Appendix B – IBC, Grade Crossing Analysis and Design Brief

The Study has two parts: the Initial Business Case (IBC) and furthering the concept design of the proposed service. The IBC portion of the Study was conducted in alignment with the Metrolinx Business Case Manual Volume 2 to facilitate advancing the proposed Cambridge to Union passenger rail service via the Fergus Subdivision and the City of Guelph (Guelph). Accordingly, the IBC focused on the following: (A) Case for Change; (B) Investment Options; (C) Strategic Case; (D) Economic Case; (E) Financial Feasibility; and (F) Deliverability & Operational Case. The concept design work included: (G) Grade Crossing Analysis; and (H) Design Brief. The following is a summary of the findings and the Cambridge Passenger Rail IBC Report is attached after the summary.

A. Case for Change

In the coming decades, significant population growth is expected to occur within Ontario and the Region's major cities, with Ontario growing to an estimated 21.7 million and the Region growing to an estimate 923,000 by 2051 [1, 2]. Consequently, it is reasonable to assume that road and highway congestion will increase without investment into Ontario's transit network as it currently most convenient to travel by personal automobile.

As population and trips across the Region of Waterloo (Region) increase, congestion along these roads and highways will further contribute to delays, increase of travel time, and reduction of overall reliability. The transit travel time between the Guelph and Cambridge, using the existing bus service, is approximately 56 minutes. The only alternative mode to travel between Cambridge and Guelph is by personal automobile, with an approximate trip time of 25 to 50 minutes. However, this alternative contributes to growing congestion and carbon emissions within the Region. The Cambridge Passenger Rail project would offer fast and reliable service, provide opportunities to enhance local and regional connectivity, support growing populations through considered transit-oriented development, and increase economic potential of Cambridge, Guelph, and the Region.

B. Investment Options

This Study assessed 5 investment options with differing levels of associated railroad infrastructure requirements and concluded that all options outperformed the business-as-usual (BAU) scenario where no new rail service is added. The investment options rely on proposed two-way, all-day, bidirectional service with that will operate between a future Pinebush Station (in Cambridge) and Guelph Central Station using four-car Electric Multiple Units (EBMU). The investment options are summarized in Table 1.

Table 1 Summary of Cambridge Passenger Service Investment Options

Option	Track Type	Track Enhancements	Train Quantity
Business as usual	No Cambridge Passenger Rail built		
Option 1A	Single Track	Class 3	1 Running, 1 Spare
Option 1B	Single Track	Class 4	1 Running, 1 Spare
Option 2A	Single Track with a Siding	Class 3	2 Running, 1 Spare
Option 2B	Single Track with a Siding	Class 4	2 Running, 1 Spare

The double track configuration identified in the Cambridge to Union GO Rail Feasibility Study (the 2021 Study) was not carried through the IBC analysis. The reason is that the single-track options were determined to be optimal for implementation with lower capital costs while matching the expected level of service at Guelph Central Station in the short/medium term. The double tracked corridor could be revisited in a future phase of work as a long-term solution.

Table 2 shows the estimated ridership for the proposed service.

Table 2 Estimated Annualized Ridership by Investment Option

Option	2041 Annual Ridership		
	Low	Medium	High
Option 1A	540,751	540,751	540,751
Option 1B	582,975	582,975	582,975
Option 2A	611,866	611,866	611,866
Option 2B	621,137	621,137	621,137

C. Strategic Case

The case for the implementation of this potential passenger rail service is built around 5 strategic outcomes:

Table 3 Strategic Case Summary

Strategic Outcomes	Strategic Objectives
Transportation	• Support Future Regional Transportation Network • Improve Access to GO Transit • Minimize Bus Traffic in Key Transit Corridors • Leverage transit investments on the Kitchener GO Line and the Region's ION Network
Housing	• Support the Planned Intensification of Key Corridors

	and Enable Development of Transit-Oriented Communities
Quality of Life	• Connect Commuters to Jobs • Catalyze Urban Land Development • Support Innovation and Prosperity
Economic & Regional Development	• Connect Commuters to Jobs • Catalyze Urban Land Development • Support Innovation and Prosperity
Sustainable Development	• Minimize GHG emissions • Support the TransformWR Climate Strategy and the UN's Sustainable Development Goals endorsed by the Region

The proposed service will improve access to GO transit as estimated travel times trips between Cambridge to Guelph are 14-17 minutes and between Cambridge to Union are 87 minutes. These are both faster than the current fastest alternative of using private vehicles.

The proposed service will support the Region's housing goals as higher order transit supports higher density development, and the opposite is true as well. The Study leverages the planned intensification outlined in the Hespeler Corridor Secondary Plan [3]. Moreover, the Study outlines a key opportunity to plan a Transit-Oriented Community around the proposed Pinebush Station that would allow for a diverse range of housing options to accommodate the Region's demographics with a focus on higher density and mixed-use development for potential employment opportunities.

The Strategic Case finds all investment options outperform the Business-as-Usual scenario. Consequently, the Cambridge Passenger Rail project is strongly aligned with the existing plans and aspirations of the City of Cambridge, City of Guelph, the Region, and the Province of Ontario.

