess Street Corridor Cross-Section Study (2023)*.

It is important to note that as per the City's Official Plan, Princess Street is identified as the corridor meant to accommodate significant infill and intensification. The City's Transportation Master Plan (2015) and the Active Transportation Master Plan (2018) consider Princess Street as a corridor that would be at once pedestrian friendly and serve as an arterial for vehicular movement, a transit priority corridor, and a cycling-spine. The feasibility of simultaneously achieving all of these objectives is challenged by Princess Street's narrow right-of-way, which has sections that are less than 20 metres between Bath Road/Concession Street and Division Street. It is not possible to provide ideal facility widths for all modes (automobiles, transit, cycling, and walking) within the constrained 20 m right-of-way. Compromises must be made, with a focus on meeting both City of Kingston and Accessibility for Ontarians with Disabilities Act requirements.

3.1 Previous Studies

Background context from previous studies is required to establish an underlying understanding of existing conditions and to arrive at the proposed alternative designs for this Study. The following sections summarize the key findings and recommendations from the previous studies that have informed the development of this present study. More details are provided in the following sections.

- Princess Street Operational Needs Analysis (2020) recommended that a specific strategy be developed to reduce single occupancy vehicle dependence and improve the safety and desirability of transit and active modes; and
- Princess Street Cross-Section Study (2023) looked at alternative design solutions that could provide an improved environment for pedestrians, cyclists and transit users along Princess Street between Bath Road and Division Street.

- These studies were recommendation of the OP and Zoning updates for the Williamsville Main Street Study in December 2020.

3.1.1 Williamsville Transportation Plan - Operational Needs Analysis (2020)

The *Williamsville Transportation Plan - Operational Needs Analysis (2020)* study was completed by Dillon to review the road network's existing performance and assess how the network may perform under two future land use/development scenarios. This study focused on performing traffic modelling for the following primary transportation corridors in Williamsville:

- Princess Street between Bath Road/Concession Street and Division Street.
- Concession Street between Princess Street and Division Street.
- Division Street between Concession Street / Stephen Street and Princess Street.

The ultimate development conditions considered a total of 3,265 person trips in the PM peak period by the 2036 planning horizon. The analysis of transportation network impacts resulting from the planned growth was completed for two mode share scenarios:

- Auto mode share of 22% (based on previous studies of existing residential developments within the Princess Street Corridor), and
- Auto mode share of 35% (based on the preliminary mode share results for Williamsville from the City's 2019 household travel survey).

Travel times were predicted to increase along Princess Street and Division Street under both mode share scenarios. This outcome was anticipated based on the approved growth and the city's desire to avoid widening of roadways. The analysis indicated that intersections will only operate at satisfactory levels to 2036 if aggressive modal split targets are achieved within Williamsville. **The study recommended that a specific strategy be developed to reduce single occupancy vehicle dependence and improve the safety and desirability of transit and active modes.** The current study is a component of this strategy.

Further details on the land use scenarios and operational analysis can be found in **Appendix A**.

3.1.2 Princess Street Cross-Section Study (2023)

In 2023, Dillon conducted the *Princess Street Cross-Section Study* to identify alternative design solutions that could provide an improved environment for pedestrians, cyclists and transit users along Princess Street between Bath Road and Division Street. The study included a review of transit operations and transit travel time for Princess Street needed to achieve the City's goal of providing transit headways of 5 minutes or less.

The features identified as most desirable for Princess Street included the following:

- Street trees and furniture,
- 2 metre sidewalks,
- Transit priority measures (queue jump lanes), and
- Two-way cycle facilities.

Traffic modelling identified that without any mitigation measures, one-way peak hour transit travel time on Princess Street will increase by approximately one to two minutes by the year 2036. In combination with increased transit frequency, this could result in up to 20 minutes of transit delay per hour compared to existing travel times.

Design alternatives such as queue jump lanes, left turn lanes, and transit signal priority were considered as potential mitigation measures for Princess Street. Queue jump lanes act as a transit priority measure that allow transit vehicles to "jump" the queue of vehicles by introducing a "transit only lane" at intersections that buses may pull into. The following recommended operational improvements were made based on the traffic modelling analysis:

- Signalize the intersection and implement a westbound queue jump lane and transit signal priority at Princess Street and Drayton Avenue.
- Provide an eastbound left turn lane at Princess Street and MacDonnell Avenue.
- Provide an eastbound left turn lane at Princess Street and Victoria Street.
- Implement a curbside queue jump lane in the westbound direction and implement transit signal priority at Princess Street and Albert Street.

More detail regarding the recommendations and the results of the traffic and transit analysis can be found in **Appendix B**.

Six alternative design concepts were developed for Princess Street, each of which prioritized combinations of transit amenities, widening pedestrian realm, cycling amenities, and landscaping. Compromises were made as necessary. Two lanes of vehicular traffic were maintained in every alternative to facilitate bi-directional transit movements and minimize the risk of traffic bypassing using local streets. **However, vehicular lanes were reduced to minimum widths of 3.3 m in all alternatives to prioritize space for alternative modes. Parking was recommended for removal in all alternatives to make space for improved active transportation facilities and discourage auto trips to the area.** The six alternative cross-sections developed as part of the *Princess Street Cross-Section Study* included the following list. Minimum cross-section dimensions are provided for each alternative for comparative purposes only. The Princess Street right-of-way ranges between 18 to 20 m wide.

- Alternative 1 (Wide Sidewalks): Prioritized the pedestrian realm by removing bike lanes and adding street trees and rest areas where possible. Widened sidewalks to 2.0 m minimum where possible. Minimum cross-section width: 13.2 m mid-block, 16.5 m at intersections.
- Alternative 2 (Cycle Tracks): Substituted existing street-level bike lanes with grade separated cycle tracks. Cycle tracks would be a minimum of 2.0 m wide on both sides of the roadway. Sidewalks would be designed to 2.0 m widths where possible. Design did not include desirable separation between cyclists and pedestrians. Minimum cross-section width: 17.2 m mid-block, 20.5 m at intersections.
- Alternative 3 (Bi-directional cycle track): Replaced the existing street-level bike lanes with a bi-directional cycle track on the north side of Princess Street. Bi-directional cycle track would be a minimum of 3.5 m wide. Design did not include desirable separation between cyclists and pedestrians. Sidewalks would be designed to 2.0 m widths where possible. Minimum cross-section width: 16.7 m mid-block, 20 m at intersections.
- Alternative 4 (One-way Cycle Track): Replaced existing street-level bike lanes with a one-way cycle track on the north side of Princess Street. Cycle track would be a minimum of 2.0 m wide, with additional space between cycle tracks and sidewalks. Sidewalks would be designed to 2.0 m widths where possible. Minimum cross-section width: 15.2 m mid-block, 18.5 m at intersections.

- Alternative 5 (On-road cycle lanes): Provide conventional street-level cycling lanes, similar to the current condition. Cycle lanes would be a minimum of 1.5 m wide, making use of the 0.3 m wide gutter to provide extra width for maneuvering. No buffer would be provided between cycling and vehicular lanes. Sidewalks would be designed to 2.0 m where possible. Minimum cross-section width: 16.2 m mid-block, 19.5 m at intersections.
- Alternative 6 (Continuous Transit Lane): Created a dedicated westbound transit lane throughout Princess Street to improve transit travel times. Required the removal of bike lanes and left turn lanes. Sidewalks would be designed to 1.5 m widths where possible. Minimum cross-section width: 16.5 m, continuous.

A high-level overview of the evaluation of the six long-listed design alternatives is provided in **Table 1**. Note that this evaluation considered application of the six alternative cross-sections along the length of Princess Street and therefore included the impact of the varying right-of-way width. Additional details are provided in **Appendix B**. Two of the design alternatives were identified as being 'feasible' and were carried forward to the current study. These short-listed design alternatives are explored in greater detail in **Section 3.2**.

Table 1 Rationale

Alternative 1 was carried forward because it provides many of the desired elements except for two-way cycling facilities. Alternative 2 does not provide desired elements except for cycle tracks, while Alternative 3 does not provide street trees or left turn lanes or queue jump lanes, which would result in delays to buses and cars as noted by traffic analysis. Alternative 4 does not provide the two-way cycling facilities that are preferred, such as in Alternative 5. **Alternative 5 was carried forward because it maintains Princess Street as spine cycling route, although cycle tracks would be prefer**red. Traffic analysis revealed that the removal of all left turn lanes in Alternative 6 would cause significant delay for general traffic and non-prioritized transit service direction.

Table 1: Long-List Cross-Section Alternatives - Ability to Provide Desired Elements

Features Generally Accommodated	Street Trees	Minimum 2 metre sidewalks	Left turn lanes or transit queue jumps	Two-way Cycle Facilities	Carried forward
Alternative 1: Wide Pedestrian Realm	Yes	Yes	Yes	No	**Yes**
Alternative 2: Cycle Tracks (Both Sides)	No	No	No	Yes	No
Alternative 3: Bi-Directional Cycle Track	No	Yes	No	Yes	No
Alternative 4: One-way (northwest) cycle track	Yes, in most blocks	Yes	Yes, in most blocks	No	No
Alternative 5: On-road cycle lanes	No	Yes	Yes, in most blocks	Yes	**Yes**
Alternative 6: Continuous transit lane	Yes, in most blocks	Yes	No	No	No

3.2 Alternative Designs

The Princess Street Cross-Section Study shortlisted two alternatives for further analysis. These were Alternative 1 (Wide Pedestrian Realm) and Alternative 5 (On-Road Cycle Lanes). The two short-listed alternatives are detailed in Section 3.2.1 and Section 3.2.2.

A set of design criteria were developed which indicate minimum facility widths to be applied when designing the shortlisted alternatives for further review. **Table 2** explains the design criteria established for Princess Street, as well as the rationale behind them.

Table 2 Rationale

The furnishing zone width ensures that the placement of furniture does not obstruct the walkway zone by providing space for access, use and maintenance of furniture elements. 1.5 m is the absolute minimum width for a walkway zone indicated by AODA, while 2.0 metres is the recommended width for areas with a peak pedestrian flow rate greater than 400 pedestrians per 15 minutes. Additionally, a minimum width of 3.5m is preferred for the bus lane.

Table 2: Design Criteria for Princess Street

Right of Way Component	Minimum Dimensions	Factors and Guidelines References
Frontage Zone	0.5 metres	Transportation Association of Canada Geometric Design Guidelines (TAC GDG) Chapter 6 Section 6.3.1.1.
Walkway Zone	1.5 metres to 2.0 metres	AODA standards for Accessible Exterior Paths of Travel (2019) TAC GDG Chapter 6 Table 6.3.1.
Furnishing Zone	1.85 metres	TAC GDG Chapter 6 Section 6.3.1.3.
Transit Shelter:	Landing Pad: 9 m x 2.5 m min Ramp Deployment: 1.5 m x 2.5 m min Clearway: 1.5 m min width	City of Hamilton HSR Stop Accessibility Guidelines.
Cycle Track	2.0 metres (One way) 3.5 metres (Two way)	OTM Book 18 Table 4.4.
Curb/Gutter	0.5 metres	City of Kingston Technical Standards and Specifications. References OPSD 600.100
Cycle Lane	1.5 metres + 0.3 m buffer	OTM Book 18 Table 4.7.
Bus Lane	3.3 metres	Minimum width indicated by City staff and supported by TAC GDG Table 4.2.3.
Through Lane/Turn Lane	3.3 metres	TAC GDG Table 4.2.3.

3.2.1 Alternative 1 - Widened Pedestrian Realm with Transit Priority

Alternative 1 prioritizes enhancing the pedestrian experience along Princess Street while providing additional transit amenities.

As discussed in **Section 3.1.2**, transit expansion and pedestrian experience are key priorities for Princess Street. First, Princess Street is identified as a priority transit corridor within the City. Second, for transit corridors to serve their purpose, users must also feel that the area is walkable. As a result, this alternative considers reducing vehicle travel lane widths and turning lanes, removing on-street parking, removing on-street cycling lanes, and widening the pedestrian walkways to a minimum of 2.0 metres where possible. The remaining space within the right-of-way would be allocated for street furniture, street trees, and amenities as a means of livening the corridor. A sample rendering of this alternative can be seen below in **Figure 1**.

