Road Network Planning Discussion Paper

Brampton Mobility Plan

Revised May 24, 2023

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1 Introduction

Multi-modal road network planning is an integral part of transportation planning and an important consideration for the Brampton Mobility Plan (BMP), the city's new transportation master plan. The road network is a critical component of a transportation system, connecting people to their friends and family, to goods and services, as well as education and employment. It does this by providing a network that not only moves cars, but supports trucks for goods movement, and functions as the backbone for sustainable transportation modes, including transit, cycling and walking.

The City of Brampton has an extensive road network, including roads and highways owned and managed by the Province of Ontario and by the Region of Peel. Many roads under the jurisdiction of Brampton are experiencing congestion and have been identified for improvements through expansion from 4-lanes to 6-lanes.

Traditionally, road network planning has focused on the volume and the capacity on the road for vehicles, with recommendations to add travel lanes to mitigate vehicle congestion and delay. This has resulted in continued widening of the road network with population and employment growth.

Transportation planning has experienced a shift in approach to road network planning moving away from road expansion projects that accommodate more cars, towards a more integrated approach that considers investment in more sustainable transportation modes including transit, cycling, and walking. Road widening projects have now become widely recognized as expensive, impactful, environmentally harmful, and ineffective at reducing traffic congestion.

The Region of Peel's Regional Official Plan (RPOP) acts as framework for planning policies in the City of Brampton. The RPOP's overarching theme is sustainability, meaning that the goals and policies of the Plan are intended to support sustainable development through healthy, safe and, connected communities.

Brampton has also had a shift in policy and direction through the new 2040 Vision, The Brampton Plan. The Plan influenced a number of principles that will be used as a foundation to this BMP study. These include a focus on enhancing mobility options, environmental sustainability, safety and public health, integration of transportation and land use, multi-modal transportation equity and leveraging technology.

The 2040 Vision for transportation also identified a number of priorities for transportation in Brampton. These priorities start with walking, then cycling, transit, goods movement, and then shared vehicles. Private vehicles will remain an important part of the transportation system, but are last in terms of Brampton's priorities.

The efficacy of road widening is being re-examined through the BMP study given this current policy context in Brampton and industry best practices. Many road widening projects are in various stages of the project lifecycle including environmental assessment and detailed design, and are being reviewed and considered as part of the BMP study. There are alternatives to expanding roads that can still increase the capacity of the network, to move more people using various modes of transportation, and increase the overall person-capacity instead of focusing on the vehicle-capacity of the network.

Alternative approaches to increasing person capacity of the road network considered in this paper include High-Occupancy-Vehicle (HOV) lanes, reversible lanes, transit priority measures, and complete streets. Complete streets is one alternative where roads are designed to be safe for all users, and the design increases the capacity for moving people on all modes, including pedestrians and cyclists. Streets can be designed to encourage sustainable modes of transportation like walking, cycling, and transit, which can move a higher volume of people in less space. This approach can be a more efficient use of the available space, to increase person-capacity within the existing right-of-way (ROW) (**Figure 1**).

Figure 1: Downtown Brampton Streetscape

Source: Bramptonist

The purpose of this paper is to inform the Brampton Mobility Plan on new approaches to road network planning and evaluate their alignment with the BMP principles and policy context. The paper is organized into the following sections:

- Section 2 outlines the context for this paper including a scan of related transportation and planning policy documents;
- Section 3 evaluates traditional road network planning and explores alternative approaches;
- Section 4 explores road design and road widening;
- Section 5 discusses alternative operational strategies; and
- Section 6 is a summary of recommendations and next steps.

2 Context

The previous transportation master plan (TMP) for Brampton was approved in 2015 within a different municipal and provincial policy framework. Since 2015, there have been new plans developed and there are new emerging priorities, industry trends, and best practices for transportation with a focus on equity, complete streets, vision zero, and climate change mitigation through a shift to multi-modal systems that prioritize walking, cycling, and transit. The planning context for the City of Brampton has shifted towards an approach that encourages all forms of mobility and away from the traditional approach, which focused on the movement of private automobiles and reducing delay and congestion. This shift is evident in the 2040 Vision that has the goal for Brampton to become "a mosaic of safe, integrated transportation choices and new modes, contributing to civic sustainability, and emphasizing walking, cycling, and transit." This 2040 Vision will be embedded into future municipal planning documents, including the draft Brampton Plan (the new Official Plan).

Transportation is a shared responsibility in Brampton between the municipality, Peel Region, and the province. Guidance on planning the transportation network comes from each of these jurisdictions. The province provides direction from provincial policy documents and provincial policies such as the Metrolinx 2041 Regional Transportation Plan, and Connecting the GGH: A Transportation Plan for the Greater Golden Horseshoe. The Region of Peel Long Range Transportation Master Plan provides policy direction on the Regional network. The common themes in these policy documents are to create safer and more sustainable communities, applying a complete streets approach, integrating land use and transportation, and encouraging multi-modal transportation options.

The roads policies for the Brampton Mobility Plan (BMP) will be shaped by the policies in these transportation planning policy documents, while also building on the themes that have been outlined in the Brampton 2040 vision. Council has endorsed the following guiding principles for the BMP, which may be further refined through the study process:

1. Enhance Mobility and Travel Options for People and Goods
2. Advance Multi-Modal Transportation Equity
3. Integrate Transportation and Land Use Planning
4. Protect Public Health and Safety
5. Improve Environmental Sustainability
6. Leverage Technology
7. Emphasize Community Engagement and Collaboration

These principles reflect the direction of the City of Brampton and they align well with the other municipal and provincial strategic planning documents.

3 Factors Affecting Road Network Planning

3.1 Existing Approach

The existing approach to road network planning to all three jurisdictions that operate in Brampton are assessed below. This was completed to identify gaps and opportunities to better align with the BMP principles.

3.1.1 City of Brampton

Road network planning in Brampton has followed a traditional approach that designs a network to accommodate all current and forecasted future motor vehicle demand. Although there was consideration of transit, cycling, and walking in the previous TMP, network planning continued with a traditional approach.

This traditional approach to road network planning has been widely used across North America for the past 70 years and the result has been the development of auto-centric cities. The approach involves first reviewing the current road network and estimating capacity based on typical lane auto capacities. The population and employment forecast for the horizon year are used to estimate future auto volumes, and are adjusted for rapid transit opportunities which may influence mode share. The forecasted demand and volume are then compared to the network capacity, and roads are identified for expansion, with the goal of adding additional road capacity to the system. This traditional approach of planning considers the Level of Service (LOS) of roads and intersections for motor vehicles, which are based on the delay experienced by vehicles. Plans for the road network are then identified to address congestion and reduce auto delay. New Environmental Assessment’s (EA) and road widening projects have traditionally been driven by auto demand and lane capacity within a constrained ROW.

Brampton, like many Canadian cities, has started to recognize the many problems associated with auto-centric road networks and has begun exploring alternative approaches. A Multi-Modal Level of Service (MMLOS) lens has been utilized recently by Brampton to also include the consideration for the LOS for transit, pedestrians and cyclists. Brampton has used both the City of Ottawa’s MMLOS tool and the Ontario Traffic Council MMLOS Guidelines to test this new approach to network planning. Building on the Brampton 2040 Vision, there is increased attention and interest in prioritizing the needs of vulnerable road users (pedestrians and cyclists) including in the recent draft Complete Street Guide Study (CSGS), which has an MMLOS tool in the appendix.

Brampton has also started to review their road widening projects intended to address congestion through an Interim Road Widening Strategy. There is widespread industry recognition that expanding roads has not historically reduced congestion, is not financially prudent, and can limit the use of ROWs for other more sustainable modes like walking, cycling and transit.

3.1.2 Peel Region

Peel Region owns and manages several Major Arterial Roads in the City of Brampton such as Airport Road and Steeles Avenue. The Region has also followed a traditional road network planning approach outlined above in **Section 3.1.1**.

The Region recently updated their Official Plan and adopted a 50 percent sustainable mode share target and a plan to offer multi-modal and viable travel options. The Region is also embarking on an update to their TMP beginning in Q3 2022, which will aim to be a comprehensive approach to consider all modes of transportation. This policy context and new direction may change Peel Region's approach to road network planning.

3.1.3 Policy-Driven Alternative Approach

A number of municipalities have recently begun to adopt a policy-driven alternative network planning approach to rebalance streets and reduce dependence on motor vehicles. The policy-driven approach is often referred to as Integrated Mobility Plans (IMP) or a Sustainable TMP. IMPs start by setting policy-direction that encourages the adoption of sustainable modes of transportation, prior to increasing capacity for single-occupant vehicles. The approach looks at the network as a whole, and sets policies that are reflective of the goals of Council. Ideally these policies and programs are intended to improve the flow of people and goods throughout the network. If Council's goal is to reduce motor vehicle mode share to help mitigate climate change, the transportation planning approach will provide policies and programs that intend to shift mode share towards sustainable modes such as walking, cycling, and transit. The management and operations of the system places emphasis on the overall movement of people and goods versus the movement of cars, and uses demand modeling forecasts to consider the performance for other modes of travel. By focusing on the transportation network as a whole, the approach provides a transportation network that maintains the mobility for all people and goods.

A jurisdictional scan found that the following municipalities have implemented a policy-driven approach for their Transportation Master Plans:

- The City of Guelph;
- The City of Burlington;
- The Regional Municipality of Halifax;
- The City of Mississauga; and
- The City of Oshawa.

The plans that were reviewed had similar visions, goals, and policies that aim to encourage a mode shift away from motor vehicles. An IMP differs from a TMP in that it is mode share driven rather than corridor-capacity driven. At its core, the alternative approach sets mode share targets for the future and develops the plan to achieve them. All of the plans consist of a preferred multi-modal network that includes pedestrian, cycling, transit, vehicle, and goods movement priority networks. The preferred network selected encourages multi-modal trips since the networks are integrated and minimize barriers to transfer from one mode to another (i.e. bus stops located along cycling corridors). This was further supported by the road network hierarchy which classifies roads based on the role and function of all modes and the demand at each destination they connect to (rather than only looking at their vehicle capacity). The plans include a network of complete streets that rebalance planning and design priorities between the transportation modes to better align the road network with community priorities. Many municipalities went even further and are including their intention to no longer widen roads to address vehicle congestion in their plans. Instead, any road widening must be completed to improve mobility for sustainable modes only.