D. Economic Case

The Economic Case compares costs and benefits of the project (incremental to the BAU option) for all users, and to society. The analysis accounts for changes in value and not price. Consequently, it does not account for general inflation. The analysis also uses a social discount rate to account for the fact that a benefit or cost incurred tomorrow holds less weight in our expectations and calculus of value than the same benefit or cost incurred today.

The economic costs, over the 60-year life cycle, include capital costs and operating and maintenance costs and range between $431 million and $623 million in 2023 dollars.

Property costs are excluded in the Economic Case under the assumption that land does not change in value as part of a government project despite its price changing with inflation. The economic benefits consist of the monetization of the transportation user impacts, external impacts, and wider economic impacts over a 60-year life cycle. The total economics benefits of implementing the proposed service range between $606 million to $759 million in 2023 dollars. It is important to note that planning a mixed-used transit-oriented community could substantially add to the economic benefits of the project; however, further work is needed to determine the impact. All amounts are in net present value for 2023.

The benefit-cost ratios for all investment options range between 1.2-1.5 indicating that the costs of all investment options are offset by their benefits of implementation and operation. Consequently, all investment options are superior to the BAU or no passenger rail service scenario. Table 4 is a summary of the Economic Case.

Table 4 Economic Case Summary (all values in the first two rows are in net-present value $M, $2023 over a 60-year lifecycle)

Item	Option 1A	Option 1B	Option 2A	Option 2B
Economic Benefits	$606	$665	$742	$759
Economic Costs	$431	$455	$613	$623
Benefit-Cost Ratio	1.2-1.5			

E. Financial Case

The Financial Case compares the capital and operating requirements to deliver and operate the project (incremental to the BAU option), while considering the revenues (fares) it would generate over 60 years. The Financial Case accounts for inflation or change in price over time in addition to change in value. Moreover, a financial discount rate is applied to account for transit-specific increases in price that tend to exceed inflation in accordance with Metrolinx' best practice.

The high-level financial capital cost estimation for the implementation of this service ranges between $396 million and $505 million in 2023 dollars. The financial operating and maintenance costs range between $149 million and $273 million in 2023 dollars. The fare revenue ranges between $106 million and $132 million, in 2023 dollars, from net new riders to the service. All amounts are in net present value for 2023.

The Financial Case finds all investment options have a revenue/cost ratio of below 1.0, indicating all options would require some subsidy to operate. However, an operating subsidy is reasonable for transit projects. The subsidy could be optimized with some attention to fares and operating plans which are beyond the scope of concept design completed for this study. Further work, in the form of a transit-oriented community study,

may uncover avenues to significantly offset capital costs through third parties by purchasing land around the proposed station and developing it for commercial and residential uses integrated with transit.

Table 5 provides a summary of the Financial Case.

Table 5 Financial Case Summary (all values are in net-present value $M, $2023 over a 60-year lifecycle)

Item	Option 1A	Option 1B	Option 2A	Option 2B
Capital Costs	396	407	494	505
Operation and Maintenance Costs	149	162	273	273
Fare Revenue	106	117	129	132

The 2021 Study suggested a joint partnership between the proponent municipalities and Metrolinx as likely the most efficient. This recommendation lines up with the recently legislated Bill 131 whereby the Province enables a formal mechanism for municipalities to apply a charge to developments surrounding the proposed stations/transit which would be used to build the station and station infrastructure. Other possible sources of funding are the Canada Infrastructure Bank and the, recently announced, Ontario Infrastructure Bank. A more detailed economic analysis in future business casing efforts will identify the financial benefits to the Federal and Provincial governments.

F. Deliverability & Operations Case

The Deliverability and Operations Case finds the project will require a new station in Cambridge, upgrades to Guelph's Central GO station, the installation of a new track and creation of a new storage and light-maintenance facility, among other initiatives. It finds these requirements are feasible to implement. The EBMU technology continues to appear as the best balance between performance, cost, and future-proofing. However, other rolling stock options are not eliminated at this stage of the project as further work is needed. The roles and responsibilities of each impacted municipality in the planning, delivery and operation of this service are subject to further discussion, but it is the opinion of Region staff that Metrolinx should assume ownership of the delivery of the project, given the inter-regional and heavy-rail nature of the concept. Steps for the delivery of this project are depicted in the Project Schedule.

G. Grade Crossing Analysis

This Study outlines the existing at-grade crossings, the necessary upgrades or modifications needed to implement the passenger rail service which informs a more detailed estimation of capital costs. Some crossings are subject to cost-prohibitive or non-practical construction constraints such as adjacent hydro corridors, nearby private

driveways, underground utilities, or neighbouring property impacts. The approach is based on a predominantly single-track railway assumption. Double tracking may at certain locations introduce new considerations. It is recommended that all crossings are upgraded with improved warnings and signage with some cases of active restraint devices (e.g., gates). The Study recommends a grade separation for the rail crossing at Wellington Road 124 to mitigate risks related to the highly skewed intersection and arterial traffic. However further studies, like environmental assessments, of the crossings will be required.