Figure 1: Alternative 1 Rendering

Based on preliminary drawings, high level constraints were mapped out in **Figure 2.**

Figure 2: Alternative 1 Constraints

Referring to **Figure 2**, two metre desirable sidewalks widths are met throughout 98% of the corridor, with an additional 1.85 metres for furnishing and street trees available on both sides of Princess Street for 60% of the corridor. These improvements have been made possible by reducing the vehicle travel lanes to 3.3 metres, as explained in **Section 3.1.2**, removing on-street parking, and the removal of on-street bike lanes. It is expected that these improvements would encourage increased pedestrian traffic on Princess Street, which in turn has the potential to increase transit use. Additionally, this would improve Williamsville from an accessibility perspective as there are many existing locations where there are narrow sidewalks or physical barriers in the sidewalk as shown in **Figure 3**. Wider sidewalks would allow for two people with mobility devices to comfortably travel side-by-side or pass each other with no issues compared to existing conditions. Additionally, wider sidewalks allow for groups of pedestrians to walk side-by-side and encourages a social space. A wider pathway and fewer physical barriers also improve mobility in these areas as there are fewer obstacles to maneuver around. Cyclists would continue to be allowed to use Princess Street as a shared facility as explored in **Section 4.3.1**. The narrower travel lanes and the removal of on-street parking is expected to slow down vehicle traffic which results in safer shared spaces for cyclists and drivers.

Figure 3: Comparison of Existing (Left) and Proposed (Right) Sidewalk Conditions
(Source: Google Maps, 2020)

Conceptual drawings have been prepared for Alternative 1 which highlight the areas of concern along Princess Street. The drawings have been provided in **Appendix C.** The plans also identify the locations of proposed transit queue jump lanes.

3.2.2 Alternative 5 - Cycle Lanes with Transit Priority

Alternative 5 maintains cycling infrastructure as a priority and encourages cycling as a sustainable mode of transportation on Princess Street. This alternative would take advantage of the removal of on-street parking and narrowing of vehicle travel lanes to realign the bike lanes creating a continuous network along Princess Street as well as expanding the existing sidewalks, where possible. Transit queue jump lanes would be provided at key intersections to continue to promote and grow transit usage in Williamsville.

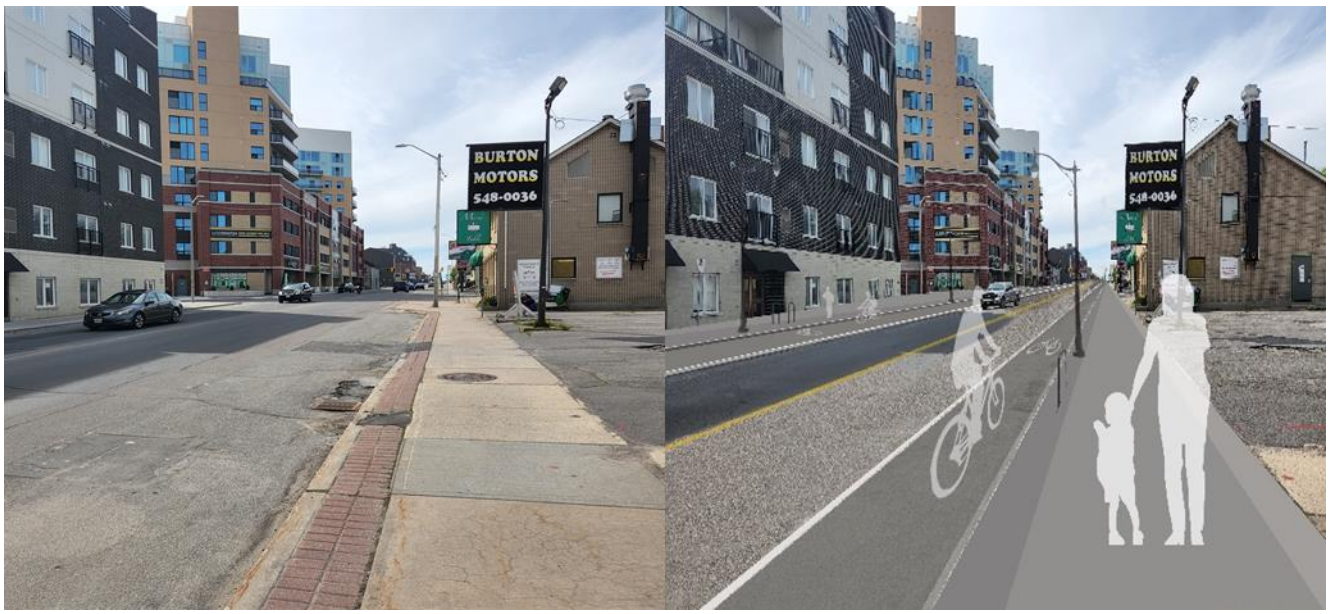
A sample rendering of the alternative is shown below in **Figure 5**. Based on preliminary drawings, rough constraints were mapped out in **Figure 4**.

Figure 4: Alternative 5 Constraints

Compared to **Alternative 1**, a 2.0 metre sidewalk is only feasible for 86% of the length of the corridor. In some cases, sidewalks may be narrowed to approximately 1.4 metres to accommodate the proposed elements in this alternative. However, wider sidewalks are possible in many locations with some areas, primarily in the section closest to Division Street, having sufficient space for some furnishings and street trees.

In addition, the preservation of the bike lanes in conjunction with the removal of on-street parking is expected to encourage cyclists to continue to use Princess Street and the opportunity of drawing cyclists back who were previously concerned about being "doored" by parked cars. **Figure 5** below is an image of existing conditions along Princess Street, where on-street parking conflicts with the bike lane. One of the concerns brought up at previous engagement sessions (**Section 3.3**) was that drivers tend to park illegally and block bike lanes. It is expected that this may still be a concern with on-street bike lanes although on-street parking is removed. It is recommended that parking enforcement is reviewed upon removal of on-street parking along Princess Street.

Figure 5: Comparison of Existing (Left) and Proposed (Right) Bike Lane Conditions
(Source: Google Maps, 2020)



Conceptual drawings have been prepared for Alternative 2 which highlight the areas of concern along Princess Street. The drawings have been provided in **Appendix C.** The plans also identify the locations of proposed transit queue jump lanes.

3.3 Engagement

The cross-sections for the two shortlisted alternatives were presented to residents at a Town Hall in April 2023 and an Open House in October 2023. During the April 2023 Town Hall, only Alternative 1 (Wide sidewalks) was presented. During the October 2023 Open House, the preliminary design drawings for both shortlisted alternatives (Alternative 1 and Alternative 5) were presented. An online survey was also posted on Kingston's Get Involved website to collect feedback about the presented cross-sections. The following section outlines each stage of engagement and what we heard. Additional information on the engagement sessions and the feedback received can be found in **Appendix D.**

3.3.1 April 2023 Town Hall

The purpose of the April 2023 Town Hall was to collect feedback on a potential re-design of Princess Street which included a focus on wider pedestrian realms and transit priority measures. Attendees also provided feedback on key local roads that could be used to provide connections for a potential neighbourhood bikeway network.

Three main topic areas of feedback were received at this session.

1. There was a strong preference towards keeping bike lanes on Princess Street as well as support for the neighbourhood bikeway network. On the topic of neighbourhood bikeway networks specifically, attendees requested that additional traffic calming measures be introduced alongside them to encourage vehicles to drive slowly and share the roadway with cyclists.
2. There was support for a widened pedestrian realm and "greening" of the corridor.
3. There were concerns about the removal of on-street parking along Princess Street, suggesting it may result in additional vehicles parking on local roads adjacent to Princess Street with already limited spaces.

Attendees expressed a lack of clarity in the design selection process, noting missed opportunities for additional engagement sessions, which could have provided more options and considerations. Although the City of Kingston staff noted multiple alternatives had been considered, attendees expressed transparency of design and limitations of the alternatives would have been beneficial to understand the decision-making process to date.

3.3.2 October 2023 Open House

An Open House was hosted on October 26, 2023, at St. Luke's Anglican Church. The purpose of the Open House was to present additional details for the long list of six alternative designs for Princess Street. Details on the trade-offs and restrictions present in each alternative were explained further. Additional information was also provided about the required widths of the facilities.

Preliminary roll plans for the two short-listed alternatives were brought to the Open House to show attendees the restrictions they would have on the pedestrian realm and what trade-offs would be required between the two short-listed alternatives:

- Wider sidewalks and transit priority; and
- Bike lane and transit priority.

Attendees continued to support bike lanes on Princess Street. Potential advisory bike lanes and neighbourhood bikeways were also introduced as a potential alternative for the local bike network and are explored further in **Section 4.0**. Attendees were able to provide comments on both the panels and sheets that were presented.

3.3.3 What We Heard

Based on feedback received from both public engagement events, the cycling alternatives were most preferred by the attendees. Many attendees indicated they would strongly prefer to keep bike lanes on Princess Street even though it would impose restrictions on the pedestrian realm (See **Figure 6** below). Feedback from both the Open House and online feedback forms also emphasized the need for separated cycling infrastructure to improve safety for cyclists. In terms of the pedestrian realm itself, there were some concerns about cross-sections where the sidewalks were less than 1.5 m wide. Concerns about accessibility were also voiced for the alternative with bike lanes since narrow sidewalks would make it difficult for individuals with disabilities to travel. Additionally, it was noted that many of the existing intersections along Princess Street do not have accessible features (tactile walking surface indicators, accessible push buttons, etc.). Attendees also voiced safety concerns with existing right turn lanes along Princess Street, indicating that it's dangerous for both cyclists and pedestrians.

Figure 6: Ranked Features for Princess Street Based on Open House Surveys

3.4 Next Steps

It is recommended that Alternatives 1 and 5 be presented to City Council for further consideration along with supporting information from **Section 4.0** and **Section 5.0**.

Based on the technical design and policy analysis that was undertaken for the Princess Street Corridor, Alternative 1 provides a design that is most consistent with the direction adopted by Council as part of the Williamsville Main Street Study update in December 2020 as well the Official Plan strategic directions. It can prioritize pedestrians, greening opportunities, and transit priority within the available space. Moreover, Alternative 1 also best addresses accessibility concerns raised as part of this study by community members and the Municipal Accessibility Advisory Committee.

As mentioned in **Section 3.3.3**, many of the community members are supportive of maintaining bike lanes along Princess Street, represented by Alternative 5, even after understanding the potential trade-offs of narrower sidewalks reduced accessibility, greening opportunities, and street furniture.

It is recommended that the City investigate opportunities to maximize accessibility during the detailed design phase with whichever design is selected. A feasibility study should be conducted for the preferred design which should focus on the ability to widen sidewalks and the benefit and feasibility of the proposed transit queue jump lanes.

Additional studies will be required as part of the detailed design process including, but not limited to, a full topographic survey of Princess Street.

4.0 Part 2: Neighbourhood Bikeways

The concept of 'supportive infrastructure' was first formally introduced to the City of Kingston through the City's 2018 Active Transportation Master Plan. Supportive infrastructure is an approach that improves cycling network connectivity using quiet, low volume, low speed streets within the existing transportation network. Streets can either be selected based on their existing characteristics, or they can be modified through signage and physical changes to meet the low speed/volume requirements.

Implementation of supportive infrastructure within Williamsville will not only improve cycling connectivity throughout the area, but also reduce vehicle dependency. Reduced private vehicle dependency is required to accomplish the target modal splits noted in **Section 2.0** of this report as well as to address directives of the City's *Climate Leadership Plan*.

In Part 2 of this report, preferred cycling corridors and facility types are identified and analyzed for the purposes of establishing "Neighbourhood Bikeways" within the Williamsville neighbourhood, with opportunities for extending into the City's broader cycling network.

4.1 Policy Background

Section 2.0 of this report discussed the policy documents that were reviewed as part of the Williamsville Transportation Study. By extension of the Official Plan (OP), the Transportation Master Plan (TMP), and the Active Transportation Master Plan (ATMP), and the overall vision for shaping the Princess Street Corridor, this report explores infrastructure opportunities that can support cycling along commonly used routes in the Williamsville neighbourhood. The ATMP is a direct response to Council approved directions focusing on sustainable development and transportation network prioritization in favour of active transportation. Building off the mode share goals noted in **Section 2.0**, the ATMP identifies a city-wide transportation network that provides key north-south and east-west connections, split into focus areas that inform context-specific solutions for implementing the appropriate infrastructure. The Williamsville neighbourhood falls within Focus Area "K" – bordered by Concession Street to the north, Division Street to the east, Johnson Street to the south and Sir John A.

MacDonald Boulevard to the west. This neighbourhood-level information is an important component for ongoing land use, development planning, and policy initiatives tied to the OP and other growth and development-related planning initiatives.