Leading transportation planning associations like NACTO are also promoting the move towards policy-driven network planning. NACTO has begun to encourage the shift towards multi-modal transportation planning through its 2022 Policy Platform. The Policy Platform is focused on influencing American state and federal legislation and regulation, to improve transportation by emphasizing the importance of an equitable and safe transportation network.

3.1.4 Alignment with Brampton Mobility Plan Principles

The advantages of the alternative approach in planning are associated with the policy-driven approach that helps municipalities make planning decisions that advance broader city-building policy goals. The policy-first approach would enable the City of Brampton to set policies and plans in the BMP that will ensure progress towards the Brampton 2040 Vision and the council-approved BMP Review principles, as shown in **Figure 2**.

Figure 2: Traditional vs Policy-Driven Approach Alignment with BMP Principles

Principle	Traditional	Policy-Driven
Enhance Mobility and Travel Options for People and Goods	🟡	✅
Advance Multi-Modal Transportation Equity	🟡	✅
Integrate Transportation and Land Use Planning	🟡	✅

Principle	Traditional	Policy-Driven
Protect Public Health and Safety	○	☑
Improve Environmental Sustainability	✕	☑
Leverage Technology	✕	☑
Emphasize Community Engagement and Collaboration	○	☑

☑: Fully advances this principle
○: Partially advances principle
✕: Does not advance principle

The alternative approach develops an integrated network of complete streets which emphasize enhancing mobility options, rather than focusing of motor vehicle congestion reduction first. Under the alternative approach, mode share targets are identified for all modes based on broader goals and vision set by City Council. Supporting the BMP principle to enhance mobility options, the alternative approach would focus infrastructure improvements away from road widenings and towards sustainable infrastructure improvements to achieve the mode share target as a first priority. Only after this, is expansion of the road network for automobiles considered.

The alternative approach advances multi-modal transportation equity through a complete streets philosophy for road design. Recognizing that many people are unable to drive and need alternatives, this approach considers providing space for the variety of alternative modes. The policy-driven approach focus on complete streets improves the LOS for modes with lower user costs.

A weakness of the traditional approach is that the goal to improve the transportation network only considers where the road network will be affected by forecasted auto demand, and does not consider system-wide, multi-modal equity. However, there has now been a shift towards multi-modal equity in more recent plans such as the Region of Peel's 2019 Long Range Transportation Plan. Unlike this traditional approach which considers designs that are established from the centreline out, the alternative approach design is made from the property line in. New streets are then designed to consider all modes of transportation to ensure that they align with the hierarchy outlined in the Brampton 2040 vision that prioritizes pedestrians, cyclists, transit, goods movement, shared vehicles, and single occupancy vehicles, in that order. The design may include the prioritization of space for pedestrians and cyclists by reducing the ROW width dedicated to motor vehicles, to accommodate wider sidewalks, trees and green space, and bike lanes. These designs may be enforced through policies which state that new and existing roads, where applicable, are to be designed using the Complete Streets Guide (CSG).

The advantage of the alternative approach is that it enhances mobility options and person-capacity by improving the active transportation and transit network in key areas. The preferred network ensures that residents are able to travel throughout the City regardless of which mode they choose. The alternative will allow the City of Brampton to provide a safer, healthier, and more resilient environment for residents and visitors.

The connection between land use planning policies and transportation planning is established in the alternative approach. The policies in the alternative approach often encourage density and services to be located along transit corridors and/or at transit hubs which ensure that destinations are accessible by alternative modes of transportation. The integration between land use policies and transportation planning also encourages the use of sustainable modes to access goods and services as key destinations in a neighbourhood.

The Brampton Plan states that the physical layout and design has a direct effect on the health and well-being of residents. The policy-driven approach focuses on increasing mode share for walking and cycling which supports actions to improve public health. The alternative approach will enable the City to prioritize public health and safety through policies that support the pedestrian and cycling priority networks. This approach also focuses on the design of roads to improve the safety for vulnerable road users. Policies that refer to complete streets guide and the adoption of the MMLOS guidelines help to ensure that pedestrian and cycling facilities are safe and comfortable for all users, which encourage travel by active modes.

The alternative approach aims to reduce VKT and the need for road widenings by shifting the mode share towards sustainable modes of transportation, while considering future population and employment growth. This has the added benefit of reducing GHG emissions and improving public health. The City's Community Energy and Emissions Reduction Plan estimated that 59% of Brampton's emissions in 2016 were from the transportation sector. Increasing the number of people who walk, cycle or use transit will help reduce emissions and improve environmental sustainability in Brampton.

The alternative approach helps to leverage new technology to improve the overall transportation network and better align if with policy direction of the BMP. This could include exploring new transportation technologies such as transit signal priority to improve reliability of the transit network and reduce vehicle travel, identify opportunities for electrification to meet climate-change goals, introduce micro-mobility to provide travel options and enhance equity in areas that may not support a traditional transit service. Traditional approaches may reference new technologies, but they are mainly focused on how it would reduce congestion and improve capacity for motor vehicles and transit vehicles. The existing Brampton TMP only makes one reference to new technologies regarding an alternative to buses that would operate on Main Street.

Both the alternative and traditional approaches emphasize community engagement and collaboration. However, the alternative approach will provide more opportunities for meaningful engagement with the community, and City Council, and will be key to getting “buy-in” on the alternative approach to transportation planning in Brampton. The engagement process can help to identify gaps in the transportation network and solutions to integrate each mode into the preferred network and facilitate complete trips.

The narrow scope and focus on the movement of cars of the traditional approach will not allow the city to meet all of the BMP principles. Although the alternative approach shifts away from auto-centric planning practices, it still utilizes traditional road planning tools such as travel demand forecasting to inform decisions and understand the impacts of changes to the road network. A strength of the alternative approach is that infrastructure decisions on road improvements are not based solely on forecasting data and traditional performance measures, but also on the overarching policy-objectives for the City. The strengths associated with the alternative approach would allow the City of Brampton to make progress towards the BMP principles, 2040 Vision, and provide a transportation network that will meet the needs of current and future residents.

3.2 Performance Measures

Performance measures are used to evaluate the performance of current transportation network and reflect the planning objectives for the network. The City of Brampton currently uses traditional performance measures that reflect traditional objectives to maintain sufficient auto capacity. The traditional performance measure estimates the volume-to-capacity ratio (V/C) during one peak hour, which is defined as the number of vehicles on the road to the vehicle capacity of that same road, based on number of lanes and lane width. When a road has a V/C of 0.85 or higher, Brampton recommends improvements to the road. This ratio indicates that the road is becoming congested and therefore, is not performing well for motor vehicles. When the V/C ratio is above 1 on a road, Brampton would strongly recommend and expedite improvements to the road, often through road widening. The traditional performance measures only looks at the volume of vehicles and congestion, and does not consider the overall multi-modal performance and people capacity of the road, including pedestrians and cyclists, or other factors such as equity, choice and GHG reduction.

3.3 Demand Modeling

Travel demand forecasting is the process of predicting travel behaviour and demands within a defined timeframe. To do this, Brampton utilizes a travel demand forecasting model, which is based on a number of assumptions including population and employment growth, origin-destination patterns, trip generation rates, volume-delay functions, mode share, and other factors. Brampton has historically used the EMME travel demand forecasting model for predicting travel conditions, as well as growth rate calculations, greenhouse gas emissions forecasting, and for Development Charge studies. The information from the demand model helps Brampton decide on future transportation improvements, investments, policies, services, and programs, such as where and when to add more road capacity, by adding additional lanes, or where rapid transit is needed.

Brampton now uses a new travel demand forecasting model, the GTA ModelV4.1, which provides new modeling capabilities. Features include testing different policy decisions, a built-in GHG emissions calculator, and a transportation equity analysis to better understand the accessibility and affordability of transportation options for all. The use of a forecasting model helps Brampton use data to make informed decisions about the future of their transportation network. The traditional approach uses modeling to drive network planning and indicate where road widenings are needed, whereas the policy-driven alternative will use modeling to test how network will function.

3.3.1 Induced Demand

Induced demand is a concept broadly based on the idea that increasing roadway capacity will encourage more people to drive, which in turn leads to congestion. Also known as “induced traffic” or “consumption of road capacity”, the phenomena of induced demand has been observed by transportation researchers since the 1960s.

Historically, demand forecasts in urban transportation planning have been based on infrastructure, capacity increases, and external variables such as land use, population, employment, and income. Once the impact of these variables are assessed, an estimate of future traffic volumes for different horizon years can be developed. This theory maintains that demand is not influenced by transportation infrastructure or money; but rather, is almost entirely influenced by external factors (i.e. land use, population, etc.) (Lee, Jr., Klein, Camus, 1999).

More recently, a contrasting concept of induced demand has emerged which claims that increases in road capacity stimulates corresponding increases in demand. The concept that additional capacity is directly proportional to increased demand epitomizes the idea of “build it and they will come”. Induced demand is closely related to the idea of “latent demand”, which suggests that demand exists, but is suppressed by the limitations of the road network. There are willing buyers who will express their demand for travel once the service is offered (Lee, Jr., Klein, Camus, 1999).

According to the concept of induced demand, once a new road is opened (or an existing road is widened), capacity is quickly reached and congestion occurs. From a traffic modeling perspective, an increase in roadway capacity will make that route attractive, which in turn leads to an increase in traffic using that route. The vehicle demand on the widened roadway increases but often from vehicles that are rerouting from other roads. With increased capacity and initially faster travel times (or the perception of such), changes to travel patterns behaviours would be expected.