H. Conceptual Design Brief

The Design Brief contains highly conceptual, feasibility level, key design components of the track layout, Guelph Central GO Station and the proposed Pinebush Station for the proposed passenger rail service. At Guelph Central Station, the initial phase of the proposed service leverages ongoing investment by using the new side platform and pedestrian connection being constructed along the southern side of the existing rail corridor. The proposed Pinebush Station is planned to be a comprehensive transit hub, incorporating various modes of transportation, including the planned Stage 2 ION, and promoting active travel by connecting with nearby infrastructure and bike lanes. Importantly, there is potential for the station to integrate with future development adjacent to the site, which could enable better urban design outcomes with an integrated multi-modal transport hub and mixed-use development. This could represent a new centre for Cambridge that is walkable, cyclable, and transit-oriented. The design and review work for the track layout is intended to prove a reasonable trip time for rail services linking the two stations to input to the business case. Further work is needed as more information becomes available based on continued engagement with Metrolinx, CN, and other stakeholders.

References

[1] Government of Ontario, "Ontario Population Projections Update: 2022-2046," 2022.

[2] Government of Ontario, "A Place to Grow," 2020.

[3] City of Cambridge, "Hespeler Corridor Secondary Plan (Draft)," 2022.

[4] Region of Waterloo, "Cambridge to Milton Passenger Rail Business Case and Implementation Strategy," 2014.

[5] The Region of Waterloo, "Cambridge to Union GO Rail Feasibility Study," 2021.

Cambridge Passenger Rail

Initial Business Case

July 2024

H372245

List of Acronyms

	Definition
BAU	Business As Usual
BCR	Benefit-Cost Ratio
BRT	Bus Rapid Transit
CN	Canadian National Railway
DMU	Diesel Multiple Unit
EBMU	Electric Battery Multiple Unit
EMU	Electric Multiple Unit
GGH	Greater Golden Horseshoe
GTA	Greater Toronto Area
GTHA	Greater Toronto and Hamilton Area
IBC	Initial Business Case
LRT	Light Rail Transit
MTSA	Major Transit Station Area
NPV	Net Present Value
MTO	The Ministry of Transportation of Ontario
R/C Ratio	Recovery Cost Ratio
PMTSA	Protected Major Transit Station Area
RTP	Regional Transportation Plan
SDG	Sustainable Development Goals
TOC	Transit-Oriented Community
TOD	Transit-Oriented Development
VKT	Vehicle Kilometres Travelled

Executive Summary

In 2023, Hatch Ltd. and Dillon Consulting Limited ('Dillon'), were retained by the Region of Waterloo to prepare an Initial Business Case (IBC) for a new GO service between the City of Cambridge and the City of Guelph, connecting to the Kitchener GO Line (the 'Cambridge Passenger Rail' project). This project was previously referred to as the 'Cambridge to Union Passenger Rail' project. Creation of an IBC is best practice when considering whether or how best to invest in a new transport project. The aim of this IBC is to inform the Region of Waterloo's decision-making regarding the costs and benefits of implementing this new service under a variety of scenarios.

This IBC is structured consistent with the Metrolinx Business Case Guidance, which has become the standard for evaluating transit investments in Ontario and has been voluntarily adopted by other cities in Canada. This IBC follows Metrolinx's practice of preparing IBCs that consist of four core elements: the Strategic, Economic, Financial, and Deliverability and Operations cases.

The Region of Waterloo (the 'Region') is a major population and economic node in southern Ontario. Construction of heavy-rail public transit is a sustainable, scalable, and efficient investment to improve connections, and serve existing travel patterns more efficiently, aligned with regional investment in light-rail and other higher-order transit modes.

The case for change relies on the significant population growth expected in the Region in the coming decades; the crippling congestion this growth would impose if served entirely by automobile trips; and the lack of an alternative, given current plans for transit expansion are not expected to serve travel between Cambridge, Guelph, and Toronto with higher-order service.

The introduction of higher-order service would face some constraints; however, will enable a variety of opportunities. Constraints include limited capacity on the CN Fergus Subdivision and the Guelph Central Station, while opportunities include forthcoming two-way, all-day GO service on the Kitchener GO Line; potential for transit-oriented development at a new Cambridge station (Pinebush Station); and multi-modal service with the Region's Stage 2 ION project.

To form recommendations, the IBC considers a Business-As-Usual (BAU) scenario (in which no new rail service is implemented) and four other rail investment options connecting Cambridge, through the proposed new Pinebush Station in Cambridge, to Guelph Central Station. The four investment options rely on trains that consist of four-car Electric Battery Multiple Units. Options 1A and 1B propose a single-track layout along the corridor that allows for bi-directional service with one trainset operating on the line. Options 2A and 2B similarly offer bi-directional service on a single-track layout but utilize a rail siding that allows for the simultaneous operation of two trainsets. In all four investment options, the Cambridge Passenger Line will connect with the existing Kitchener GO Line service, and potentially to the future Stage 2 ION. The IBC compares the four investment options (Options 1A, 1B, 2A, and 2B) to a Business-as-Usual option in each of the four constituent cases.