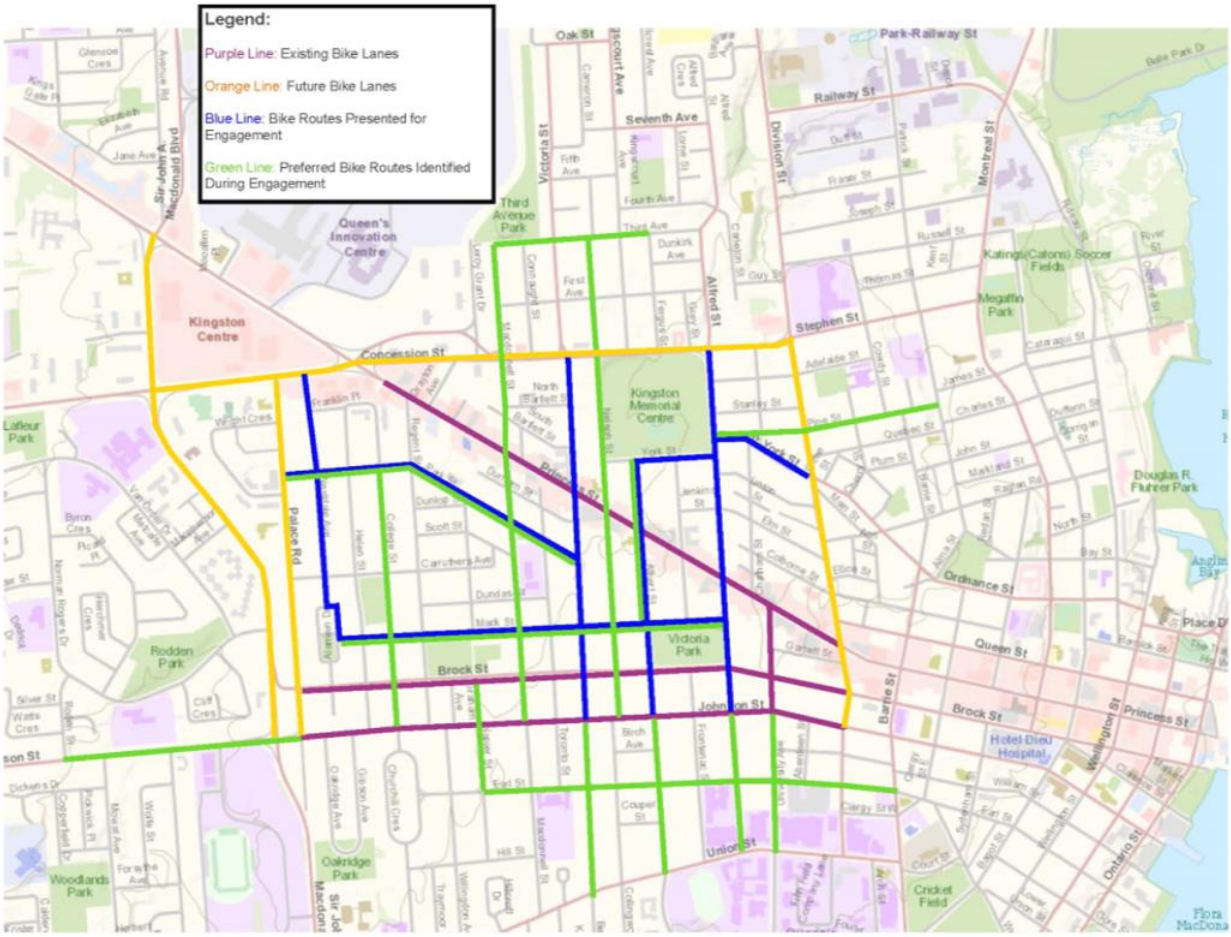
The following sections discuss candidate neighbourhood streets that would both benefit from and contribute to a multimodal shift in Williamsville, and the City more broadly, focusing on cycling as a viable mobility option for meeting growing travel demands.

4.2 Preferred Corridors

The addition of designated neighbourhood bikeways in the Williamsville area will improve cyclist wayfinding and access throughout the neighborhood. These new east-to-west and north-to-south signed and traffic calmed connections will link the bicycle routes identified in the ATMP and the existing cycling routes on Brock Street and Johnson Street. They will also improve access to key destination throughout, and adjacent to, the Williamsville area. This includes improved connections to the Leroy Grant Trail, the various parks in the area (Victoria Park, Compton Park, Third Avenue Park, etc.), and destinations along Princess Street.

The concept of a Williamsville local street bike network was presented to the public for comment during the April 2023 Town Hall meeting. The public was also encouraged to provide feedback through an online survey hosted on Get Involved Kingston between October 13, 2023 and November 17, 2023. Public input, together with technical analysis completed by the City, resulted in identification of the list of preferred local street cycling corridors listed below and illustrated in **Figure 7**.

Figure 7: Preferred Neighbourhood Corridors Identified

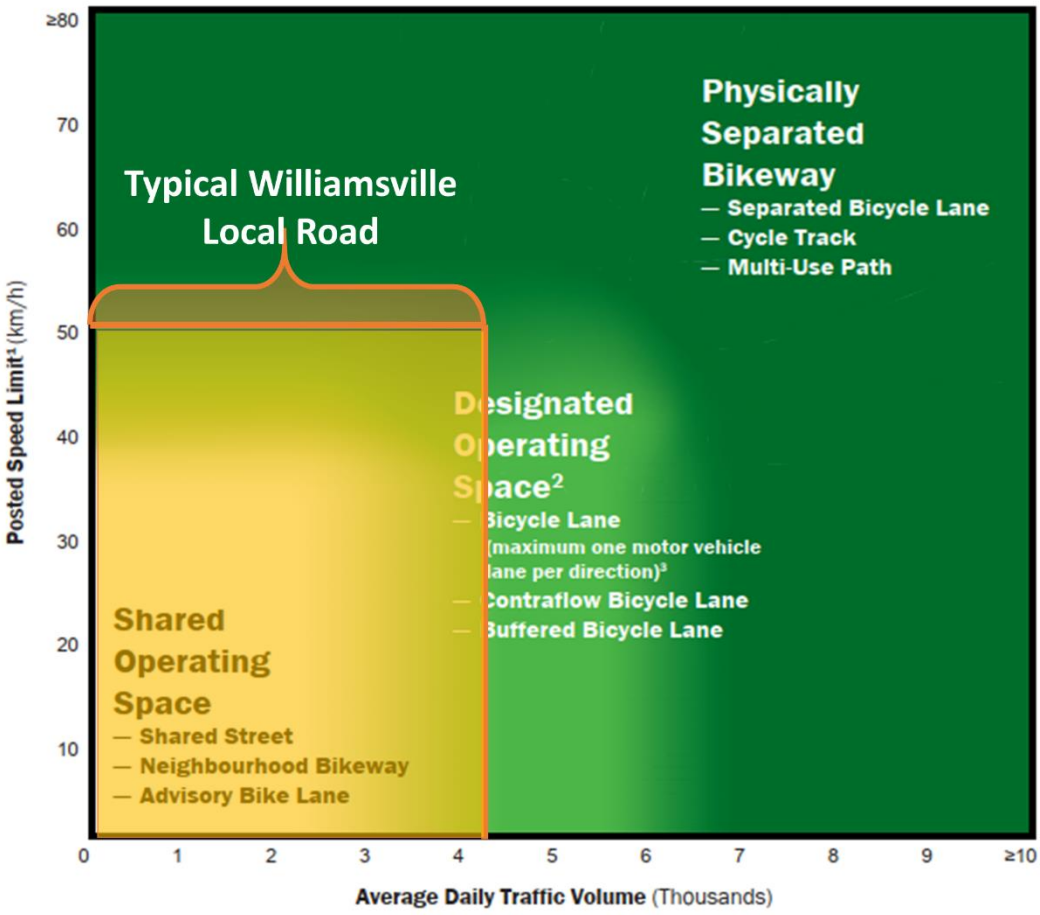


College Street	Park Street	MacDonnell Street
Park Street	Nelson Street	Mack Street
Albert Street	Napier Street	Earl Street
Pine Street	Victoria Street	

4.3 Alternative Facility Types

Appropriate facility types for the preferred neighborhood bikeway corridors identified in **Section 4.2** were determined using guidance from Ontario Traffic Manual (OTM) Book 18: Cycling Facilities. OTM Book 18 recommends three alternative cycle facility types for streets with the speed and volume profiles measured along local streets within the Williamsville area. Recommended facility types include, shared streets, neighborhood bikeways, and advisory bike lanes. Each of these facility types is explained in more detail below the nomograph shown in **Figure 8**.

Figure 8: Typical Williamsville Road Nomograph



4.3.1 Shared Street

Shared street operations represent the least protected option for cyclists. Cyclists are expected to ride on the right side of the travel lane where there is space for side-by-side operation; otherwise, they have the right to travel in the centre of the lane.

Shared streets are most appropriate on roads with the following features:

- Low volume <3000 Average Daily Traffic,
- Low posted speed <40 km/h,
- Lane widths of 4.5 m or less,
- Local streets, and
- Streets with low volume driveways or unsignalized intersections.

No provisions are required for shared streets other than signage to indicate to drivers that cyclists share the lane. Optional sharrow pavement markings can be used to further denote that the lane is shared by cyclists and drivers. A sample shared street facility is shown in **Figure 9**.

Figure 9: Shared Street Facility (Source: OTM Book 18, 2021)

4.3.2 Neighborhood Bikeway

Neighbourhood bikeways, also referred to as bicycle boulevards, build on the concepts introduced in shared street facilities by prioritizing through movements for people riding on bikes while discouraging through trips by motorized traffic[1]. This treatment is most appropriate on roads with the following features:

- Low volume <3000 Average Daily Traffic,
- Low posted speed <40 km/h,
- No heavy vehicle traffic,
- Local streets,
- One travel lane in each direction,
- Limited on-street parking,
- Lane widths of 4.0 m or less, and
- Streets with low volume driveways or unsignalized intersections.

[1] OTM Book 18 Section 4.5.2

Neighbourhood bikeways utilize the same signage and sharrow pavement markings as shared street facilities, but further encourage cyclist activity by introducing additional restrictions on motorized vehicle traffic. These restrictions are explored further in **Section 4.5** and include measures to reduce traffic volumes and traffic speeds to encourage cycling on local roads. A sample neighbourhood bikeway is shown below in **Figure 10**.

Figure 10: Sample Neighbourhood Bikeway
(Source: BC Active Transportation Guide, 2019)

4.3.3 Advisory Bike Lane

Advisory bike lanes are a relatively new facility in Canada but have begun to see application in a handful of cities across the country. It is originally a European approach to delineate space for cyclists on narrow roadways and clarify operating positions for

cyclists and motorists and increase comfort for cyclists[2]. This treatment is most appropriate on roads with the following features:

- Low volume <4000 Average Daily Traffic,
- Low posted speed <50 km/h,
- Restricted heavy vehicle traffic,
- Local streets,
- Geometry is straight and level,
- 6.6 m to 8 m roadway width without parking lane,
- 10 m to 11.5 m roadway width with parking lane, and
- Streets with low volume driveways or unsignalized intersections.

Advisory bike lanes contain no centreline and motorists are expected to travel in both directions in a shared centre travel lane which is typically between 3.0 and 4.0 m wide, or 5.0 to 5.7 m wide. The bike lanes are distinct in that they are temporarily shared spaces with motor vehicles during turning, approaching, and passing manoeuvres. A sample advisory bike lane facility is shown in **Figure 11** below.

[2] OTM Book 18 Section 4.5.1

Figure 11: Sample Advisory Bike Lane Facility in Ottawa, Ontario.
(Source: CBC News)

4.4 Recommended Facility Types

The screening criteria touched on in **Section 4.3** was used to identify appropriate cycle facility types for each of the preferred local street cycling corridors. **Table 3** below outlines the existing facilities on they key corridors considered and the recommended facility type on each corridor.