A number of case studies have been completed across North America which illustrate that adding road capacity *fails* to address congestion issues. In fact, a study focused on the Katy Freeway in the Houston Metropolitan Area demonstrated that congestion got worse *after* the freeway was widened. Travel times increased by 30 percent during the morning commute and 55 percent during the evening commute. Economist Anthony Downs described it well in his Law of Peak Hour Traffic Congestion; “on urban commuter expressways, peak-hour traffic congestion rises to meet maximum capacity.” (Schneider, 2018)

Based on the concept of induced demand, an increase in roadway capacity is not always the solution to congestion issues. Furthermore, the addition of roadway capacity also correlates to an increase in VKT, resulting in increased air pollution. Instead of increasing capacity, increased investments in other modes of transportation is worthwhile. The improvement and expansion of public transportation as well as the enhancement of active transportation facilities can make these mode choices more attractive. (Schneider, 2018)

In growing urban areas, the evidence from recent decades seems to support the induced demand theory. Although the concept has not been implemented as a formal forecasting method, the theory implies the demand is influenced more by internal factors (i.e. latent demand), rather than external factors. This concept should be considered when reviewing road widening projects as part of the BMP study.

3.4 Factors Affecting Mode Choice

For Brampton residents, numerous factors influence the decision to choose one mode over another for travel. Currently in Brampton, trips are largely completed by motor vehicle. The 2021 Canada Census data showed that only 1.5% of journeys to work by the employed labour force are made by walking or cycling, 10% by public transit, and a large majority, 86% of the trips were made as a driver of a motor vehicle in Brampton. Mode choice is very competitive as there are various factors that influence an individual's decision, including the land use and urban design characteristics of the origin and destination, trip characteristics like distance, convenience, comfort, reliability and travel time, options available, cost, and perceived safety and security.

Characteristics of individual travelers also influence their mode choice, including a personal preference for one mode over others. Preference could be based on desire for privacy, social norms among their peers, environmental attitudes, and perceptions of walking and cycling. In recent years, there has been a greater mainstream understanding of the negative environmental impact of cars and a desire to use alternative modes, however, for a large portion of North America, the infrastructure to support alternative modes of travel remains limited.

An individual's level of comfort and perceived safety of a transportation mode influences which mode they ultimately decide to use for their trip. The largest portion, around 60% of the population in North American cities, are “interested but concerned” to cycle. This means they are curious about cycling and like to ride, but are afraid to do so on the road network, and therefore, do not regularly bike for transportation (Dill, McNeil, 2012). This population often rides for recreation, but could be attracted to cycling for transportation through the implementation of designated and separated facilities that provide safe and comfortable space for cyclists.

Safety perceptions about walking can also influence mode choice with factors such as poor lighting near sidewalks and at transit stops, pedestrian facilities such as sidewalk width, and availability of crosswalks, traffic speed, number of businesses and destinations, and the amount of activity and people on the streets (Garcia, Khan, 2018). Perceptions of safety and comfort have a stronger influence over women’s likelihood to choose cycling or walking for travel over men (Dill, McNeil, 2012).

Transportation options that are physically accessible to the individual from the origin and to the destination will also influence the decision on travel mode. Traditional transportation modelling often captures the key listed factors affecting mode choice, including the accessibility and availability of a transit route between the origin and destination (including by time of day or day of the week), possession of a driver's license, physical capability to walk or cycle, and availability of safe cycling or pedestrian infrastructure. In many North American cities, transit routes, stops, and active transportation infrastructure are not present, reliable, accessible or well connected, making selecting the motor vehicle a default choice for their travel.

Land use characteristics such as population and employment density and the type and mix of uses in the surrounding development influence the decision to use some modes over others. Five urban design qualities are shown to impact the likelihood of walking in a neighbourhood as outlined by Ewing and Cervero (2010). These include density, diversity of land uses, design, distance to transit, and distance to opportunities. Mixed-use and medium to high-density built environments with good quality active and public transit infrastructure are widely acknowledged to encourage travel by walking, cycling, and transit (McCarthy, Delbosc, Currie, Molloy, 2016). Not surprisingly, several studies associated greater travel distances between uses, low-density built environments or poor quality pedestrian and cycling infrastructure with increasing car trips. Physical and environmental factors are shown to influence behavioral patterns related to the choice of mode of transportation.

Characteristics of the trip will also influence the mode choice for the individual including the origin and destination of the trip. Factors such as the availability and cost of parking, convenience, pedestrian and cycling environment, and travel time and convenience of transit will influence the decision to travel by a specific mode. End-of-trip facilities to accommodate active transportation such as showers and secure bike parking influence the choice to bike to a destination whereas accessibility of the pedestrian network, shelters at transit stops and snow clearing policies can influence walking and transit use.

Influencing mode choice requires consideration of all of these factors in order to shift the mode share, and there are many of these key factors that Brampton can influence. Through the Brampton Plan and other policy documents, Brampton is looking to integrate land use with transportation, increase bicycle parking and facilities, and implement complete streets, which will provide increased travel options for residents and improve perceptions of safety and comfort.

Factors influencing mode choice are the same for both the traditional and alternative approach to road network planning. The difference is in how the approaches determine their target mode shares and use those as a driver for network planning. The traditional approach mode share targets are tied to existing and historical mode share trends. The alternative approach is based on the municipality’s city-building strategic objectives and supported by the mode share potential of the network.

3.5 Complete Streets

Complete streets are designed to be comfortable and accessible to all road users. Municipalities across North America are adopting complete streets policies that create a framework and road classification system for planners, engineers, and City officials to incorporate all modes into road design projects. The City of Brampton has existing policy commitment to complete streets including a Complete Streets Guide (CSG), which establishes a framework for road design.

Brampton’s complete street policies use a people-first design principle which will balance the needs of all users and prioritize vulnerable road users.

To support Brampton's policy goals including the Brampton Plan, staff involved with road projects will need to apply the following principles to all road projects:

- Create safe and accessible streets;
- Promote healthy and active living;
- Improve transportation choice and balance priorities;
- Develop connected networks;
- Respect existing and planned context;
- Create vibrant and beautiful places;
- Enhance economic vitality; and
- Improve sustainability and resiliency in alignment with the Sustainability and Climate Change policies to reduce GHG emissions.

Traditional road network planning did not consider other modes of transportation beyond the motor vehicle. As such, many arterial and collector roads in the city currently only provide safe, accessible, and comfortable conditions for motor vehicle drivers. The traditional approach designs a street from the centreline out, and the alternative approach is from the property line in, ensuring the needs of sustainable transportation are met, while potentially compromising space for vehicles. While there are some exceptions, including the expansion of the Züm transit network and introduction of on-street cycling lanes, other road users were not typically prioritized in traditional road network planning. The new complete streets approach will be a shift in road network planning and road design to consider and accommodate all modes. The design of complete streets consider the context and not all complete streets are the same. All road design and planning projects in Brampton will provide an opportunity to apply the complete streets principles and advance the goals through the city's capital roads program.

3.6 Noise Walls

Noise walls are structures that are designed to block the direct path of sound waves from road and railway to sensitive land uses such as residential areas. While they can mitigate the impact of noise pollution they also have many disadvantages. Noise walls can create a shadow on nearby properties, and can attract graffiti. They are a visual barrier which can create safety concerns with fewer eyes on the street and reduced views for nearby residents. Noise walls are also a physical barrier to transit stops and arterial road sidewalks and cycling lanes, and the adjacent neighbourhoods, reducing the overall connectivity of the street to the surrounding transportation network. They also reduce traffic noise, but do not eliminate the noise.

There are alternatives to noise walls that should be considered. These alternatives include:

- Paving roads with more porous surfaces to reduce the number of grooves, resulting in less road noise;
- Low height berms;
- Vegetated screens; and
- Sound absorbing ground surface and ground treatments.

There have been ongoing conversations within the City of Brampton regarding the construction of noise walls to mitigate transportation noise. An example of recent discussions includes the potential expansion of the noise wall along Williams Parkway in advance of widening to six lanes. There are emerging directions that may be considered for future noise walls include the use of transparent materials to allow light to pass through the wall, mitigating their physical presence. This alternative reduces the visual barrier, but the physical barrier and negative impacts on overall mobility remain. Another alterative may be to consider one-sided local roads directly beside an arterial road to increase the separation between homes and arterial roads. This can create greater separation between homes and the arterial roadway, but results in inefficient network design.

3.7 Road Classification

A road classification system categorizes roads according to their functions and capacities. The following section assesses the existing road classification in Brampton and alternatives for consideration.

3.6.1 Existing Road Classification System

The current City of Brampton Official Plan (2006) consists of a road network to accommodate road conditions up to the planning horizon year of 2031. We note that other than “Urban Collectors’ the defined function of the streets within the Brampton OP does not mention how they facilitate walking and cycling. Rather, the focus is towards the movement of motor vehicles as outlined below:

Major Arterial (City & Regional): Major arterials under the jurisdiction of the City are planned, designed, constructed, and designated to carry medium to high volumes of traffic at medium speeds to and from principal areas of traffic generation and highways. Major Arterials are to be designed to be continuous and be able to accommodate High Occupancy Vehicle (HOV) lanes, dedicated transit, or other transit priority measures to facilitate transit operations. Additionally, Major Arterials should have a high degree of access control to abutting properties. Schedule B1: Road Right-of-Way Widths of the OP indicates that the ROW width for major arterial roads is 40-45 metres. Under the Jurisdiction of the Region, Arterial Roads are classified within the Major Road Network which are designed to provide high levels of inter-and intra-municipal travel.

Minor Arterial: Minor Arterials are planned, designed, constructed, and designated to connect and support traffic on Major Arterial Roads. Minor Arterials carry moderate volumes of traffic over medium distances at medium speeds. Given the function of these roads, they may include HOV lanes, dedicated transit lanes, or other transit priority measures with appropriate street furniture, where appropriate. Compared to Major Arterials, Minor Arterials control the movement of through traffic by limiting the direct access to abutting properties. Schedule B1: Road Right-of-Way Widths of the OP indicates that the ROW width for minor arterials is 36 metres.