Summary of Cambridge Passenger Service Investment Options

Option	Track Type	Class 4 Track Enhancements	Train Quantity
Business As Usual	No Cambridge Passenger Rail built		
Option 1A	Single Track	No	1 Running, 1 Spare
Option 1B	Single Track	Yes	1 Running, 1 Spare
Option 2A	Single Track with a Siding	No	2 Running, 1 Spare
Option 2B	Single Track with a Siding	Yes	2 Running, 1 Spare

The **Strategic Case** finds all investment options outperform the Business-as-Usual scenario; i.e., the Cambridge Passenger Rail project is strongly aligned with the existing plans and aspirations of the City of Cambridge, City of Guelph, the Region, and the Province of Ontario.

The **Economic Case** compares costs and benefits of the project (incremental to the BAU option) for all users, and to society. It finds the Cambridge Passenger Rail project's benefits exceed its costs. The benefit-cost ratios for all investment options ranged between 1.2-1.5. Sensitivity tests were performed on a few model variables (ridership, value of time growth rate, economic discount rate, and operating cost growth rate).

The **Financial Case** compares the capital and operating requirements to deliver and operate the project (incremental to the BAU option), while considering the revenues (fares) it would generate. It finds all investment options have a revenue/cost ratio of below 1.0, indicating all options would require some subsidy to operate; however, the operating subsidy is reasonable and could be optimized with some attention to fares and operating plans which are beyond the scope of concept design completed for this study.

The **Deliverability and Operations Case** analyzes risks and issues related project delivery, service plans, operations and maintenance requirements, and the primary foreseeable technical constraints to implementing the options. It finds the project will require a new station in Cambridge, upgrades to Guelph's Central GO station, the installation of new track and creation of a new storage and light-maintenance facility, among other initiatives. It finds these requirements are feasible to implement.

In summary, the IBC finds this project has a strong planning rationale, a reasonable cost, and benefits that exceed those costs; and can be delivered with reasonable certainty. All four options outperform the BAU of no new passenger-rail service.

As such, the IBC recommends:

- **Metrolinx**, following best practices of business casing and prioritization, adopt and advocate for this project, while including it in the upcoming Regional Transportation Plan update;

- The **Ministry of Transportation of Ontario** direct Metrolinx to include this project in its planning, given the solid business case and clear alignment with the provincial policy and priorities and the agency's plans; and
- The **Province of Ontario** acknowledge the project's potential to help address the ongoing housing crisis by providing opportunity to connect the City of Cambridge with rail and enable housing options aligned with transit, consistent with their focus to deliver housing access and growth in intensifying communities and adjacent to higher order transit.

The IBC proposes the next steps for this project should include:

- Further design and engineering to take the project to a Preliminary Design Business Case. This includes a rail simulation assessment to determine optimal location and specification of track siding(s);
- Refined ridership forecasting to investigate demand response to greater service frequency;
- Further discussion with CN to investigate next steps required to eventually upgrade existing infrastructure to allow the Cambridge Passenger Rail to progress and ensure the project complements existing freight operations and plans;
- Planning for a transit-oriented community at the proposed Cambridge station (Pinebush Station), estimating the economic, financial, and deliverability considerations and benefits possible; and
- Engagement with Metrolinx to ensure that Kitchener GO Line speed improvements are pursued and proceed; and to better establish project planning and delivery responsibilities.

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1. Introduction

In 2023, Hatch Ltd. (Hatch) in partnership with Dillon Consulting Limited (Dillon) was retained by the Region of Waterloo to conduct the Cambridge Passenger Rail Initial Business Case and 10% Conceptual Design. This project was previously referred to as the 'Cambridge to Union Passenger Rail' project. The initial business case (IBC) evaluates the costs and benefits of implementing a new GO service between Cambridge and Guelph (the 'Cambridge Passenger Rail' project), that provides a connection to the Kitchener GO Line (see Figure 1). Various service models and track alignments are evaluated.

The findings from the IBC and Conceptual Design aim to inform the Region of Waterloo's decision-making regarding the costs and benefits of implementing this new service under a variety of scenarios; the preferred service strategies and service plan; and evaluating the financial impact of the proposed investment options. It should be noted that this IBC was conducted in 2023; therefore, reported costs are reflected in $2023.

The proposed Cambridge Passenger Rail project is shown in Figure 1, along with the connecting ION rapid transit service (Stage 1 light rail transit (LRT) and proposed Stage 2) and the existing Kitchener GO Line passenger service.