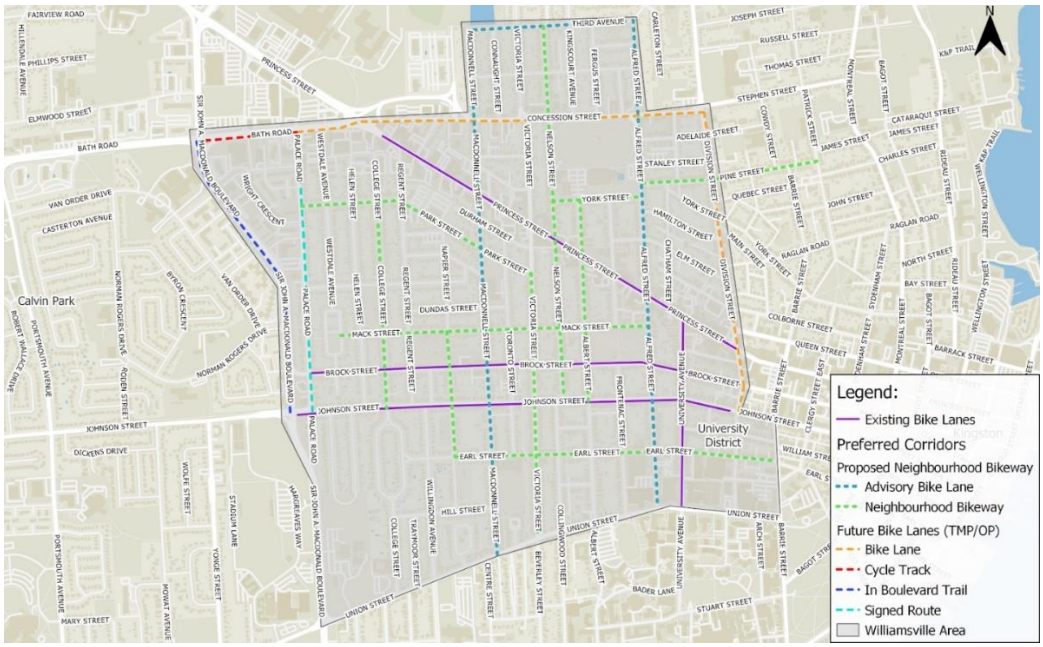
Table 3: Recommended Local Cycling Infrastructure

Corridor	Roadway Width (m)	Posted Speed Limit (km/h)	Max Annual Average Daily Traffic (AADT)	Existing On-Street Parking	Recommended Facility
College Street	9	50	238[3]	Both	Neighbourhood Bikeway
Alfred Street	11	50	4661[4]	Both	Advisory Bike Lane/Neighbourhood Bikeway
Park Street	9	50	1549[5]	One	Neighbourhood Bikeway
Mack Street	8/9	50	885[6]	Both	Neighbourhood Bikeway
MacDonnell Street	9	40	2141[7]	Both	Advisory Bike Lane/Neighbourhood Bikeway
Nelson Street	7/8	50	621[8]	One	Neighbourhood Bikeway
Albert Street	9/10	50	1771[9]	One	Neighbourhood Bikeway

The addition of these local street facilities will create a more comprehensive 'Neighbourhood Bikeway Network' within the Williamsville area. The location of all existing and proposed cycling facilities within the study area are illustrated on the map provided as **Figure 12**.

[3] College Street @ Carruthers Avenue Traffic Count (2023)
[4] Alfred Street @ Johnson Street (2017)
[5] Park Street @ MacDonnell Street (2017)
[6] Mack Street @ MacDonnell Street (2017)
[7] MacDonnell Street @ Princess Street (2017)
[8] Nelson Street @ Concession Street (2016)
[9] Albert Street @ Johnson Street (2018)

Figure 12: Proposed Neighbourhood Bikeway Network



4.5 Neighborhood Bikeway Facility Treatments

The following sections provide guidance on the types of treatments that could be considered to reduce vehicular volumes and speeds, as well as improve wayfinding, along the local street cycling corridors.

4.5.1 Applicable Guidelines

The following guidelines were referenced when identifying appropriate treatments for the streets within the proposed Williamsville neighborhood bikeway network:

- Ontario Traffic Manual (OTM) Book 18: Cycling Facilities (2021)
- Transportation Association of Canada (TAC) Chapter 5 - Bicycle Integrated Design (2017)
- City of Kingston's Active Transportation Master Plan (ATMP) (2018)
- British Columbia Active Transportation Design Guide (2019)[10]
- National Association of City Transportation Officials (NACTO) Urban Bikeway Design Guide (2014)

[10] Used as a reference for the design and application of advisory bike lanes through case studies.

4.5.2 Design Toolbox

The successful implementation of cycling supportive infrastructure requires that affected streets have low operating speeds (<40km/h) and low average daily traffic volumes (<3,000 ADT). Streets are often selected for inclusion in a cycling supportive network because they exhibit these characteristics in their existing condition. Streets that don't exhibit these characteristics will often be added to the network to provide improved north-south and east-west connectivity. These streets may require additional pavement markings and signage, as well as physical modification to reduce vehicular speeds and volumes to suitable levels. The City of Kingston's Traffic Calming Guidelines were referenced for approved traffic calming measures in the City.

Design techniques can be used to reduce vehicular speeds and volumes, as well as to help prioritize cycling over cars all into the following five categories[11] [12]:

- Traffic Reduction Design Measures
- Major Intersection Treatments
- Minor intersection treatments
- Speed Management
- Signs and Pavement Markings

The following sections provided additional detail regarding how each of the techniques can be applied within the City of Kingston context. Additional information about the expected cost for implementation of the each of the alternative techniques can be found in **Appendix E**.

4.5.3 Traffic Reduction Design Measures

Traffic reduction, commonly referred to as traffic calming, design measures are typically applied at intersections to restrict vehicle movements at intersections while permitting cyclists. The *City of Kingston Traffic Calming Guidelines* is developed in accordance with standards set out in the Transportation Association of Canada (TAC) Canadian Guide to Traffic Calming. It encompasses two main approaches. Type I approaches are classified as minor adjustments such as pavement markings, speed-display devices, vertical centreline treatments. Type II approaches are classified as engineered-based which are

[11] Ontario Traffic Manual Book 18 (2021)
[12] National Association of City Transportation Officials (2014)

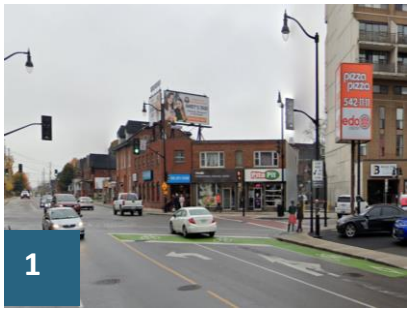
more permanent in nature and involve planning, designing, and constructing. Type II approaches can include horizontal deflections such as curb extensions, vertical deflections such as speed cushions, intersection treatments and/or cross-sectional treatments.

Traffic reduction measures may not be applicable in all cases; however, they do provide the greatest benefit for cyclists, pedestrians, and residents through reduced exposure to collision risks, traffic noise and emissions (OTM Book 18, 2021).

4.5.4 Major Intersection Treatments

Major intersection treatments improve cyclists' ability to cross a major roadway with higher vehicle volumes and speeds. These treatments improve driver awareness of cyclists, help with cyclist navigation, minimize crossing distances, and reduce vehicle/bicycle conflicts. Examples of intersection treatments are provided in the list below. The City of Kingston's ATMP recommends the use of bike boxes and cross-rides as potential intersection treatments at major intersections as they have lower implementation costs and are familiar to both drivers and cyclists. Local and International Examples of Major Intersection Treatment include:

1. **Bike Boxes** (Image source: Google Maps, Kingston, ON, Princess Street and Division Street)
2. **Advanced Stop Bars** (Image source: NACTO, Portland, OR)
3. **Bicycle actuated signals** (Image source: Google Maps, Kingston, ON, Highway 15 and Gore Road)
4. **Crossrides/Intersection Crossing Markings** (Image source: Google Maps, Kingston, ON, John Counter Boulevard and Portsmouth Avenue)
5. **Refuge Islands** (Image source: NACTO, Portland, OR)
6. **Curb Extension (Bump Outs)** (Image source: NACTO, Portland, OR)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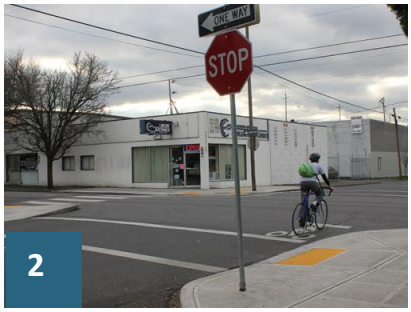

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The preferred corridors identified in **Section 4.4** intersect with major roads such as Princess Street, Concession Street and Johnson Street. The following major intersections should be analyzed in more detail and could benefit from one of the major intersection treatments listed above:

- MacDonnell Street & Princess Street,
- Albert Street & Princess Street,
- Nelson Street & Princess Street,
- MacDonnell Street & Concession Street, and
- Victoria Street & Johnson Street.

4.5.5 Minor Intersection Treatments

Fewer treatments are necessary where a neighbourhood bikeway intersects with a minor road due to lower speeds and vehicle volumes. It is desirable, however, to minimize stop controls on cycling corridors and slow vehicle speeds through intersections. For the preferred corridors, it is recommended that stop signs, where not warranted, be removed in the direction of cyclist travel at minor intersection.

4.5.6 Speed Management

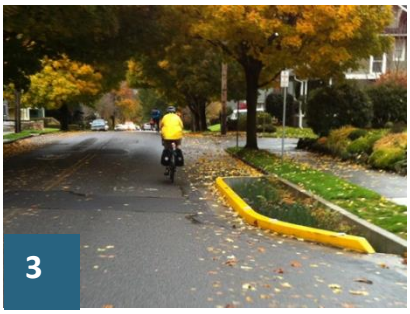
Speed management on neighbourhood bikeways is one of the best ways to improve safety for cyclists and thereby encourage the use of bicycles. Reducing posted speed limits is generally not effective at reducing operating speeds below 40km/h, and typically requires the use of physical speed management tools. Reduced vehicle operating speeds can improve the perception time of both motorists and cyclists and further improve safety for both users.

Some examples of speed management measures, including traffic calming devices and minor road design changes, are listed, and illustrated below:

1. **Speed humps** (Image source: NACTO, Portland, OR)
2. **Raised crosswalks** (Image source: Google Maps, Toronto, ON)
3. **Curb extensions/ Bump Outs** (Image source: NACTO, Portland, OR)
4. **Chicanes** (Image source: NACTO, Seattle, WA)
5. **Narrowing of motor vehicle lanes**
6. **Dynamic "watch your speed" signs** (Image source: Google Maps, Toronto, ON)

1

2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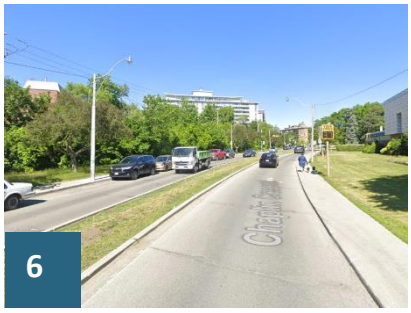
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4.5.7 Signs and Pavement Markings

Providing appropriate signage and pavement markings along neighbourhood bikeways and advisory bicycle lanes has the following benefits:

- Brings attention to the existence of the facility, encouraging use;
- Heightens driver awareness that the space is to be shared with cyclists; and
- Improves
- cyclist navigation through intersections and towards key destinations and network connections.

The most common signs used to denote shared cycling facilities on Ontario streets are signs Wc-19 OTM (Share the Road) and Wc-24 OTM (Single File), which are illustrated in **Figure 13**. These signs indicate the intended relative position of vehicles and cyclists within the roadway. The green bike route sign, Rb-69, should also be used to identify designated cycling corridors. This sign is illustrated in **Figure 14.**

Figure 13: Shared Facility Signs

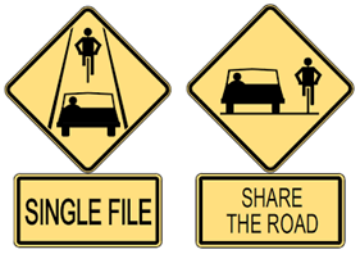


Figure 14: Rb-69.

Shared facility pavement markings such as “sharrows” can be used to improve the visibility of cyclists and to clarify that the roadway is a shared-use lane. Bicycle lane markings should be used for advisory bike lanes with a buffer between bicycle lanes and parking lanes. Examples of sharrows and advisory bike lane pavement markings are provided in **Figure 15**. At the time of writing, neither OTM Book 18, or TAC GDG have a standard advisory bicycle lane sign to inform drivers how to operate with these facilities. Both Gibbons, BC and Ottawa, ON have created custom signs to inform both cyclists and drivers.