Collector: Collector roads are planned, designed, constructed, and designated to accommodate moderate traffic speeds and volumes for short to medium distance trips. The type of trips that utilize collector roads occur between residential or business and employment areas or to and from the arterial systems, including transit service. Direct access from abutting industrial and commercial properties is permitted. However, direct access from abutting residential properties is not permitted near intersections with arterials. Through traffic is discouraged from using these roadways. Schedule B1: Road Right-of-Way Widths of the OP indicates that the ROW width for Collector roads is 23-26 metres.

Urban Collector: Urban Collector roads are planned, designed, and constructed to accommodate moderate traffic volumes to and from arterial roads. Compared to Collector roads, Urban Collectors encourage more opportunities to provide transit, pedestrian, and cycling facilities. They are constructed with wide asphalt to accommodate on-street bicycle lanes and/or on-street parking. Trips along Urban Collectors occur between residential, business, and employment areas. However, unlike Collector roads, direct access from abutting industrial, retail, and commercial properties are encouraged. Whereas access near intersections next to arterial roads will be appropriately managed similar to Collector roads. Schedule B1: Road Right-of-Way Widths of the OP indicates that the ROW width for urban collector roads is 20 metres.

Local: Local roads are planned, designed, constructed, and designated to accommodate low to moderate volumes of traffic travelling at low speeds between neighborhoods, points of origin, and the Collector road system. As such, through traffic is discouraged along Local roadways. Additional differentiation between categories of Local and Collector roadways and in the standards pertaining to them may be detailed in secondary plans.

The role and function of each street in the road network is defined within this traditional classification system to support the design and expansion of a road network with the capacity to move vehicles and respond to travel demands. However, this traditional road classification only defines the road by what happens within the right-of-way with transportation volumes, transit infrastructure, and vehicular traffic. Cycling and walking are only briefly mentioned, indicating that the functional classification system favours the movements of vehicles over people.

3.7.1 Draft New Road Classification System

While the traditional approach focuses on the roads ability to facilitate the movement of cars, the new street classifications better integrates the road with land use and expands on the multi-modal approach to planning. The street classification policies use a complete streets classification and provide a land use framework for new and existing neighborhoods that intend to permit a range of uses that support 15-minute neighborhoods[1]. The road classification also provides predictability for the type of development that exists or is being proposed on lower or higher-order streets since it provides guidance for the type of land uses that are permitted adjacent to them. The functional street classifications of the Brampton Plan are further categorized into street typologies which include:

- Urban Main Street;
- Neighbourhood Connector;
- Commercial Connector;
- Mixed Use Residential;
- Neighbourhood Residential;
- Employment Connector;
- Downtown Street;
- Local Residential;
- Local Employment;
- Shared Street; and
- Lane.

The draft street typologies of the Brampton Plan are sourced from the CSG and build on the existing street classifications and are intended to close the gap between transportation and land use planning. Street typologies are associated with land uses in order to inform their design and function in relation to the transportation network. In doing so, facilitates the efficient movement of passenger vehicles and goods movement in the transportation network. This contrasts with the existing street typology which was is mainly focused on motor vehicle capacity. For example, Urban Collector roads are intended to connect residential and employment land uses while incorporating cycling lanes. The draft street typologies provide more context as they also provide guidance for the type of land uses and modes that are to be accommodated along the roads. In the case of the Commercial Connector road, it is identified as a link to employment

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[1] 15-minute neighbourhoods provide a diverse mix of land uses, including clusters of business and economic activity, and creating an urban form that supports active transportation and transit (Source: Brampton Plan).

areas, and that multi-story commercial offices and buildings are permitted adjacent to them. The associated land uses provide more context for transportation planners by indicating the goals and users of the road. These classifications will be used for the BMP and are described in more detail in Section 4.1 on the Complete Streets Guide (CSG).

4 Road Design Review

The following section provides an overview of the City of Brampton's CSG, the City's current approach towards road widening, and an assessment of the LOS provided for all modes on a typical six-lane road concept. This section also outlines how auto lane reduction and providing complete streets can increase overall people capacity within the existing ROW.

4.1 Complete Streets Guide (CSG)

City Council will consider the Draft CSG for adoption, which will further articulate the intended character, goals, and functions for each street. The CSG considers a street's role within a complete street network and identifies appropriate goals for the street. The draft Brampton CSG provides a series of street typologies that builds on the Brampton Plan's functional street classification. The street typologies are meant to inform and motivate well-considered designs that respond to the range of existing and planned contexts in the City of Brampton. The street typologies, function, and ROW widths are outlined in **Table 1**.

Table 1: Complete Streets Guide Street Classification

Street Typology	ROW Width (m)	Function
Urban Main Streets	25-45	Vibrant mixed-use destination streets located in Urban and Town Centres and along Primary and Secondary Urban Boulevards where higher density, transit supportive development is intended to occur.
Neighbourhood Connectors	25-50	Through streets that serve as major links between Neighbourhoods. These streets typically have residential buildings along their edges, which are setback from the street edge or rear-facing residential lots with backyard fences along the street. Businesses or stretches of commercial plazas or parklands can be found along the edges.
Commercial Connectors	25-50	Through streets that serve as major links between Employment Areas. Buildings along Commercial Connectors usually range from multi-storey commercial offices to wholesale or large format retail, industrial, warehousing and distribution, manufacturing and processing facilities.

Street Typology	ROW Width (m)	Function
Mixed-Use Neighbourhood Streets	18-30	Vibrant mixed-use streets that will apply as Brampton continues to intensify. Mixed-Use Neighbourhood Streets will serve a focus within Town Centres and Mixed-Use Districts beyond the downtown and will serve as the focus for Brampton's future neighbourhoods.
Neighbourhood Residential Streets	23-30	Provide gateway access to Neighbourhoods from Neighbourhood Connector Streets, with predominantly residential uses facing the street, though stretches of businesses and existing rear facing lots may be present.
Employment Collector Streets	23-30	Provide access to and from Brampton's Employment Areas and often mark the entrances to Employment Areas.
Downtown Streets	15-30	Smaller streets concentrated within Brampton's historic Downtown and serving important commercial, office, and institutional uses as well as a growing mixture of residential and retail uses. Most people travelling along these streets are visiting shops or businesses and as such have lower traffic speeds and volumes then the collectors and connectors. Due to their importance, visibility, and high levels of pedestrian activity, downtown streets should have high levels of pedestrian amenities, and distinctive, formal design treatments.
Local Residential Streets	17-20	Relatively low traffic volumes, lower speeds, and prioritize active Neighbourhood life. Local Residential Streets are the most common streets in Brampton.
Local Employment Streets	20 or less	Typically found outside of the Downtown and Centres and provide access to industrial or commercial businesses. The design of Local Employment Streets needs to balance elements for maneuverability of large trucks with elements that create a safe and comfortable public realm, recognizing that many people travelling on these streets will be visiting businesses along them or passing through.
Shared Streets and Lane	6-18	Smaller and lower speed local streets which emphasize pedestrian scale and calm traffic. Shared streets can have a flexible design which can function as a public space that provides a safe and accessible environment.

It is recognized that each context will be unique. The general approach will be to consider which modes are desirable and how much space is required to accommodate them. The preferred street cross-section may be limited due to pressures such as existing street width, the location of existing light poles, stormwater management features, street trees, private properties, topography, and the number of driveways along the street. The existing street width, infrastructure and natural features will be evaluated to see if the available ROW is adequate for the desired modes. If the space available is limited, staff will need to explore opportunities for road space reallocation, additional building setbacks for redevelopments, and redistribution of some modes to other streets while considering the broader complete street network.

4.2 Road Widening

4.2.1 Current Plans for Road Widening to Six-Lanes

While the BMP study is underway, there is a long list of road projects currently in various stages of the implementation process of the City's Capital Plan including in the EA and design phase. Several roads have been identified for widening from four to six-lanes through travel demand modeling and the traditional approach for road network planning. These plans for widening placed a strong emphasis on the demand modeling results, and not the policy directions or space for other modes of transportation beyond the motor vehicle.

The efficacy of road widening is being reviewed more generally through the BMP given the current policy context of the Vision 2040, Brampton Plan, and Brampton's principles for a safe and healthy community, and to improve environmental sustainability and multi-modal equity. Within a constrained right-of-way, road widening projects have often removed existing landscaping and trees, negatively impacted urban design, and have been unable to accommodate provisions for active transportation. Brampton staff have developed an interim strategy to assess the planned six-lane road widenings that are currently listed in the City's capital plan using a BMP principles scorecard based on the new council-approved principles.

An Interim Strategy Coordinating Committee conducted an initial review and screening of the road widening project and they were placed in the following categories:

Capital Refocus Projects

Six-lane road widening projects that have been re-evaluated and scoped to deliver multi-modal infrastructure and improve the landscaping and tree canopy instead of dedicating the majority of space to motor vehicles.

- Williams Parkway (McLaughlin Road to North Park Drive).

Priority Evaluation Projects

Six-lane road widening projects that are time sensitive projects which are approaching a milestone in planning and design. They need an expedited re-evaluation to determine next steps to proceed, pause, or rescope.

- Torbram Road (Queen Street to southern City limit); and
- Sandalwood Parkway (McLaughlin Road to Heart Lake Road).

Reframe and Ongoing Review Projects

Six-lane road widening projects will be reviewed pending the recommendations on road widenings in the BMP. Options may then be explored and the scope of work revised to help achieve strategic priorities.

- Torbram Road (Queen Street to Bovaird Drive);
- Clark Boulevard (500m East of Dixie Road to Rutherford Road);
- Sandalwood Parkway (Dixie Road to Airport Road);
- Williams Parkway (Torbram Road to Humberwest Parkway); and
- Bramalea Road (Queen Street to Bovaird Drive).

Paused Projects

These projects are planned for beyond the short-term implementation horizon, and they will be assessed following the TMP Review.

- Bramwest Parkway (Steeles Avenue to Financial Drive);
- Humberwest Parkway (Castlemore Road to Williams Parkway);
- Castlemore Road (McVean Drive to The Gore Road);
- Castlemore Road (The Gore Road to Highway 50);
- Chinguacousy Road (Bovaird Drive to Wanless Drive);
- McLaughlin Road (Queen Street to Steeles Avenue);
- Torbram Road (Bovaird Drive to Mayfield Road);
- Ebenezer Road (Queen Street to Highway 50); and
- Humberwest Parkway (Airport Road to Castlemore Road).