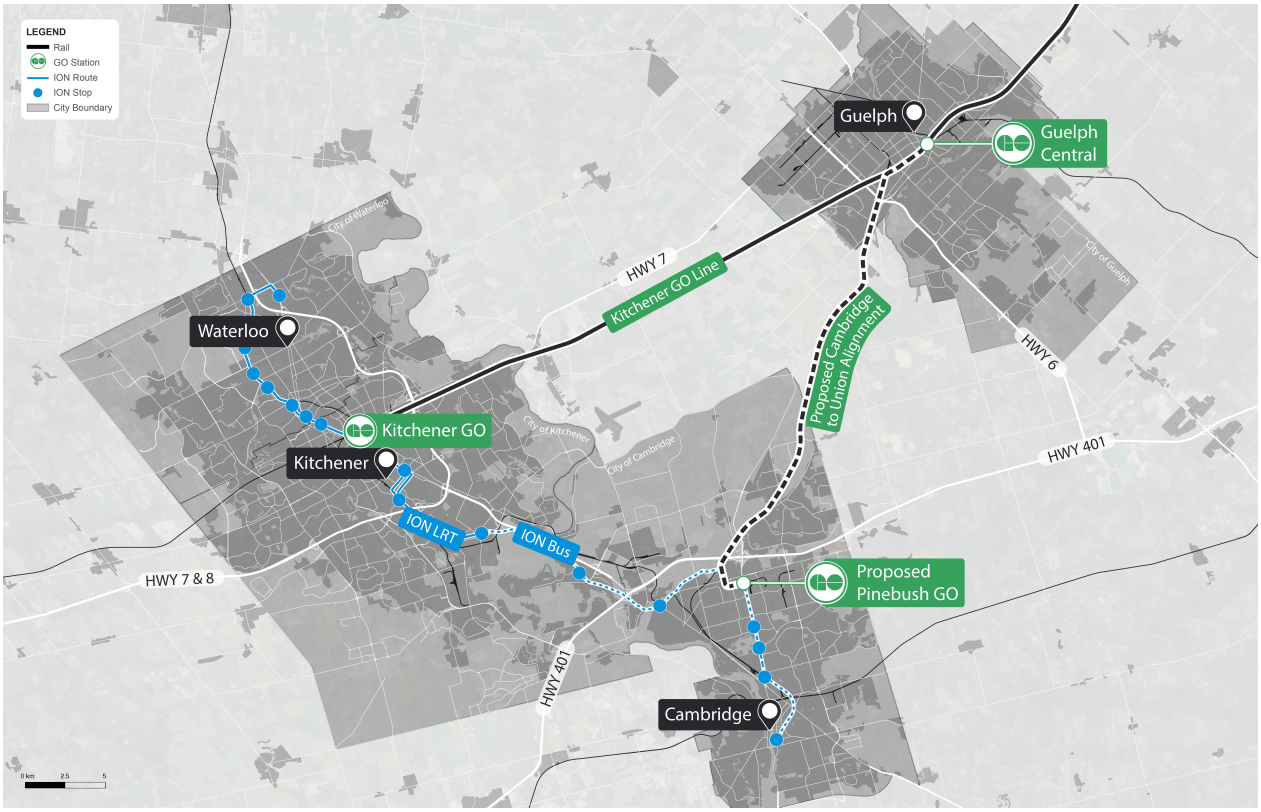

Figure 1: Region of Waterloo transit context plan, highlighting the proposed Cambridge Passenger Line, the existing Kitchener GO Line, and the Stage 1 & 2 ION

1.1 Background

The Region of Waterloo (the 'Region') is one of the largest population and employment centres in Ontario and by 2051 will be home to 923,000 residents and a workforce to support 470,000 jobs.[1] Though the Region is within the commuter shed of the City of Toronto ('Toronto'), and functions both as a major node within the regional economy of southern Ontario and as a satellite of the Greater Toronto and Hamilton Area (GTHA), the Region has sufficient self-contained population and economic activity. As such, the Region draws commuters from other nearby communities, notably from the City of Guelph and the GTHA.

Today, the Region is connected to the GTHA by Ontario's GO Transit and VIA Rail networks, which have stations in the City of Kitchener ('Kitchener') and the City of Guelph ('Guelph'). These connections continue to improve, with the GO Expansion project (previously referred to and still understood within industry as Regional Express Rail or RER) aiming to introduce not only faster and more efficient trains, but also two-way, all-day service, to the Region.

The first phase of work to expand the Kitchener GO Line began in 2022. A variety of other GO Expansion projects have begun or are set to begin, with the most significant change – electrification of service on part of the line.[2] These improvements aim to increase the number, and speed, of available train trips.

Recognizing the significant travel that occurs between the GTHA, the City of Guelph, and the Region, mostly by road vehicles, the Ministry of Transportation (MTO) has recently undertaken a major widening of Highway 401. However, many trip origins and destinations are not immediately adjacent to the widened areas but are instead at or near parts of the highway network which can no longer be widened, such as portions of Highway 401 in central Toronto, or Highways 427, the Gardiner Expressway, and the Don Valley Parkway in central Toronto. Consequently, the overall effect of the Highway 401 widenings on the outer part of the Central Ontario network has been to exacerbate the already extreme congestion encircling Toronto, making journey times and reliability worse.[3] Investment in the regional rail network, so that it resembles networks in similarly large polycentric urban regions, could help facilitate travel without worsening congestion, as it has in peer jurisdictions.

Locally, the Region has invested in rapid transit to support growth. In 2019, the Region began service on its ION corridor, connecting major hubs in Kitchener and Waterloo. In 2021 the Region completed the Transit Project Assessment Process for ION Stage 2 extending the rapid transit service to the City of Cambridge. The Stage 2 ION IBC is currently in progress.