Figure 15: Example pavement markings for shared cycling facilities

Sharrow pavement marking in London, ON

Advisory bike lane, Ottawa, ON

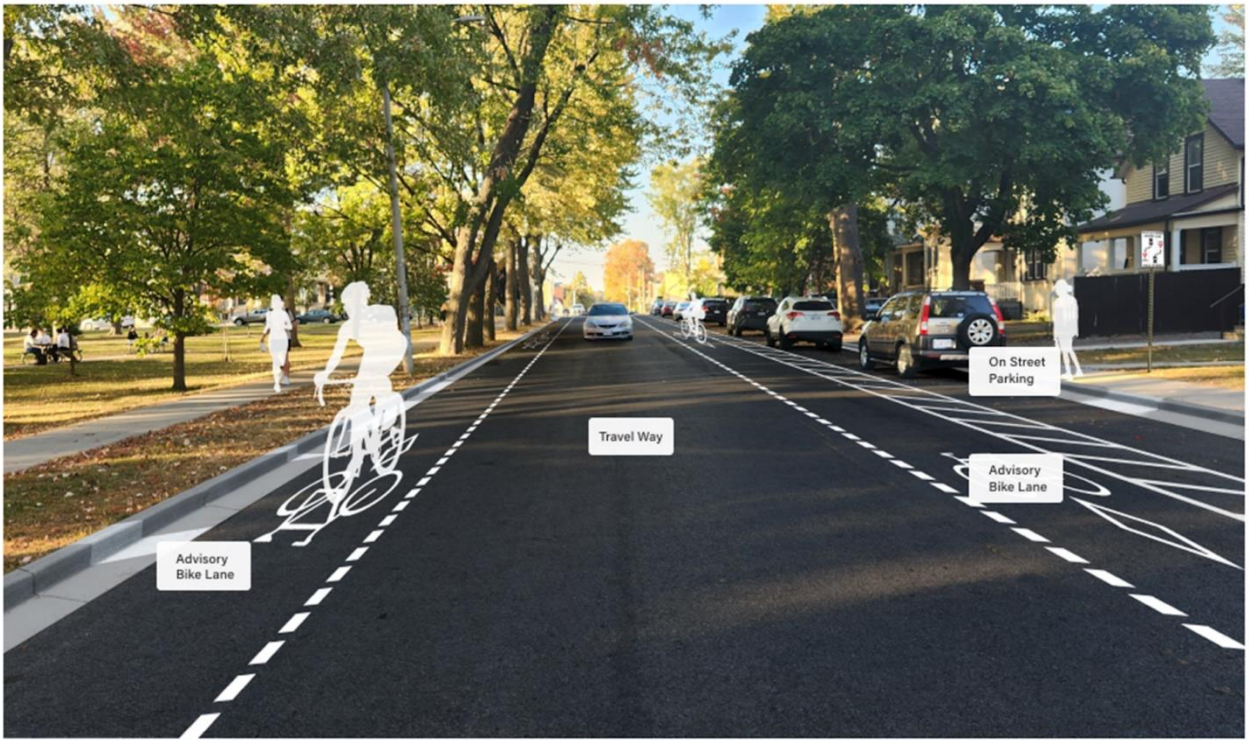
4.5.8 Sample Designs

A variety of sample drawings and renderings were created to illustrate what neighbourhood bikeways and advisory cycling lanes could look like in Williamsville. These are shown in **Figure 16** to **Figure 18**. Note that local roads in the Williamsville area have narrow road right-of-way widths that vary between 15 m and 20 m and provide limited space for additional landscaping.

Figure 16: Typical 15 Metre Right-of-way Neighbourhood Bikeway

Figure 17: Typical 20 Metre Right-of-way Neighbourhood Bikeway

Figure 18: Typical 20 Metre Right-of-way Advisory Bike Lane



Detailed cross section drawings can be found in **Appendix E.**

4.6 Engagement

Alternative design concepts for the local street cycling facilities were presented during the October 26, 2023 Open House. Information and imagery were also provided on the 'Williamsville Bikeway' page of Get Involved Kingston. During the Open House attendees were asked to provide comments on the routes, facilities and traffic calming measures that were proposed. The Get Involved page included a survey where the public could provide comments between October 13 and November 17th, 2023.

The attendees at the Open House were generally supportive of the proposed designs for the neighbourhood bikeways and the proposed locations for advisory bike lanes. Feedback from the online survey was similarly supportive of the potential changes – including the recommended streets.

Traffic calming and speed control measures were included as part of the recommended design for the neighbourhood bikeways. Speed control measures such as lowering the posted speed limit were appreciated by attendees, who felt that it would make the streets feel safer to bike on. There were mixed reactions to traffic calming measures, including the use of bump outs. Bump outs were positively viewed by some who noted a benefit to people with disabilities through reduced crossing distances. Some attendees, however, were concerned that snowplows would not be able to clear them properly during the winter.

Attendees also recommended additional bike routes to consider for neighbourhood bikeways. One of the routes that was recommended was to add bike infrastructure on York Street between Alfred Street and Barrie Street as an alternative to Princess Street. After further discussions with attendees and City staff, it was also noted that Concession Street, Division Street, and York Street may also serve as appropriate alternative routes for cyclists.

Feedback collected through Get Involved Kingston also suggested that dedicated bike lanes should be added on Pine Street, Albert Street, Mark Street, Bath Road as well as on Brock Street and Johnson Street. Respondents who recommended these routes expressed that they should be used for pass-by trips and that the bike lanes on Princess Street should not be removed.

4.7 Next Steps

It is recommended that a detailed implementation plan be developed to introduce and construct the local cycling facilities. This plan should include confirmation of preferred cycle facility type, recommended traffic management techniques, identification of project budgets, and specific timeframes for implementation. Key north-south corridors and east-west corridors that should be developed first to provide the most significant improvements for cyclists through Williamsville include the following:

North-South	East-West
MacDonnell Street	Mack Street
Alfred Street	Park Street

These corridors provide the longest continuous local routes within Williamsville and connections to the existing cycling routes. Immediate, low cost, changes to these corridors could include the addition of pavement markings, signage and temporary intersection narrowing that uses of flexible bollards. Construction of planted bump outs and the addition of street trees can progress as budget becomes available. Other immediate actions could include strategic removal of some on-street parking to begin encouraging mobility behaviour change amongst residents.

Facility transitions and connections should also be explored further once the preferred facilities have been confirmed for each cycling corridor. A feasibility study for the removal of stop signs, removal of on-street parking, introduction of traffic circles, and traffic calming measures including modal filters and diverters, should be conducted. The effectiveness of traffic calming, and speed management measures should be monitored following implementation to inform the design of additional corridors.

There was an overall positive response to the advisory bike lane concepts, and as such it is recommended that these relatively new cycling facilities be piloted in Williamsville and monitored to understand impacts. There were some requests from the attendees to introduce advisory bike lanes on additional corridors which may be explored after a pilot program has been completed. This pilot program should review conflicts, operating speeds of vehicles, and vehicle compliance with the lane markings and signage. By prioritizing the routes listed above, it would also be possible to pilot an advisory bike lane on either MacDonnell Street or Alfred Street, or both.

5.0 Part 3: Green Streets

The City of Kingston is exploring opportunities to implement 'Green Streets' within the broader Williamsville area. Discussed more fully in **Section 5.2**, the 'Green Streets' concept generally refers to streets that are intentionally designed to reduce impact on the social and natural environments. The desire to implement green streets within the Williamsville area was one of the key themes that was part of the Williamsville Main Street Study and showed up in consultation on the Princess Street and neighborhood bikeway concepts. Within the Williamsville area, 'greening' of streets can be used to discourage auto traffic, promote sustainable transportation options, improve treatment of stormwater, and beautify the area. It is necessary to have a more fulsome understanding of what this means to the City of Kingston, and particularly the residents of Williamsville, before moving forward with any roadway modifications within the neighborhood.

The following content is intended to provide the reader with a baseline understanding of the design elements and benefits associated with the proposed changes. This includes visualization of alternative green streets concepts that could be applied to corridors with sections of Frontenac Street used to represent the concepts.

5.1 Policy Background

The concept of Green Streets is embedded in the City's Official Plan Section 10E.1.43 as "Green Streets", as previously detailed in **Section 2.0** of this report. Green Streets for the City of Kingston are intended to be pedestrian-focused with added greenery, rest areas, and space to increase pedestrian comfort, supporting active travel along commonly used neighbourhood routes. Green streets also include traffic calming measures as a mechanism for slowing traffic down along local roadways.

Green Streets also support the City of Kingston with its Official Plan vision for sustainability. In December 2021, the City of Kingston adopted a *Climate Leadership Plan* which sets out a strategy to reach carbon neutrality by 2040. The Plan sets out short- and long-term objectives across the sectors of buildings and energy, waste, transportation, and food and forestry. Within the transportation sector, Council identified the objective of "[Developing] active transportation connections and

foster[ing] transit-oriented development to encourage a shift to sustainable modes and a reduced reliance on personal vehicle use."[13] Specific actions recommended under the plan include:

- Continued implementation of the Active Transportation Master Plan, which is focussed on improving connectivity and safety for pedestrians and cyclists,
- Increasing transit ridership through such things as the addition of express routes (like what is planned on Princess Street), and
- Implementation of parking, car-share, and micro-mobility sharing solutions that reduce reliance on single occupancy automobile trips.

The priorities of the Climate Leadership Plan are also reflected in the City's OP, TMP and ATMP, as discussed in **Section 2.0**. All of these put sustainable transportation at the forefront of their policy directives and recommended approaches, with a goal of reducing dependency on the automobile and single-occupant use. Implementation of green streets concepts will help advance policy objectives by making active transportation more inviting and reducing the environmental impact of vehicle operations.

5.2 Kingston's Definition of 'Green Street'

It is important to define what 'Green Streets' mean to the City of Kingston before rolling out the concept in Williamsville and the rest of the city. As previously mentioned, the term is generally used to describe the transformation of streets to more resilient and sustainable designs. How this definition is realized in terms of actual implementation, however, differs significantly between municipalities.

Two distinct definitions are provided by the cities of Toronto and Seattle. The City of Toronto defines Green Streets as "roads that include green infrastructure – natural and human-made – that capture rainwater and direct it to plants and trees, acting as a natural filter that cleans the water before it makes its way into local waterways." On the other hand, the City of Seattle, Washington defines a Green Street as "a street right-of-way that, through a variety of design and operational treatments, gives priority to pedestrian circulation and open space over other transportation uses. The treatments

[13] City of Kingston (2021). Climate Leadership Plan. Pg. 86.

may include sidewalk widening, landscaping, traffic calming, and other pedestrian-oriented features." While the two definitions seem divergent, designing road right-of-way according to either definition would result in roads that accomplish the following objectives:

- Protection and restoration of natural resources,
- Promotion of a healthy and equitable human habitat,
- Climate change resiliency, and
- Performance optimization.

The City of Kingston has used the combination of the definitions above to develop its own green street design principles for the Williamsville area. These principles should be considered when working on transformational roads projects through the study area, including work on Princess Street:

- Intersections should be designed with a focus on vulnerable user safety. Techniques to consider should include intersection narrowing, reduced curb radii, raised crossings/intersections, conspicuous pavement marking, and improved lighting,
- Vehicular lane widths will be minimized to encourage reduced travel speeds and reduce impermeable surface area within the road right-of-way (ROW),
- Traffic calming techniques should be considered for local roadways where speed or volume is a demonstrated concern in order to improve multi-modal safety and discourage use of private vehicles within the Williamsville area,
- Planting of street trees and landscaped boulevards / islands should be considered to provide shade and visual interest. If required, existing on-street parking should be considered for removal to provide additional space. Where parking cannot be removed, parking lane widths will be minimized, and
- Where feasible, based on space and soil conditions, Low Impact Development (LID) features, including rain gardens and permeable pavements, should be used to improve the quality, and decrease the volume, of stormwater entering waterways.

5.3 Green Street Concept

Frontenac Street was used as a preliminary sample for developing concepts of how green streets could be implemented in Williamsville and other areas of the city. Before moving forward, the City wanted to be able to gauge public interest in green streets, as well as the degree of transformation. To assist with this, three alternative green streets designs were developed for Frontenac Street as a sample segment.