The BMP will continue this review of the road widening projects listed above, and will aim to have future road projects and roadway designs align with the BMP principles, along with Brampton's goals and overall policy objectives. City of Brampton staff are required to notify Regional staff of any changes being contemplated to approved EA's which cross Regional Road Infrastructure.

4.2.2 Multi-modal Level of Service (MMLOS) Assessment

The following section is an assessment of a proposed concept for a six-lane cross-section segment in Brampton TMP and Interim Road Widening Strategy. Transportation engineering has traditionally used the concept of LOS to evaluate an intersection or road segment's performance for motor vehicles through vehicle delay and congestion metrics. This approach does not take into consideration how any other road users, including cyclists, pedestrians, and transit users, experienced the intersection or street. Instead, it only considers the efficient movement of vehicles, and does not consider how that aligns with the function and intent of the street or the larger planning and policy context.

This leads to design decisions that consistently prioritize the motor vehicle over alternative modes of transportation.

As a comparison, the MMLOS approach offers municipalities a tool to evaluate, design, and build streets that balances the priorities and needs of all road users and enables and encourages travel by modes other than the motor vehicle.

A MMLOS approach was developed as part of the draft CSG for Brampton. The approach is based on best practices used in cities such as Charlotte, North Carolina and Ottawa, Ontario. The City of Brampton MMLOS tool applies a user-based approach focused on the experience by each mode. It does this by setting modal priorities which are based on the transportation and land use context of the project. The modal priorities are then used to guide the subsequent MMLOS analysis of the existing conditions and future alternative solutions that are being proposed. The modal priority is then followed by an assessment of the pedestrian, cycling, transit, goods movement, and vehicular LOS.

Pedestrian LOS

The Pedestrian LOS at the segment level is evaluated using the following measures: Sidewalk width, boulevard width, annual average daily traffic (AADT), and vehicle operating speed. Based on the evaluation criteria found in Brampton CSG, the Pedestrian LOS for the proposed road is predominantly determined by the width of the sidewalk and the operating speed of the road (**Figure 3**).

Figure 3: Six-lane Road Concept

Source: City of Brampton TMP and Interim Road Widening Strategy

Based on a Brampton cross-section road design, the road would provide Pedestrian LOS E. The reason being is due to the auto-oriented design of the road. Due to the width of the road and the lack of on-street parking, the operating speed is typically 60km/h or greater, which is the case for most arterial roads in the City of Brampton. The high speed of vehicles on the road in addition to the minimum sidewalk width, the segment does not provide a high LOS for pedestrians, regardless of the boulevard width and traffic volume.

Bicycle LOS

At the segment level, the Bicycle LOS is based on the Level of Traffic Stress (LTS) method and best practices. The LTS method is based on the Mineta Transportation Institute report no.11-19, which relates the LTS of the cycling facility and the degree of comfort experienced by cyclists and users. The cross section of the proposed road segment also does not have cycling infrastructure. As a result, it would provide a LTS 4, which would only be used by confident cyclists given the stress associated with cycling in mixed traffic conditions.

In addition to LTS, the Bike LOS also evaluates the safety and comfort level for cyclists using the following measures: type of Bikeway, number of travel lanes, bike lane width, operating speed, bike lane blockage, and presence of parking lane. Based on the lack of cycling facilities in this typical six-lane road design segment, it provides a Bike LOS F.

Transit LOS

The Transit LOS evaluation focuses on the availability of transit, comfort, and convenience. Availability of transit refers to the operational aspect of transit which pertains to headway, service hours, and coverage area. Comfort and convenience evaluates the service side of transit which includes the transit facility type, reliability, transit-auto time ratio, access to the transit stop, and the transit stop facility. The inputs required to evaluate these measures include the transportation network for walkshed analysis surrounding transit stops and stations. Based on the cross section for the proposed road segment, the Transit LOS cannot be determined for the purpose of this assessment due to site specific details. However, based on the transit operating schedule and auto-oriented street cross section that require buses to operate in mixed traffic, it can be assumed that the street would provide a low LOS for transit.

Truck LOS

The Truck LOS for road segments are evaluated based on the street width and curb lane width to determine the ability for trucks to navigate corners and operate safely within travel lanes. Based on the proposed cross section for the six-lane road segment, the street width along the curb lane will be wide enough to facilitate truck movement. As a result, the segment provides Truck LOS A.

Vehicle LOS

Vehicle LOS along road segments are measured using travel speeds and times. The benefit of this measure is that it can be easily interpreted by the public and that travel speeds are directly related to V/C ratios. Vehicle LOS also considers full day traffic volume in addition to peak volume to avoid over-building the road at the expense of other road users such as cyclists and transit. Additionally, the guidelines indicate that a low LOS should not trigger road widenings given the opportunity to increase the overall people capacity on the street including for pedestrians, cyclists, and transit.

A number of roads were planned for expansion to attempt to improve the vehicle LOS and relieve traffic congestion. Based on induced demand, the expanded roads will eventually become congested again, and would likely have a low LOS, even after widening. This may be due to existing passenger vehicle trips rerouting from other less efficient but previously less congested routes, often lower-order roadways. As such, network-wide effects of road widenings should be examined and monitored.

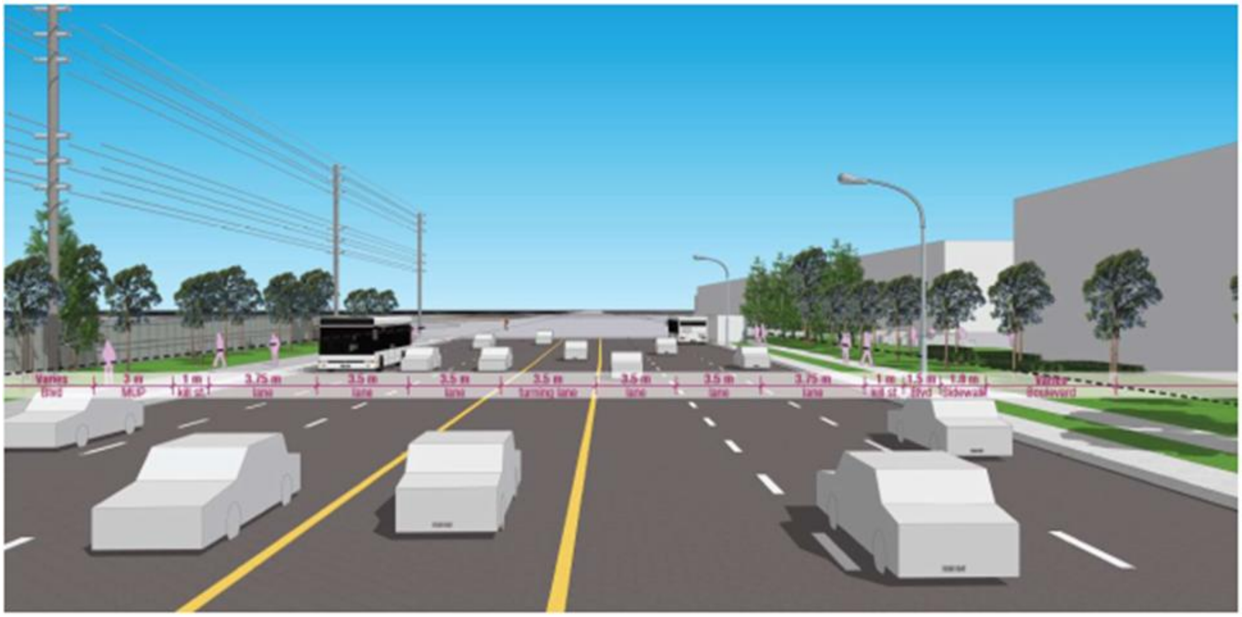
The Brampton MMLOS guidelines in the CSG also have supplemental performance measures that should also be considered when evaluating corridors. The measures include: person-moving capacity, VKT per capita reduction, and connectivity. These measures consider future demand and the impact of land uses surrounding the corridor which also impact connectivity of the network. The evaluation of these measures will indicate whether there is a need to encourage alternative modes such as walking, cycling, and transit and how different land use scenarios may affect demand on the corridor. As a result, these additional measures will have to be evaluated on a site-specific basis for intersections and road segments.

Although the overall LOS cannot be determined for a typical cross section concept based on the data available, the LOS provided along a segment prioritizes car and truck LOS at the expense of transit, cycling and pedestrian LOS. However, over time Vehicle LOS is anticipated to decrease due to widening not effectively relieving congestion. In order to mitigate the decrease in Vehicle LOS within the network, the City of Brampton should consider improving pedestrian, cycling, and transit facilities, given that the lack of dedicated facilities make them vulnerable road users. By improving the LOS for these modes within the network, the overall people capacity of the system and road safety will increase.

4.2.3 Lane Reduction

There are cases where reducing the number of lanes planned for a road is appropriate and can help to alleviate pressure on the ROW, and increase the overall people capacity of the street. According to Schedule 8: City Right-of-Way Widths, most roads that are subject to widening in the Brampton TMP and Interim Road Widening Strategy are identified to have a ROW width of 36m. Historically six-lane roads provide low LOS for walking, cycling, and transit as the majority of space is reserved for motor vehicles. Typically, 21.5m of pavement space is required for six vehicle lanes (26.5m with a centre median), leaving only 9.0m for boulevard features (4.5m per side). Based on the CDSG, the recommended minimum width for sidewalks is 2.1m (per side) and 5.5m (per side) for the furnishing and planting zone, so the amount of space to accommodate utilities, sidewalks, cycling lanes and transit facilities would be limited (See **Figure 4**). However, limiting the road to four-lanes, limits the width of vehicle lanes to 14.0 m, which leaves 22.0 m of width that can be used for street furniture, cycling lanes and wider sidewalks (See **Figure 5**).