[1] Official Plan Review, Region of Waterloo, 2021
[2] Government of Ontario.
[3] Recent Hatch Analysis concluded there is a notable resemblance between Greater London's M4 Motorway connecting Western London suburbs and business centres, Heathrow, and suburban communities Slough, Reading, and Oxford to Highway 401 in Ontario connecting Western Toronto, Pearson Airport, Mississauga, Milton, and Guelph and Kitchener-Waterloo. While London is a larger city than Toronto and the M4 is notoriously congested, travel times on Highway 401 are more greatly affected by congestion, and trip times are affected to a greater degree and have less reliability than M4 trips. The parallels are strong: the M4 and the western 401 both serve principal airports and are key routes in economic corridors of innovation, productivity, and trucking.

1.1.1 The City of Cambridge

The City of Cambridge ('Cambridge') is located at the southern end of the Region, bisected by Highway 401. In 2021, Cambridge had a population of approximately 146,000 people. Relative ease of access to and from both Toronto and Kitchener-Waterloo has driven population and employment growth creating an anticipated population of around 215,000 people by 2051.[4]

While Cambridge's location on the Highway 401 corridor provides economic benefits through access to labour and goods movements, continued population growth may prove challenging, given existing and expected increases to congestion. In this regard, it is notable Cambridge has no connections to the GO or VIA rail networks. The implementation and expansion of Ontario's regional rail network would provide significant benefits for Cambridge and greater region, providing sustainable connections to adjacent population centres and key areas of employment.

In recognition of this strategic value, the Region and Cambridge have recently studied the feasibility and market potential of GO Rail service to Cambridge. Some of these efforts are as follows:

- 2009 – a Phase 1 Feasibility Report was conducted by the Region, investigating the potential of two different methods of operating GO Rail service to Cambridge
- 2014 – the Region, in conjunction with Cambridge, undertook a subsequent study to further develop the rationale for this connection
- 2021 – the parties undertook a Phase 2 Cambridge to Union GO Rail Feasibility Report ('Phase 2 Feasibility Report') to assess the feasibility of connecting Cambridge to the Guelph Central Station via the Fergus Subdivision corridor
- 2024 – the first draft of the Cambridge Passenger Rail Initial Business Case and 10% Concept Design is complete. Public consultation and community engagement began.

1.1.2 The City of Guelph

The City of Guelph ('Guelph') is approximately 21 kilometres northeast of Cambridge and 70 kilometres west of Toronto. By the end of 2022, Guelph had a population of approximately 146,000 people and supported 85,000 jobs; and is expected to grow to 208,000 people and support 116,000 jobs by 2051.[5]

Guelph's growth, its proximity to Highway 401 and nearby population and job centres, and its own growing population and employment opportunities allow Guelph to be well served by improved commuter-rail access, which at present is limited. At present, courtesy of GO and VIA Rail services, travellers can reach Toronto's Union Station from Guelph Central Station. Journey times are approximately 80 minutes. Limited off-peak services are available.

There is a relationship of economy, education, and housing that exists between Guelph and Cambridge; some people live in one community and work/study in the other. Thoughtful planning, including the proposed Cambridge Passenger Rail service, will not only support current populations, but will also encourage future growth in both Guelph and in other parts of Southwestern Ontario. Enhanced connectivity will additionally help Guelph achieve its strategic goals including direct growth to urban areas, the creation of new housing opportunities, the realization of a multi-modal transport network,

[4] City of Cambridge
[5] Long-Term Population and Housing Growth Shaping Guelph: Growth Management Strategy, City of Guelph, 2022

increased transit trips to adjacent communities, and the attraction of new residents and businesses, and services to Guelph's community.[67]

1.1.3 Cambridge to Union Station GO Rail Feasibility Report (Phase 1 and 2)

The previously completed Cambridge to Union GO Rail Feasibility Report was completed in two phases:

- **Phase 1:** The first phase evaluated, at a high level, the feasibility of a passenger rail service between Cambridge and Union (via Guelph). Three service and ridership scenarios were presented, for the 2026, 2031, and 2041 horizon years. The year 2016 was used as the "base year" in the design of the service scenarios and ridership forecast. The scenarios were then compared with the preferred option recommended along the Milton corridor, based on findings from the 2014 Study which was structured to be easily adaptable to the Metrolinx Business Case process. The results of the Phase 1 Study indicated that there was a strong case for considering a connection between Cambridge and Guelph to facilitate GO connectivity to Union Station as a viable alternative to a Milton corridor connection, warranting closer examination of the high-level financial, economic, and deliverability and operational considerations.
- **Phase 2**: The second phase of the project provided an assessment of the Cambridge to Guelph rail corridor, including the physical condition of the track on the Fergus Subdivision, an assessment of vehicle technology, integration with other GO train services, and cost estimate and business case inputs.

1.1.4 Key Stakeholder Engagement

Key stakeholders were engaged through the preparation of the preliminary scope of work for Phase 1 and 2 of the previous Feasibility Report, including:

- The Region of Waterloo;
- Metrolinx;
- Ministry of Transportation (MTO);
- Canadian National Railway (CN);
- City of Cambridge;
- City of Guelph;
- Wellington County; and
- Guelph-Eramosa Township.

Throughout preparation of this IBC, regular progress meetings were held monthly, which were attended by Region staff.