The three alternatives include the following, which are detailed in the following sub-sections:

1. Green 'Lite',
2. Green 'Mid-Level', and
3. Green 'Heavy'

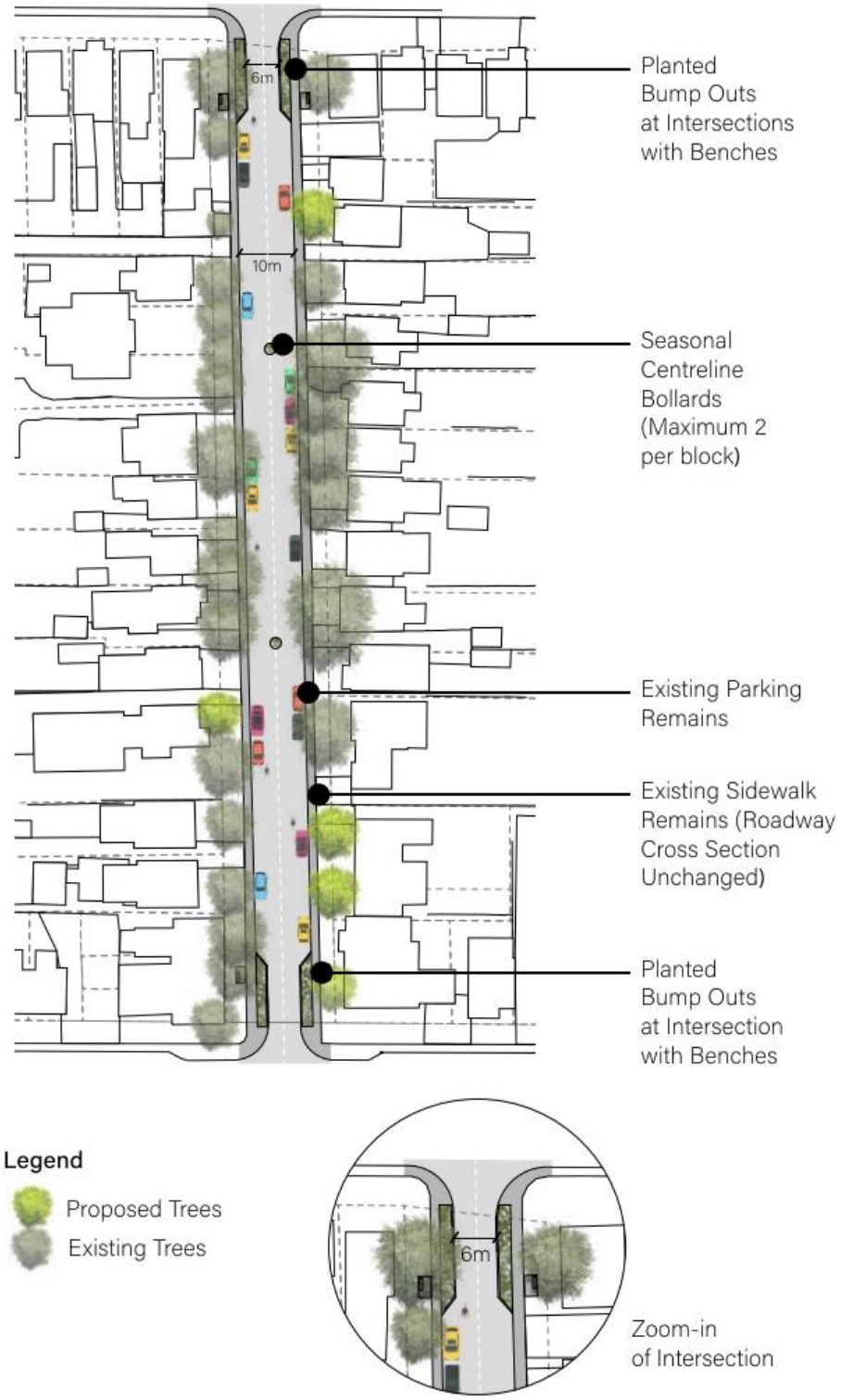
The three alternatives have increasing levels of changes to the local streets, with the Green 'Lite' alternative retaining the most amount of on-street parking and existing number of street trees, while the Green 'Heavy' option resulted in the greatest reduction of on-street parking and the largest increase in number of street trees.

5.3.1 Green Lite

The Green 'Lite' concept was designed as the lowest cost alternative for implementation, requiring the fewest infrastructure changes. In this alternative, bump-outs are only included at intersections, with no additional bump-outs or traffic calming mid-block. On the sample Frontenac Street corridor (**Figure 19** and **Figure 20**), the Green 'Lite' alternative would result in a total of five additional trees (20% increase), and a reduction of two on-street parking spaces (3% reduction).

Figure 19: Green 'Lite' Cross-Section Rendering

Figure 20: Green 'Lite' Alternative Concept Layout

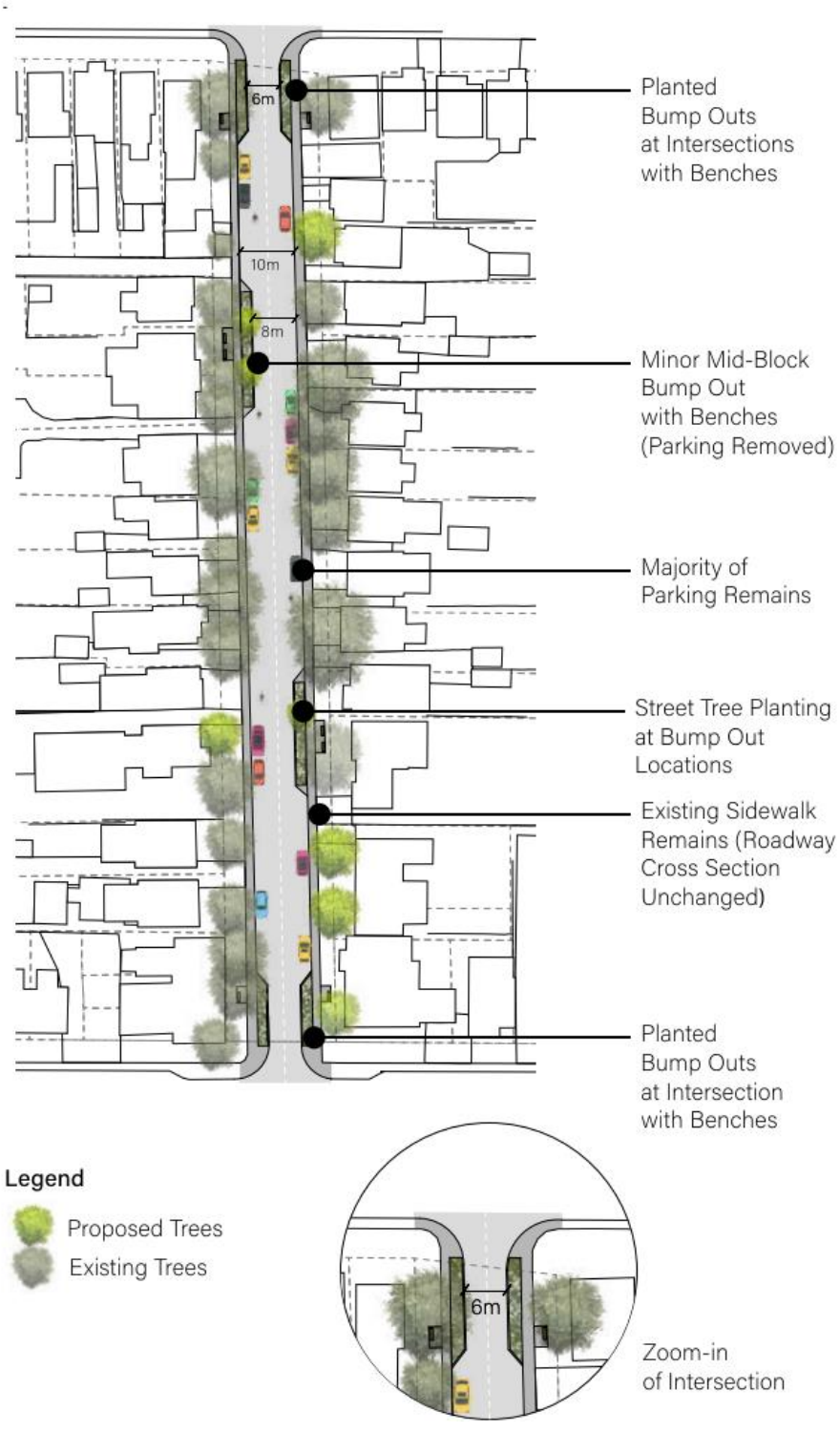


5.3.2 Green Mid-Level

The Green 'Mid-Level' concept was designed as the "additional improvement" alternative compared to the Green 'Lite' alternative. The mid-level alternative provides some additional bump-outs throughout the street as well as the bump-outs at the intersections. These bump-outs are intended to provide additional space for trees and benches throughout the street. On the sample Frontenac Street corridor (**Figure 21** and **Figure 22**), the Green 'Mid-Level' alternative would result in a total of eight additional trees (32% increase), and a reduction of thirty on-street parking spaces (53% reduction).

Figure 21: Green 'Mid-Level' Cross-Section Rendering

Figure 22: Green 'Mid-Level' Alternative Concept Layout

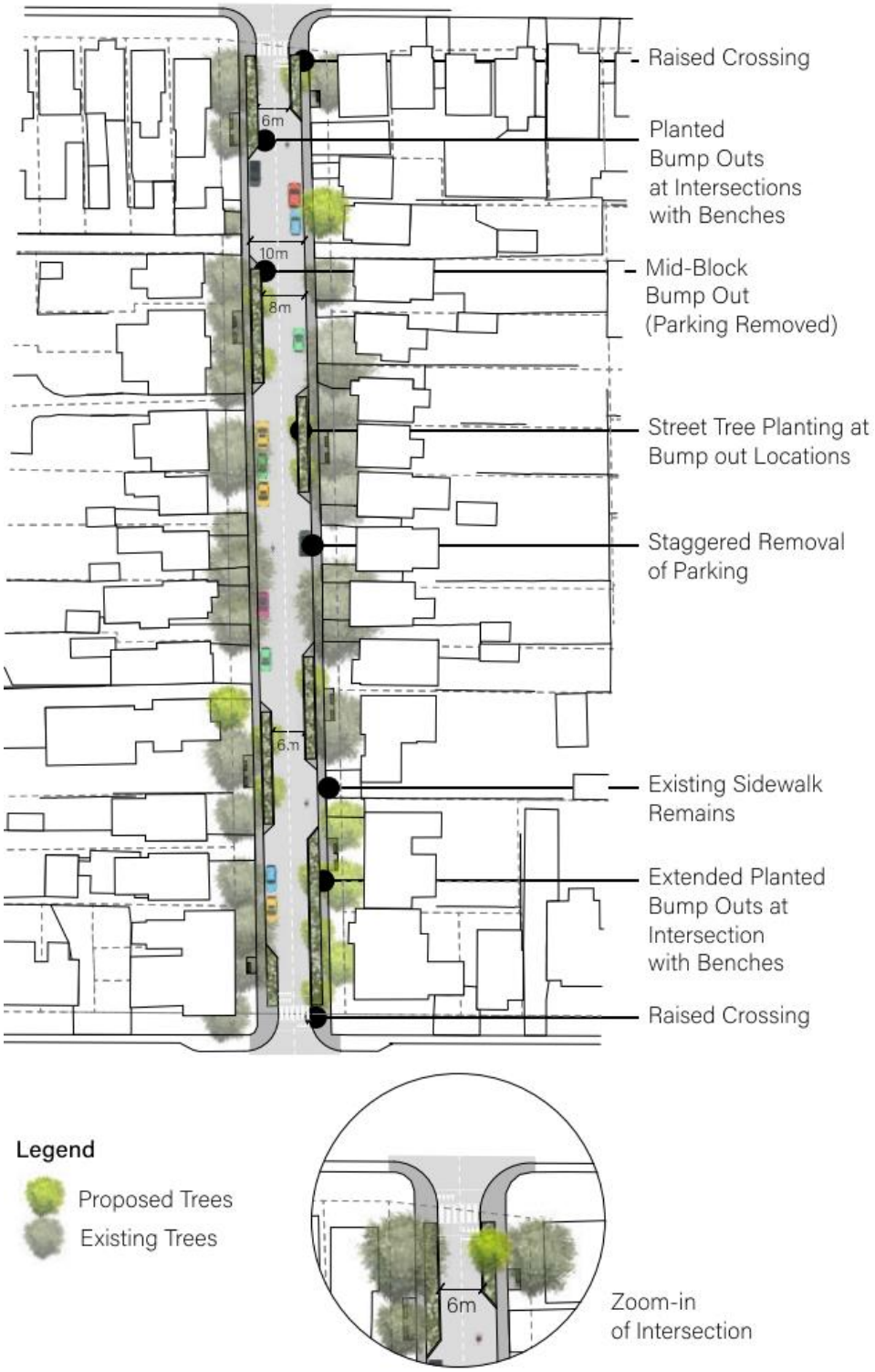


5.3.3 Green Heavy

The Green 'Heavy' was designed as the "greatest change" alternative, when compared to existing conditions. The heavy-level alternative provides mid-block bump-outs in addition to the bump-outs at the intersections and has limited space for on-street parking. These bump-outs are intended to provide additional space for trees and benches throughout the street, while slowing vehicles down as they navigate around them. On the sample Frontenac Street corridor (**Figure 23** and **Figure 24**), the Green 'Heavy' alternative would result in a total of 16 additional trees (64% increase), and a reduction of 36 on-street parking spaces (63% reduction).