Figure 4: Six-lane Wide Road with Centre Median



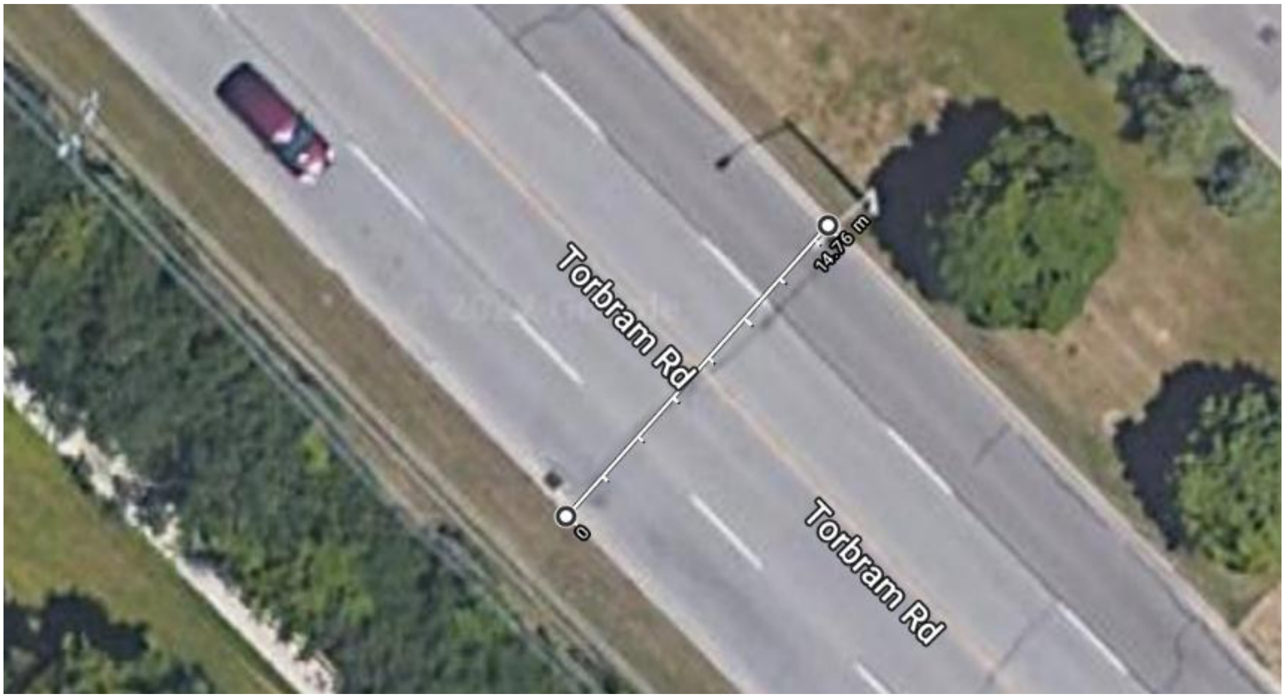
Source: City of Brampton TMP and Interim Road Widening Strategy

Figure 5: Complete Street Cross Section for a Four Lane Road

Source: City of Brampton Complete Street Design Guide

Undertaking these road widening projects would be very costly due to the amount of construction, infrastructure and servicing relocation, and expropriations that would be involved. Aerial and street view imagery of 4-lane roads that are subject to widening, show that they only have a width of approximately 14.8m with no cycling lanes, meaning that the City would have to double the size of the existing road segments (See **Figure 6**). Although road widenings may have been used to mitigate congestion in the past, the large investment that the City will be making will only result in them becoming congested again in the future due to induced demand. However, congestion impacts can be mitigated if future road widening projects are planned to accommodate other modes of transportation such as transit, cycling, and walking and aim to increase mode share and overall capacity.

Figure 6: Aerial Image of a Four Lane Road



Source: Google Maps, 2022

The Commercial Connector street cross-section in the CSG would be able to eliminate existing and future pressures on the ROW. The overall width of a Commercial Connector is 36m which aligns with the Official Plan, but it better utilizes the ROW width to accommodate all modes. Similar to the auto oriented 6-lane configuration, the Commercial Connector utilizes 6-lanes, however, it utilizes less pavement space while providing LOS for transit and trucks along the curb lane. The space that is saved is used towards a 4.0m multi-use path within the boulevard, which encourages cycling and walking[2]. Given that the road is subject to a 36m width, the Commercial Connector provides an alternative design that facilitates other modes of transportation, which will reduce the potential for congestion caused by induced demand in the future.

[2] It should be noted that future transportation modeling along street segments may indicate the need for fewer lanes since other modes can be utilized through the corridor.

4.3 Recommendations

While road widenings have traditionally been used to alleviate vehicle congestion along corridors during peak periods, they are not aligned with the BMP Principles and the Brampton 2040 Vision. They also result in a number of trade-offs, including:

- Environmental Sustainability. Road widenings inherently encourage auto-dependence and therefore increase GHG emissions;
- Congestion: Due to induced demand, road widenings do not effectively reduce congestion;
- Transportation Equity: Road widening projects primarily benefit individuals who are able to obtain a driver's license and can afford a vehicle. This focus on vehicles can limit the number and quality of viable, safe, and comfortable options for lower income individuals who rely on transit, and children and seniors who may not be able to drive; and
- Cycling and Walking: These modes are compromised due to the lack of facilities and service provided along six-lane corridors.

If the City decides to move forward with all of the planned road widening projects, it will be challenging to meet the environmental and social sustainability and equity principles of the BMP.

In order to meet the principles of the BMP, the City of Brampton must prioritize the movement of people rather than just vehicles. The City can utilize the complete streets approach in the CSG to ensure that all residents and visitors can safely travel where they want, how they want. This may include viewing road widenings from a transportation network perspective and reallocating space on existing roads for active transportation facilities such as cycling lanes and wider sidewalks. In the case where roads are required to be widened, the City should ensure that it provides an acceptable LOS for transit, cycling, and walking to offer multi-modal transportation options, increase people capacity, and reduce GHG emissions.

5 Alternative Network Operational Strategies

When roadway width is limited and travel demand continues to grow, there are alternatives that can be considered by Brampton. The following section outlines creative operational alternatives that could be considered to advance transportation goals and limit roadway widening, while moving people and goods. The alternative strategies are outlined along with strengths and weaknesses of each approach, when they are best applied, and alignment with the BMP principles.

5.1 Reversible Lanes

Reversible lanes are typically located in the middle of a roadway that switch the direction of flow depending on the time of day. They are generally implemented along corridors that predominantly accommodate commuter traffic. Reversible lanes are typically denoted by overhead signage with dynamic green and red lane indicators, or moveable gates and barriers (**Figure 7**).

Figure 7: Reversible Lanes

Source: Salt Lake Tribune

Strengths:

Reversible lanes eliminate the need for expensive and disruptive road expansion projects to accommodate increased vehicle demand. The lanes can expand capacity where and when it is needed most by allowing the road space to be used more efficiently for AM and PM peaks in opposite directions.

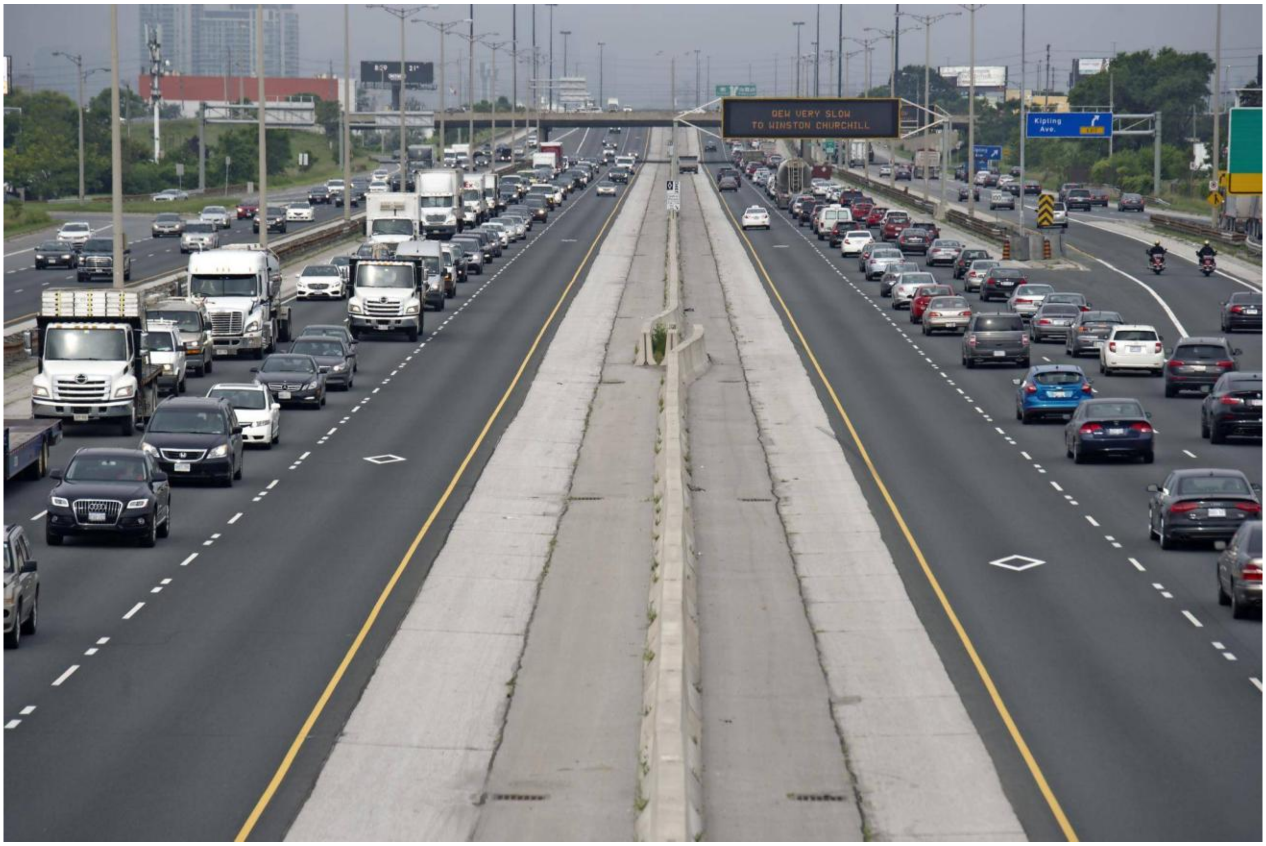
Weaknesses:

Reversible lanes do not consider road users other than motor vehicles and are focused on traditional performance measures of volume and capacity. These lanes do require further study to determine the optimal operation hours and what time and when the lane direction will switch. Since these lanes are not common in Ontario, there is often confusion for road users who are unfamiliar with the concept. There have been frequent public requests to remove the reversible lanes in the City of Toronto due to the difficulty motorists experience navigating the road and safety. The rate of collisions is 30.9% higher when a road has reversible lanes (Manuel, A, de Barros, A, and Tay, R, 2020). There are budget considerations as well, including additional overhead signage, new lane markings along with increased education and enforcement due to the confusion motorist's experience.