[6] Official Plan, City of Guelph, 2022.
[7] City of Guelph 2024-2027 Transportation Master Plan, section 3.2

1.1.5 Community Engagement

Several public community engagement sessions were conducted in March 2024. An online survey was also posted publicly on the EngageWR website between March 18th and April 5th, 2024, receiving 411 responses. Overall, public feedback gathered was overwhelmingly positive, with several participants expressing the urgency for an accelerating project delivery timeline, to meet current community needs. The responses to the online survey indicated a strong desire from the public to see the Cambridge station (i.e. Pinebush Station) designed as a transit and urban integrated hub rather than a traditional commuter station. Moreover, in support of transit and a better-connected region, many respondents noted that they would prefer to arrive at their selected station in Cambridge or Guelph by means other than driving, with local transit being the most popular alternative.

The Region will release a separate Cambridge Passenger Rail: Engagement Report summarizing public feedback received.

1.2 Business Case Overview

The Cambridge Passenger Rail IBC follows the methodology provided in Metrolinx's *Business Case Guidance,* Volume 2. As such, this document contains four cases:

- The Strategic Case, which determines the value of addressing a problem or opportunity based on regional development goals, plans, and policies.
- The Economic Case, which uses standard economic analysis to detail benefits and costs of the options to individuals and society, in economic terms.
- The Financial Case, which assesses the overall financial impact of the options, its funding arrangements and technical accounting issues and financial value for money.
- The Deliverability and Operations Case, which considers procurement strategies, deliverability risks, and operating plans and risks.

2. Case for Change

This section considers the various key drivers of strategic values and opportunities of plan and policy alignment for the Cambridge Passenger Rail project.

2.1 Problem Statement

In the coming decades, significant population growth is expected to occur within Ontario and the Region's major cities, with Ontario growing to an estimated 21.7 million and the Region growing to an estimate 923,000 by 2051.[8,9] It was reported that in 2011 in Waterloo Region, 4.8% of all-day weekday trips used active transportation, whether walking or cycling. In contrast, almost 88% of weekday trips involved the use of a personal automobile, as either a driver or a passenger.[10] To ensure this growth does not result in extreme road congestion, with the negative outcomes such congestion would entail, the GO Expansion project – including the extension of the Kitchener, Milton, and Lakeshore West GO Lines – aims to help improve regional connectivity and improve regional access. However, notwithstanding the GO Expansion project, gaps will remain across Southern Ontario's western communities, which includes service in Cambridge.

Travel by public transport between Cambridge and Guelph requires an interchange between GO Transit Bus routes 25 and 29/48/17. The transit travel time between Guelph and Cambridge, using the existing bus service, is approximately 56 minutes. As population and trips across the Region increase, congestion along these roads and highways will further contribute to delays, increase of travel time, and reduction of overall reliability. The only alternative mode to travel between Cambridge and Guelph is by personal automobile, with an approximate trip time of 25 to 50 minutes. This option allows for a shorter journey time (compared to existing public transit service) however, only contributes to growing congestion and carbon emissions within the Region.

The Cambridge Passenger Rail project would offer fast and reliable service, provide opportunities to enhance local and regional connectivity, support growing populations through considered transit-oriented development, and increase economic potential of Cambridge, Guelph, and the Region.

2.2 Key Drivers

The IBC is shaped by internal and external drivers, as summarized in Table 1.

[8] Ontario Population Projections Update: 2022-2046, Government of Ontario, 2022
[9] A Place to Grow, 2020
[10] A Profile of Wellbeing in Waterloo Region, Canadian Index of Wellbeing, 2018

Table 1: Key local and regional drivers

	Driver	Influence	Impact If Unaddressed
Internal Drivers	Travel Behaviour	• Faster and more reliable transit service between Cambridge and Guelph and Cambridge and Union Station, will shift trips from personal vehicles to transit • Improved access to transit will create other shifts for local trips (i.e., more walking, cycling, and other active-transport trips)	• Slower and less reliable local and GO bus service operating in mixed traffic between Cambridge and Guelph will limit mode shift from personal vehicles to transit • Lost ridership potential from the Cambridge commuter market
	Transport Service Provision	• Minimize the gaps in service between Ontario's southwestern communities and support future expansion projects • It is estimated over 2.7 million auto trips are taken annually between Guelph and Cambridge (Dillon, 2023); a new GO Line would support this strong travel pattern	• Ontario's GO Expansion and Kitchener GO Line improvements are finalized, delaying future Southwestern Ontario expansion projects • Enhanced inter-regional connectivity is not realized • Auto trips will continue to be the dominate mode choice (99%) for travel between Cambridge and Guelph
	Transport Infrastructure and Technology	• More efficient and reliable transit connectivity between Cambridge and Guelph and Cambridge and Toronto, will mitigate congestion and promote transit use • Potential to leverage Provincial investments in service improvements and two-way all-day service to Union Station on the Kitchener GO Line, and expected further improvements on the Kitchener GO Line • Potential to leverage Region investments in the ION rapid transit network connecting municipalities from Waterloo through to south Cambridge	• As congestion increases, there will be more service delays and less reliance on transit services, limiting mode shift • Efficiencies and ridership between the ION and GO services is not realized