Figure 23: Green 'Heavy' Cross-Section Rendering

Figure 24: Green 'Heavy' Alternative Concept Layout

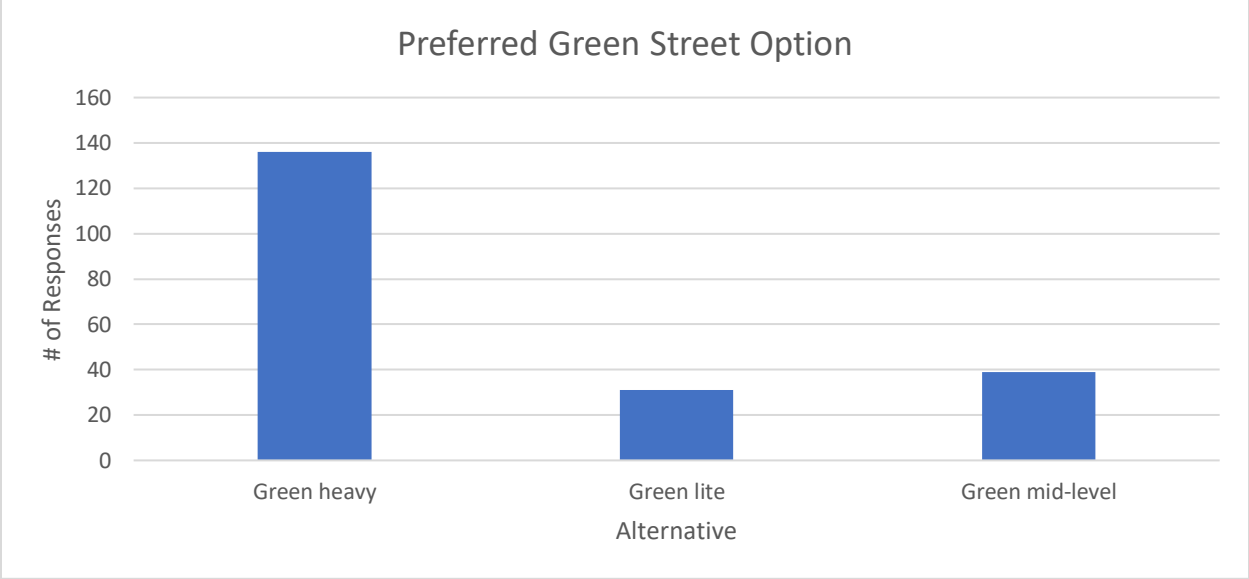


5.4 Engagement

The concept of green streets and the alternative designs for Frontenac Street were presented October 5th at the Councillor's Town Hall. The public was also invited to provide feedback through completion of an online survey on the 'Frontenac Green Streets Concepts' page of *Get Involved Kingston* between October 2 and November 17, 2023. Additionally, printed copies of the cross-sections and renderings were available for attendees of the October 26, 2023, Open House to collect additional feedback. A total of 213 survey responses were received either at the in-person events or through the online survey. The following sections provide an overview of the feedback collected through those two methods.

The results of the webpage survey found that walking and biking were the most used modes of active transportation in Williamsville. In terms of barriers to using active transportation, participants were most concerned with sharing the road with vehicle traffic and the speed of traffic. The survey found that most participants were familiar with green street concepts. When asked to rank the three green streets concepts for use within Williamsville, participants ranked the "green heavy" option as the most preferred with "green lite" rated as the least preferred. A breakdown of participant preferences is illustrated in **Figure 25**.

Figure 25: Green Street Ranking



Additionally, participants noted that the following features are most desired on green streets:

- Tree planting (ranked most important),
- Wide sidewalks (ranked second most important), and
- Curb bump-outs and reduced parking (tied for third most important).

5.5 Next Steps

There is strong support for implementation of green street concepts within the Williamsville area based on community feedback. Most survey responses indicated that the green 'heavy' option was the most preferred. However, there was some discrepancy between the most preferred option and the most desired features on green streets. Curb bump-outs and reduction of on-street parking were the least preferred design feature; however, those are the most prominent features in the Green 'Heavy' alternative. Based on the overall support for green streets, it is recommended that the City move forward with identification and screening of additional candidate sites within the Williamsville area and throughout the City.

6.0 Looking Forward

Building off the Williamsville Transportation Plan Operational Needs Assessment Study that was completed in 2020, the intent of this present study was to explore alternative options for how to best accommodate all modes of travel on Princess Street, and more widely within the Williamsville neighbourhood. The alternatives were explored through three distinct sections: Princess Street Study, Neighbourhood Bikeways, and Green Street Concepts. The intent of the three parts was to allow for the City to pursue one or more of the initiatives independent of one another.

Part 1: Princess Street

Looking forward to next steps, the City will investigate opportunities to maximize the accessibility of the short-listed alternative options presented in this report. Recognizing the right-of-way constraints, a feasibility study will need to be undertaken for the preferred design option, focusing on the need to widen sidewalks and the feasibility of the proposed transit queue jump lanes. Considering recent subsurface initiatives along the corridor, there is an opportunity to maximize City resources and combine this with the Princess Street alternative approach as a means to minimize community disruption and financial constraints.

It is important to note that additional studies will be required as part of the detailed design process in support of implementation, including but not limited to a full topographic survey of Princess Street.

Part 2: Neighbourhood Bikeways

The City of Kingston's Official Plan policy directives focus on sustainable community development, favouring mechanisms that advance active transportation and reduce vehicle dependency. Implementation of supportive infrastructure is an approach that can allow the city to improve cycling network connectivity through quiet, low volume, and low speed streets within the existing Williamsville neighbourhood. The recommendations that are proposed are intended to guide the City with the development of a detailed Implementation Plan. The Implementation Plan should confirm the preferred cycling facility type for constructability and continuity purposes, recommended traffic management techniques, as well as budgeting and scheduling.

Prioritization of corridors should provide the most significant improvements for cyclists through Williamsville, and into the City's broader cycling network.

Part 3: Green Streets

In the City's Official Plan, more specifically the Princess Street Corridor Specific Policy Area, there is a vision for Kingston to establish corridors that are vibrant and active, inclusive of improved pedestrian-oriented streetscapes. Green Streets will help achieve this goal. As a newer concept for the City, a series of recommendations are explored in this report with the intent of guiding implementation of a comprehensive Green Street Concept. Looking forward from this report, the City can identify and screen candidate corridors to further explore implementing Green Street concepts as part of planned capital projects. A Green Streets Guideline can be developed which would further define desirable design elements, decision-making processes, and steps for implementation.

The City of Kingston will be required to undertake additional detailed analysis, focusing on design and constructability to identify the preferred alternative for the Princess Street Corridor. The preferred alternative has the potential to both inform and compliment the efforts put into analyzing the benefits of Neighbourhood Bikeways and Green Streets as a mechanism for achieving reduced dependency on private automobiles and increase in multimodality throughout both the Williamsville neighbourhood and the broader city. It is critical for the City to develop a transportation network that supports the growth in Williamsville and the City of Kingston, while improving multi-modal facilities that promote sustainable community development.

Figures

Tables

Appendix A

Princess Street Operational Needs Analysis (2020)

Appendix B

Princess Street Cross-Section Study (2023)

Appendix C

Preliminary Design Drawings

Appendix D

Princess Street Study Engagement Results

Appendix E

Neighbourhood Bikeway Design Toolbox

References

Memo

To: Henk Brilliams

From: Rudi Rendel

cc: Ian Semple, Maria King, Pegah Tootoonchian

Date: January 15, 2023

Subject: Neighbourhood Bikeway Toolbox

Our File: 23-6663

1.0 Background

To enhance the cycling experience throughout Williamsville it is recommended that the local road network implements cycling supportive infrastructure. This includes converting local roads to either neighbourhood bikeways or other appropriate shared cycling facilities such as advisory bicycle lanes. When designing shared cycling facilities, a balance must be struck between permitting vehicle travel and improving cyclist safety throughout the corridor. While these corridors are shared between motor vehicles and cyclists, they are meant to prioritize through movements for cyclists while discouraging fast-moving vehicles on these corridors. Neighbourhood bikeways should only be implemented on roadways with low operating speeds (<40km/h) and low average daily traffic (<3,000 ADT). Bicycle use is typically prioritized through the use of traffic calming treatments that discourage or slow motorized traffic. Advisory bicycle lanes are typically implemented on streets with low motor vehicle traffic volumes (<4,000 ADT) and where it is relatively rare for two motor vehicles will meet each other at the same time. Advisory bicycle lanes are also appropriate to use in situations with on-street parking as designated on-street parking zones can be provided alongside bicycle lanes.

The following technical guides were used as primary resources:

1. Transportation Association of Canada Chapter 5 – *Bicycle Integrated Design (2017)*
2. Development, Construction, and Operations of a New Traffic Calming Tool, City of Calgary – *Transportation Association of Canada* (2017)
3. City of Kingston's Active Transportation Master Plan (ATMP) – *Walk n' Roll Kingston (2018)*
4. British Columbia Active Transportation Design Guideline (2019)
5. Bicycle Boulevards Feasibility Study – City of Hamilton (2021)
6. Ontario Traffic Manual (OTM) Book 18 – *Cycling Facilities (2021)*

A list of typical and recommended design criteria for the Williamsville area were created using these technical guides.

2.0 Typical Design Toolbox

Neighbourhood bikeways are designed to operate in mixed traffic conditions on roadways that encourage and prioritize bicycle travel.

These design elements can be summarized into four main categories[1][2]:

1. Traffic Reduction;
2. Intersection Treatments;
3. Speed Management/ Priority; and
4. Signs and Pavement Markings.

2.1 Traffic Reduction

Traffic reduction design measures are typically applied at intersections to restrict vehicle movements at intersections while allowing them for cyclists. These can include the following:

- Median islands/diverters: Restrict the through movement of motor vehicles at major crossings, while providing a refuge for cyclists to complete a two-stage crossing;
- Choker entrances: Allow only one direction of motor vehicle traffic either entering or exiting a side street, while allowing cyclists to pass through;
- Full diverters: Convert a four-way intersection into a "T" intersection by closing one of the legs to motor vehicles, while allowing cyclists to pass through.

Although traffic reduction measures may not be applicable in all cases, they do provide the greatest benefit for cyclists, pedestrians and residents as it reduces exposure to traffic noise and emissions (OTM Book 18, 2021). In the context of Williamsville, the preferred corridors provide necessary connections for two-way vehicle traffic and limiting a road to one-way circulation or preventing vehicles from entering a roadway in one direction are not recommended. If the local road network is changed substantially in the future to accommodate one-way roads, these measures may be applicable.

2.2 Major Intersection Treatments

Intersection treatments improve cyclists' ability to cross a major roadway with higher vehicle volumes and speeds. These intersection treatments should provide clear and safe navigation for people riding bikes. Examples of intersection treatments include:

- Bike Boxes;

[1] Ontario Traffic Manual Book 18 (2021)
[2] National Association of City Transportation Officials

- Advanced Stop Bars;
- Bicycle actuated signals;
- Crossrides/Intersection Crossing Markings;
- Refuge Islands; and
- Curb Extensions.

Based on the corridors identified, the following major intersections should be analyzed in more detail and could benefit from one of the major intersection treatments listed above:

- MacDonnell Street & Princess Street;
- Albert Street & Princess Street;
- Nelson Street & Princess Street;
- MacDonnell Street & Concession Street; and,
- Victoria Street & Johnson Street;

The City of Kingston's Active Transportation Master Plan outlines the use of bike boxes and crossrides as potential intersection treatments at major intersections to improve a user's ability to cross a roadway or intersection.

For the relatively low volume and speed roads selected as preferred corridors in the Williamsville area, it is recommended that bike boxes and crossrides or intersection crossing markings are explored further as potential major intersection treatments. Sample images of the above intersection treatments are provided below in Figure 1 to Figure 2.