5.2 High Occupancy Vehicle (HOV) Lanes

An HOV lane is a travel lane that is restricted to private vehicles with a minimum of two or three occupants, transit vehicles and taxis. The purpose of the lane is to encourage road users to adopt a more efficient mode of transportation other than the single-occupancy vehicle and ultimately to decrease the number of motor vehicles on major roadways. HOV lanes are typically located on the median lane of major highways and also the curb lane of major roads with frequent transit service. Adding HOV lanes to a major roadway can be achieved without road widening, however many HOV projects are road widening to accommodate the same number of regular lanes and add in an HOV lane (**Figure 8**).

Figure 8: HOV Lanes



Source: Globe and Mail

Strengths:

HOV lanes promote a more efficient use of space by increasing the number of people moving along a road, while decreasing the number of vehicles. They can provide a benefit (in the form of faster travel) to people who choose to carpool or take transit by restricting the number of vehicles traveling in the lane. A key factor in maximizing the benefits of HOV lanes is having a network of HOV lanes. A network can maximize the benefits to the individual with further time savings and encourage carpooling to make the HOV lanes even more efficient.

Weaknesses:

Due to the number of passenger restrictions on who can use the lanes, there is a need for increased enforcement to ensure they are being used appropriately. That is also a financial consideration, in addition to the enforcement, there is a need for lane markings and increased signage. If the HOV lane is not part of an integrated HOV network, the time savings for individuals will be moderate and may not encourage people to carpool. This would limit the potential benefit in reducing the number of single occupancy vehicles on the road in Brampton.

5.3 Transit Priority Measures

Transit priority measures include an array of tactics that prioritize transit to reduce congestion delays and improve reliability and on-time performance of buses along a roadway. Transit priority measures have been used along Brampton's Züm network (See **Figure 9)**. Transit priority measures include: queue jump lanes, signage and signal priority.

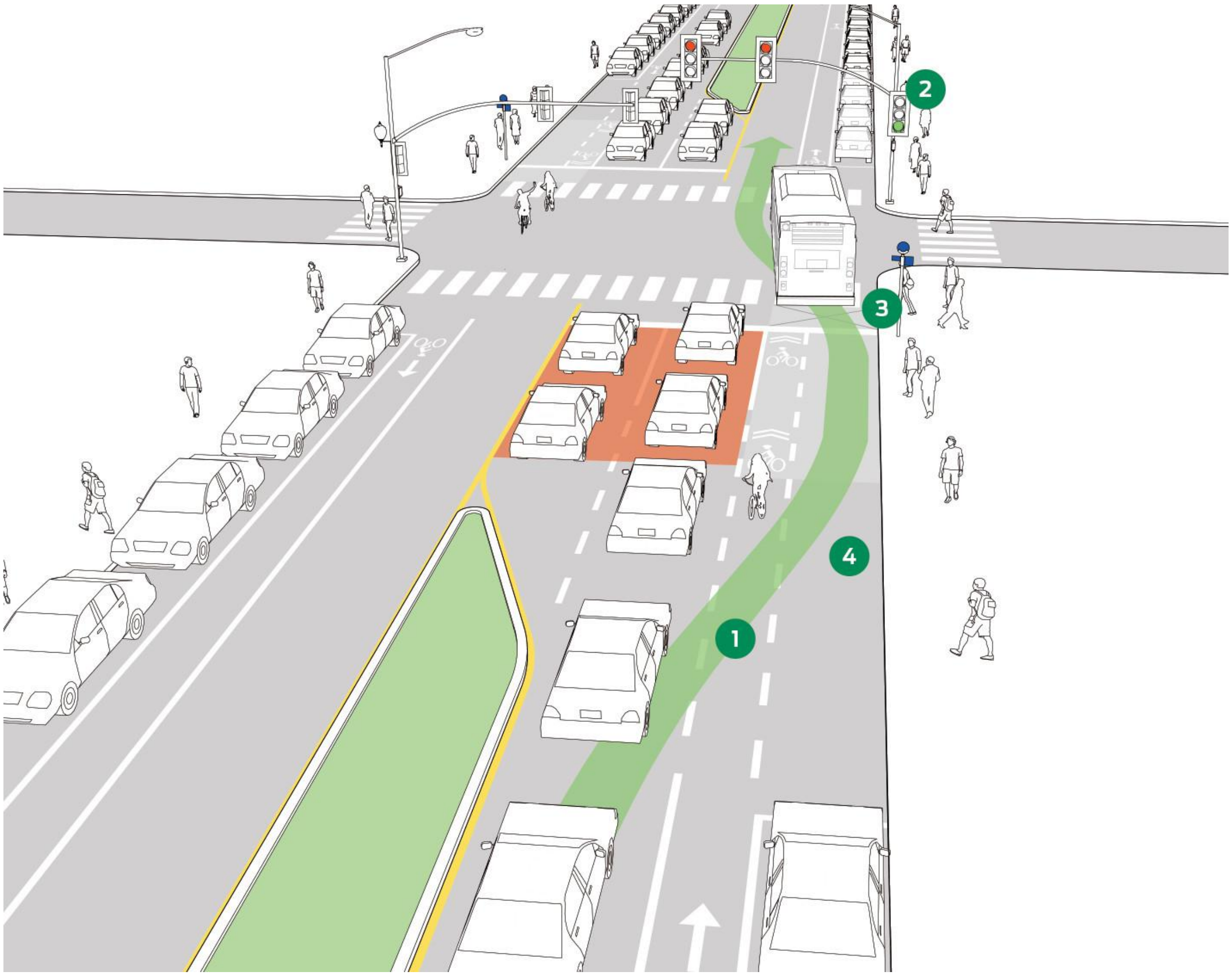
Figure 9: Züm Bus on Transit Corridor

Source: The Toronto Star

Queue Jump Lanes:

Queue jump lanes are short dedicated transit facilities with either active signal priority or a leading bus interval that allows buses to enter traffic flow in a priority position. There are two types of queue jump lanes. The first is used for near side stop stations, which allow passengers to board during the red light interval. Buses are then given priority to bypass vehicle traffic. In some cases, right-turning vehicles are permitted to use the lane for a short duration. The second type, commonly referred to as a queue bypass lanes, is used for far side stops. A dedicated bus lane is provided at both the near and far side of the intersection to mitigate their impact towards traffic flow through the intersection by reducing conflicts with motor vehicles (**Figure 10**).

Figure 10: Queue Jump Lane



Source: NACTO

Strengths:

Queue jump lanes provide buses with priority which significantly improves on-time performance by routing vehicles through congested intersections ahead of traffic. The lanes can result in time savings for transit vehicles and passengers and improve reliability, which can make transit a more appealing alternative to driving.

Weaknesses:

They are not as effective at reducing delays if there are right-turning vehicles and potential conflicts with pedestrians. Financial considerations include lane markings and signage, transit signals, and right-turns that would need to be accommodated separately from transit. Queue jump lanes can be accommodated within the existing road but depending on the specific road configuration, may require more significant improvements, design and construction.

Signage:

Signage can be used to communicate information such as restrictions, directions and speed limits to road users. Signage is typically paired with signal priority measures to communicate with road users that a lane or intersection may be reserved for transit vehicles (**Figure 11**).

Figure 11: Bus Priority Lane Signage

Source: City of Toronto

Strengths:

Signage helps communicate to road users that certain lanes are restricted for transit to ensure they are not blocked.

Weaknesses:

One challenge is that drivers may not see signs if the sign or text is too small, and signage with too much information may be confusing to road users. When there are a lot of signs on the street to communicate restrictions and laws such as transit priority, speed and parking, drivers may not be able to focus on the relevant signage. It relies on the individual driver to see the signage while driving, and then behave accordingly. Additional enforcement may be required to ensure drivers follow the restrictions.

Signal Priority:

Transit signal priority (TSP) is a tool that is used to modify the timing or phasing of traffic signals for incoming transit vehicles. TSP works by either holding a green light for approaching transit vehicles or shortening the red light cycle for transit vehicles that are stopped at an intersection to provide faster or more reliable service. Signal priority may operate under a set of rules, which is determined by the transit agency. TSP can operate either conditionally for transit vehicles that are behind schedule or unconditionally for all arriving transit. This transit priority measure works best along routes which experience delays or unpredictable travel times, which may be due to the distance between signals/long signal timing. It is most effective at intersections with no stop, or a far-side stop since it allows transit vehicles to clear the intersection without the need to wait though the signal cycle (**Figure 12**).

Figure 12: Transit Signal Priority

Source: City of Toronto

Strengths:

TSP can significantly reduce transit delay, especially along corridors with long signal cycles and distances between signals making transit more attractive. They are most effective at intersections that commonly experience long queues that delay transit vehicles.

Weaknesses:

TSP can increase delays for cross street traffic if there is high traffic volume along the main corridor. They require a high degree of coordination between transit agencies and the party that is responsible for signals.

5.4 Rapid Transit

Bus Rapid Transit (BRT) refers to a premium level of transit that is faster, more frequent and comfortable than conventional transit. Similarly, Light Rail Transit (LRT), such as the future HLRT and Queen Street BRT, operate in a dedicated right-of-way, separated from traffic, but the vehicles are electrically powered trains and operate on a track. They are both designed to deliver rapid, reliable, and safe transportation services. Rapid transit consists of a number of features that separate it from conventional bus service. These include:

- Dedicated operation in a road right-of-way or separate busway;
- Two-way direct service connecting key destinations;
- More frequent transit service than most conventional bus routes;

- Emphasis on passenger amenities at stops (including shelters, passenger information and in certain instances, off-board fare collection;
- Transit Signal Priority intersection treatments;
- Stops spaced further apart than local bus routes to improve travel time;
- Use of accessible vehicles and stops; and
- Use of large accessible vehicles with higher level of comfort and branding than conventional bus service.

The combination of these features allows rapid transit to operate reliably and more conveniently by reducing delays while traveling between stations that are caused by traffic and intersections. Rapid transit routes are most effective for improving bus routes with high passenger volumes that provide service on a congested corridor. These measures are recommended to be implemented for a BRT corridor that is planned to be along Queen Street (**Figure 13**), and for the future Hurontario (Hazel McCallion) LRT line.

Figure 13: Brampton Queen Street BRT Corridor

Source: City of Brampton

Strengths:

Rapid transit operates on their own dedicated right-of-way, providing reliable and faster service compared to traditional bus service. Rapid transit stop / stations are also designed to increase passenger comfort by providing shelters, passenger amenities and information. Certain rapid transit systems use platform-level boarding and off-board fare collection, which can further reduce delays and improve accessibility. This can all improve the transit rider experience, making transit more appealing and resulting in a mode shift.

Weaknesses:

BRT cost more to construct and operate compared to conventional bus service, and LRT significantly more costly than BRT. The infrastructure may require road widening to accommodate the dedicated lane within the right-of-way. With stops further apart to help provide fast service, it may discourage some riders from using the system and increase walking/rolling distance for passengers that live between rapid transit stops. Many rapid transit systems have an overlaid local bus route to provide access to origins or destinations.

5.5 Complete Streets

Complete streets refer to roadways that are planned and designed to balance the needs of all road users. This is a holistic planning approach that recognizes that each street is unique and there is no one solution that would fit on all streets. A complete street lens can be applied to every street at all phases from design to maintenance. Complete streets prioritize transit and active transportation as opposed to the traditional approach which is focused on motor vehicle capacity. This approach aims to create an attractive, vibrant streetscape that includes street furniture, greenery and trees, and pedestrian spaces (**Figure 14**). By planning the streetscape to prioritize sustainable transportation modes, it allows individuals, regardless of age, ability or mode of travel to move around safely within their community. Complete streets are also versatile as they can also be designed to accommodate larger vehicles, such as tractor trailers, in industrial areas of the City.

Strengths:

Complete streets can provide pedestrians, cyclists and transit users with dedicated facilities, allowing them to travel safely along the street. They promote health as the human-scale design treatments, street furniture and greenspace encourage individuals to walk or bike to their destinations. Designing complete streets would help move more people through a corridor within the same constrained right-of-way by accommodating all modes of transportation.

Weaknesses:

There are concerns over accessibility and emergency service vehicles that require curbside access, and accessibility needs to be considered as part of the design. A complete street is designed to consider the needs of all modes in the roadway design, but there needs to be discussions on priorities for different streets as it is often not possible to fit facilitates for every mode on all roads. Complete streets may require additional coordination in the transportation planning and design process.

Figure 14: Mixed Use Neighbourhood Street Complete Street

Source: Brampton CSG

5.6 Framework for Assessing Strategies

To evaluate the alternative strategies, each strategy was assessed for the appropriate implementation conditions, potential additional network capacity, cost, and then in a separate assessment, alignment with the BMP principles.

Implementation Considerations

The ideal scenario for utilizing each of these strategies is unique and the evaluation looks at the characteristics of a road to identify the appropriate conditions for implementation. Considerations include congestion along the corridor, network plans and policies, neighbourhood, and purpose of road.

Potential Capacity

Each strategy has been assessed for its potential to provide capacity into the network from low to high. For the purpose of this evaluation, capacity has been defined as person-capacity and the potential to move people through a corridor or intersection, including people cycling, walking, taking transit, or driving.

Cost

The costs for the alternative strategies vary significantly from low to high. As the cost would vary based on project scope and scale, each strategy uses low, medium, and high to provide a high-level picture of the general implementation cost.

Alignment with BMP Principles

Each strategy has been evaluated for its overall fit and alignment with each BMP principle using the BMP Principles scorecard as a guide.

5.7 Assessment of Alternatives

The alternative strategies have been assessed as shown in **Figure 15** and **Figure 16**.

Table 2 is an assessment of the alternative approaches and when they should be implemented, the potential for increasing person-capacity, and the cost of implementation. The assessment was based on the City of Brampton Transportation Master Plan Principles Scorecard which can be found here.

Table 2: Creative Alternatives Implementation Assessment

Alternative	Implementation Considerations	Potential People-Capacity	Cost
Reversible Lanes	• Roads where there is predictable commuter traffic • Resources available for increased enforcement	Medium	High
HOV Lanes	• Major roads or highways • Connected to a network of HOV lanes • Resources available for increased enforcement • Corridors with high transit ridership	Medium	Low
Transit Priority Measures	• Arterial roads • Congested roads that delay transit vehicles • Corridors with medium-high transit passenger volumes and demand • Corridors with frequent transit service • Identified in the network plan	Medium	Medium - High
Rapid Transit	• Arterial roads • Corridors with high passenger volumes and demand • Corridors with frequent transit service • Identified in the network plan	High	High
Complete Streets	• Can be applied to any road classification • Complete street treatment will be unique to the street	Medium/High	Low - Medium

Table 3 shows the alignment with the BMP principles for each alternative strategy.

Table 3: Creative Strategy Alignment with BMP Principles

Alternative	Travel Options	Multi-Modal Equity	Land Use Integration	Health and Safety	Environmental Sustainability	Leverage Technology
Reversible Lanes	✗	✗	✗	✗	✗	☑
HOV Lanes	○	✗	✗	✗	○	✗
Transit Priority Measures	○	○	○	○	○	☑
Rapid Transit	○	○	☑	○	☑	☑
Complete Streets	☑	☑	☑	☑	☑	☑

☑: Fully advances this principle
○: Partially advances principle
✗: Does not advance principle

5.8 Recommendations

There are opportunities for Brampton to recommend a creative approach to address increasing travel demand within a constrained ROW. Specific circumstances and projects will need to be evaluated to ensure it is the appropriate measure for the street, and the project's alignment with the BMP principles should be considered.

Transit Priority Measures (Züm network) and rapid transit meet many of the BMP principles and can be applied on streets where there is frequent transit service with high ridership, operating on congested roads. This will help attract ridership to transit and shift mode share towards transit. Complete streets are the most aligned with the BMP principles. Complete streets can be applied to all streets as they are not a one size fits all approach, and can be tailored to the specific street typology and neighbourhood. They also help increase road safety and the overall people capacity of the transportation network and allow Brampton residents to travel by all modes, shifting mode share towards cycling, pedestrians, and transit.

Many of the other strategies have limited circumstances where they would be effective in increasing people-capacity, and they do not meet the BMP principles. Strategies such as reversible lanes should not be considered by Brampton as they are expensive, do not advance many of the BMP principles, and there are many challenges associated with the tool such as safety concerns. HOV lanes should only be considered when they contribute to a network of HOV lanes or have the potential to convert to a Züm BRT corridor in the future.

6 Summary of Recommendations and Next Steps

The alternative policy-driven approach for transportation network planning will help Brampton meet City goals and targets and advance the policies in the Brampton Plan, the Brampton 2040 Vision, and align with the BMP principles. This represents a major shift in road network planning for Brampton, from the traditional approach based on road capacity and congestion, to a policy-driven approach where decisions will be made to prioritize advancing the City's goals and policy objectives. Demand modeling will still be valuable to understand impacts of road design alternatives, but would not be the sole criteria on which decisions are made. Shifting to this approach will require Brampton to adopt tools such as the MMLOS guidelines in the CSG to evaluate a road segment or intersection performance for all modes. The policy-driven approach and the MMLOS guidelines will help Brampton to provide more viable multi-modal transportation options, shifting mode share by providing safe and comfortable alternatives such as a network of protected bike lanes. Shifting the mode share will help to reduce the dependence on motor vehicles, reducing VKT, vehicle GHG emissions, and ultimately improving environmental sustainability.

The BMP should continue the review of road widening projects and aim to have all future road design projects align with the BMP principles, along with Brampton's goals, and overall city-building objectives. Road widenings do not help the City to advance the BMP principles and City policies, they are costly capital projects, have significant property impacts, and do not ultimately resolve traffic congestion due to induced demand. Instead of moving forward with the planned road widenings from four to six-lanes, the City should aim to improve the LOS of other modes of transportation to reduce congestion impacts, increase overall people-capacity in the network, and reduce auto-dependency. Brampton needs to shift focus to evaluate a street by the number of people using all modes of transportation, rather than only the number of vehicles. As an alternative to road widening, the City should utilize the CSG to design complete streets as it reduces pressure on the ROW and better utilizes the street to accommodate all modes.

Creative operational strategies such as HOV lanes can be an alternative to road widening under the right conditions, however few options help to advance the BMP principles. Transit improvements and infrastructure such as expanding the Züm bus system or rapid transit aligns with many of the BMP principles and can be applied to key corridors where there is demand potential. Complete streets are cost-effective, help advance all of the BMP principles, and the approach can be applied to all streets in Brampton. In order to meet the principles of the BMP, the City of Brampton must prioritize the movement of people by all modes of transportation. The City should utilize the complete streets approach in the CSG to ensure that all residents and visitors can travel safely by walking, cycling, transit, and motor vehicles, prioritized in that order. Complete streets will help reduce the need for road widenings by efficiently using the road space for pedestrians, cyclists, transit, and vehicles, prioritized in that order, and move a higher volume of people.

7 References

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