Figure 1: Bike Boxes (Portland, OR)

Figure 2: Crossride (Chicago, IL)

2.3 Minor Street Intersection Treatments

In general, where a neighbourhood bikeway intersects with a minor road, fewer treatments are necessary due to lower speeds and vehicle volumes. It is desirable to provide a continuous bikeway without stop control for cyclists while also providing vehicle speed and volume control measures for motor vehicles.

These types of treatments range from simple stop signs on cross-streets to traffic circles to slow vehicle traffic while maintaining a continuous path for cyclists. For the preferred corridors, it is recommended that stop signs are removed in the direction of travel for the corridors when a preferred corridor intersects with another minor road. Where two preferred corridors intersect, it is worth considering a solution such as a traffic circle to prevent cyclists in both directions from coming to a complete stop. Implementation of a traffic circle would be appropriate at intersections with low volumes to ensure that large vehicle queues or frequent vehicle conflicts would not be present.

Sample minor street treatments are presented below in Figure 3 to Figure 4.

Figure 3: Minor Street Stop Sign (Google Maps (2020)

Figure 4: Neighbourhood traffic circle (Baltimore, MD)

2.4 Speed Management

Speed management on neighbourhood bikeways presents the greatest way to improve safety for cyclists and thereby encourage the use of bicycles. Reducing posted speed limits is generally not effective at reducing operating speeds below 40km/h, requiring the use of physical speed management tools. Reduced vehicle operating speeds can improve the perception time of both motorists and cyclists and further improve safety for both users.

Some examples of speed management designs include:

- Speed tables;
- Speed humps;
- Raised crosswalks;
- Curb extensions;
- Chicanes;
- Narrowing of motor vehicle lanes; and
- Dynamic “watch your speed” signs;

Potential speed management solutions for the Williamsville area have been summarized below in Table 1.

Table 1: Speed Management Solutions

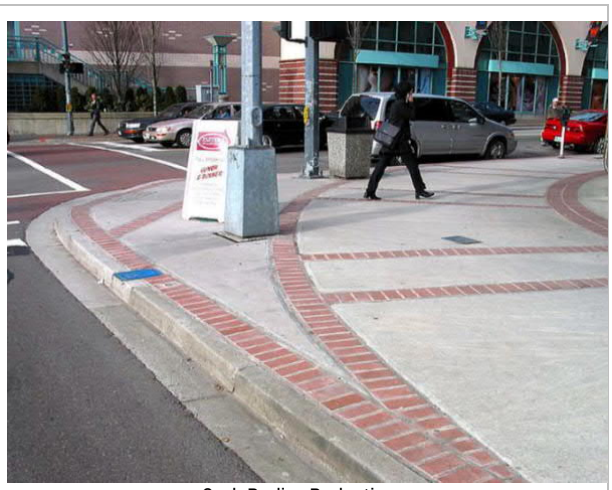
Enhanced Pavement Markings

On-Street Messaging

Speed Hump

Signage

Curb Bump Out



Curb Radius Reduction

Traffic Circle

Raised Intersection

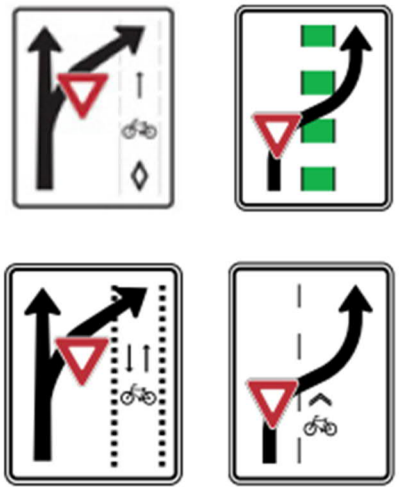
2.5 Signs and Pavement Markings

Providing appropriate signage and pavement markings encourages the use of neighbourhood bikeways and advisory bicycle lanes by communicating the intended travel path, and connections to the local cycling network, and promoting the visibility of cyclists to motorists.

In Ontario, the most common signs used to denote shared cycling facilities are signs Wc-19 OTM or Wc-24 OTM. The City of Kingston's ATMP outlines the use of the Green Bike Route Sign and the Share the Road sign. . In addition to signage, shared facility pavement markings are also encouraged to promote the visibility of cyclists and to clarify that the roadway is a shared-use lane. These pavement markings include "sharrow" (shared lane). In addition to these pavement markings and signage, bicycle lane markings should be used for advisory bike lanes with a buffer between bicycle lanes and parking lanes.

At the time of writing, neither OTM Book 18, or TAC GDG have a standard advisory bicycle lane sign to inform drivers how to operate with these facilities. Both Gibbons, BC and Ottawa, ON have created custom signs to inform both cyclists and drivers. Relevant signage and pavement markings are shown below in Table 2.

Table 2: Signage and Pavement Markings

	
Share the Road Wc-19 Sign	"Green Bike Route Sign" Bicycle Route Marker M511 Sign
	
Shared Use Lane Wc-24 Sign	Sharrow Lane Pavement Marking
	
Turning Vehicles Yield to Bicycles Ra-18 Sign	Advisory Bicycle Lane Custom Signage

3.0 Implementation Considerations

Based on the selected corridors, a list of potential design measures have been identified for implementation. Table 3 defines the design element, any relevant measures of efficacy, and a high-level estimated cost per unit.

Table 3: Recommended Design Measures

Design Element	Description	Purpose	Efficacy[3]	Implementation Considerations	Estimated Cost[4]	Design Category
Painted Cycle Symbols	On-street pavement markings designating a portion of the road way as an exclusive or shared space for cyclists.	Improve route finding for cyclists, and raise awareness for vehicular traffic that the facility is designated for cyclists	• Efficacy information unavailable/non-applicable.	• Pavement markings have a relatively low installation cost but require repainting. • Messaging intended for drivers is directly within the driver's/cyclist's field of vision. • Not visible when snow cover is present	$2,000/km – single side of the roadway	Signs and Pavement Markings
Cycle Facility Signs	Roadside signage designating a corridor as a roadway as an exclusive or shared space for cyclists.	Improve route finding for cyclists, and raise awareness for vehicular traffic that the facility is designated for cyclists	• Efficacy information unavailable/non-applicable.	• Minimal ongoing maintenance requirements • Messaging intended for drivers is located outside the roadway edge. • Requires space outside of the roadway for sign installation • Visible in all weather conditions	$2,000/km – single side of the roadway	Signs and Pavement Markings
Painted Bike Lane	On-street painted space for cyclists to travel. Typically located along the curb. May include a buffer. Cyclist travel way and optional buffer delineated by pavement markings.	Provide on-street horizontal separation between cyclists and vehicle travel lanes.	• Driver-cyclist collision rate decreased by 39%. (CMF = 0.61) (painted bike lanes through signalized intersection)[5]	• Improved safety is due to visual cues, not physical protection or separation • Not visible during snowy conditions • Ongoing maintenance required for repainting	$49/m	Signs and Pavement Markings

[3] Note that a Crash Modification Factor (CMF) indicates that this design element has been proven to reduce the number of crashes to X% of the original values. Where available, the change in condition used to arrive at the stated efficacy level has been identified.
[4] Costs estimates obtained from historical studies, may not reflect current prices.
[5] "Crash Modification Clearinghouse", Federal Highway Administration (2021)

On-Road Messaging	Provide information that is typically messaged to drivers as signage but are instead painted on the roadway to provide a larger image directly in the driver's line of sight (e.g. "SLOW")	Improve compliance with reduced speed limit, notify drivers of a change of context in the transportation network (e.g. neighbourhood bikeway vs. collector street)	• Vehicle speed reduction in 85th percentile speed up to 14 km/h[6] • Driver-cyclist collision rate decreased by 30% (CMF = 0.7)[5]	• Ongoing maintenance required for repainting	$49/m2	Signs and Pavement Markings
Speed Humps	Raised area of a roadway that causes vertical deflections to travelling vehicles. Localized vertical deflection requires that drivers slow down to mitigate damage to their vehicles.	Reduce vehicle operating speeds on local and collector streets with posted speed limits <50 km/h	• Vehicle speed reduction in 85th percentile speed up to 13 km/h[6] • Driver-cyclist collision rate decreased by 45%. (CMF = 0.55)[5] • Traffic volume reduction up to 27%[6]	• Potential increase in delay to EMS, transit travel time • Negative effects on snow plowing operations	$5,000 each	Speed Management
Curb Bump Outs	A horizontal intrusion of the curb into the roadway resulting in the narrowing of a localized section of the road. Typically implemented at intersections, but can be used mid-block.	Reduce vehicle speeds and volume, reduce pedestrian and cyclist crossing distances, increase the visibility of pedestrians, prevent parking close to intersections	• Vehicle speed reduction in 85th percentile speed up to 8 km/h[6] • Effectiveness improved when used in conjunction with other measures (e.g. speed humps)	• Forces cyclists closer to vehicle traffic at the intersection • Loss of on-street parking • Impact on EMS, truck, and transit turning movements • May require drainage adjustments • Range in construction costs driven by surface type (interlocking brick, asphalt, concrete), landscaping, and if utility improvements are required (relocating/installing and connecting catch basins, signals)	$5,000 – 15,000 per corner	Speed Management
Curb Radius Reduction	Modification of an intersection corner to a smaller Can be	Slow down right-turning vehicle traffic, reduce crossing distances for	• Particularly effective where vehicles are turning	• Range in construction costs for physical reductions driven	$10-000 - 20,000 per each corner (physical)	Major Intersection Treatment

[6] Canadian Guide to Traffic Calming (Second Edition) *Transportation Association of Canada (2017)*

	implemented with pavement markings and bollards, or by reconstructing the curb, sidewalk, and boulevard.	vulnerable road users, and improve the visibility of pedestrians.	to/from a bike boulevard to higher volume/speed streets	by surface type (interlocking brick, asphalt, concrete), landscaping, and if utility improvements are required (relocating/installing and connecting catch basins, signals) • Consider transit/EMS turning movements	$2,000 each (painted w/ Bollards)	Major Intersection Treatment
Mini Traffic Circle	A circular island located at the centre of an intersection, which requires vehicles to travel through the intersection in a counter clockwise direction, typically constructed with a raised centre and surrounded by a mountable apron.	Reduce travel speeds, volumes, and collisions points for vehicle traffic	• Vehicle speed reduction in 85th percentile speed up to 14 km/h[6] • Vehicle traffic volume reduction up to 20%[6] • Driver-cyclist collision rate decreased by 30%. (CMF = 0.7)	• Minor delay to EMS, transit travel speed and snow clearing operations • Range in construction costs for physical reductions driven by surface type (interlocking brick, asphalt, concrete), landscaping, and if utility improvements are required (relocating/installing and connecting catch basins)	$10-000 - 20,000 each	Minor Street Intersection Treatment
Raised Intersection	An intersection that may include crosswalks, constructed at a higher elevation than the adjacent approach roadways.	Reduce vehicle speeds, better define crosswalk areas, reduce frequency and severity of pedestrian/cyclist-vehicle conflicts	• Vehicle speed reduction in 85th percentile speed up to 10 km/h[6] • Improved driver to pedestrian yield rate from 18% to 54%[6] • Driver-cyclist collision rate increased by 9%. (CMF = 1.09) (slight increase in crash frequency)[4]	• Potential increase in delays to EMS, and maintenance (Transportation Association of Canada, Institute of Transportation Engineers, 2017) • Cyclist speeds are reduced at raised intersections where cyclists are not required to stop. (Transportation Association of Canada, Institute of Transportation Engineers, 2017) • Potential impact on local drainage (Transportation Association of Canada, Institute of Transportation Engineers, 2017)	$10,000 - $50,000 each	Major Intersection Treatment/Minor Street Intersection Treatment

Modular Pedestrian Traffic Diverter	150mm high pre-cast concrete blocks, 1m by 2.75m in size, which can be arranged to simulate various traffic calming measures such as curb and median extensions, mini-roundabouts or chicanes.	Act as a low-cost temporary or permanent option for implementing traffic calming.	• Average speed and 85th percentile speed reduction up to 3 km/h[7] • Speeding compliance improvement of 11% • Yielding compliance improvement of 47%[7]	• Ability to maintain existing drainage patterns • Can be used for permanent or temporary applications • Allows for planners/engineers to adjust the geometry after implementation	$1,000 per unit	Speed Management/Major Intersection Treatments

[6] Canadian Guide to Traffic Calming (Second Edition) *Transportation Association of Canada (2017)*
[7] Development, Construction and Operations of a New Traffic Calming Tool, City of Clagary, *Transportation Association of Canada (2017)*