	Driver	Influence	Impact If Unaddressed
External Drivers	Government, Policy, and Planning	• If Bill 131, *Transportation for the Future Act 2023* is passed, the Region can impose development charges around GO stations to aid implementation • Bill 23, *More Homes Built Faster Act*, permits the Region to use the implementation of a new station as a TOC opportunity, supporting realization of provincial housing targets • Broadly supportive of the Region's TransformWR and Strategic Plan including the goal to ensure most trips are taken using active transportation, with the support of a robust public transit system by 2050 • Supportive of Metrolinx's Regional Transportation Plan, which aims to establish a sustainable transportation system that is aligned with land use, and supports healthy and complete communities • The *Draft Hespeler Road Corridor Secondary Plan (2023)* aims to ensure the safety of all road users by taking pressure off the Hespeler Road corridor and allowing a variety of transportation modes to move cohesively along the corridor • The Regional Official Plan is under review following the latest round of Provincial policy changes under Bill 150. Official plan amendment 6 adopted by the Regional Municipality of Waterloo on April 11, 2023, identifies the target density for the planned Pinebush ION Major Transit Station Area at 160 people and jobs per hectare. Supporting multi-modal transportation and transit-supportive development are key elements of the Major Transit Station Areas (MTSA) policies in the Amendment.	• Region does not capitalize on the provinces initiative for GO station funding; must generate other sources of funding for the station • A transit-oriented community does not get built, limiting the overall number of homes the Region can contribute towards Ontario's housing targets • Region must rely on other transit initiatives, including the ION, to sustainably transport people within and across the region

	Driver	Influence	Impact If Unaddressed
	Economic Activity, Land Use, and Demographics	• Additional labour market potential in the science and technology sectors, with creation of attractive settings for business/ investment • Housing affordability/ diversity in Cambridge attracting skilled workers from across the GTA • Possibility to retain and support growing student populations through continued housing delivery and employment options • Attract investment with capacity for TOC development	• Future development will be shaped by other infrastructure and transportation modes, including road and highway expansions, leading to low density development and sprawl • Increased congestion may limit productivity and economic growth within the Region and negatively impact commuters travelling between Cambridge and Guelph/Cambridge and Toronto • Transit travel times will remain too uncompetitive to be attractive for personal vehicle users along the corridor to make the shift to transit • Students may opt to leave the Region following graduation due to constrained mobility and a potential lack of housing and job options

2.3 Constraints and Concurrent Initiatives Overview

In addition to the Key Drivers identified in Section 2.2, the following key constraints and interdependencies with concurrent initiatives affect the feasibility of the Cambridge Passenger Rail project:

- Metrolinx completed an Initial Business Case in 2021 for two-way all-day service on the Kitchener GO Line, and the assumptions and ridership forecast developed for this Study are considered in this analysis;
- Service along the Fergus Subdivision into Guelph Central Station will require more detailed study to investigate the platform integration at the Guelph Central Station due to the space constraints at the station;
- The development of the Pinebush Station and the lands around, to support transit-oriented development would be dependent on market potential and partnership opportunities;
- Introducing passenger rail service on the Fergus Subdivision will increase train traffic within Guelph and potentially create constraints on the service frequency, particularly at the Guelph Junction where there are space constraints for accommodating existing freight service; and
- The project can be advanced in the absence of ION Stage 2, while still accommodating subsequent build-out state.

2.4 Strategic Value

The 2041 Metrolinx Regional Transportation Plan (RTP) presents a vision for the region:

> *The GTHA will have a sustainable transportation system that is aligned with land use and supports healthy and complete communities. The system will provide safe, convenient and reliable connections, and support a high quality of life, a prosperous and competitive economy, and a protected environment.*

Ontario's population is growing, with resident numbers anticipated to reach 21.7 million around 2050, with almost all of this growth expected in Southern Ontario.[11] The Region itself is expected to grow to 923,000 people and 470,000 jobs by the year 2051.[12] With such a rapidly growing population, the expansion of Southern Ontario's transit network is a crucial component that will not only connect people across municipalities, but it will also support housing and population growth.

Without investment into Ontario's transit network, it is reasonable to assume that road and highway congestion will increase. Further, absent such investment, it is reasonable to suppose that development will continue to sprawl, lacking nodes around which to densify. If true, these assumed conditions could result in the Region being unable to support a high quality of life, increased prosperity, and environmental sustainability. Conversely, and in line with the Region Official Plan's 'balanced approach to growth' (Chapter 2), a new Pinebush Station supporting higher-order transit service offers an option for implementation of a dense, transit-oriented development model, and for the Region to achieve these goals.

[11] Ontario Population Projections Update: 2022-2046, Government of Ontario, 2022
[12] Official Plan Update, Region of Waterloo

2.5 Strategic Outcomes & Objectives

The Cambridge Passenger Rail project would advance Ontario's transit network and support the inter-connectivity of Ontario's communities. This project would enhance travel times, reliability, quality of life, economic and regional development, and further support the development of complete and sustainable communities, as outlined in Table 2.

The implementation of the Cambridge Passenger Rail project would co-exist and reinforce strong transit networks by working alongside the Region's current transit system, the future ION rapid transit stations, and the Kitchener GO Line. Expanding the GO service will connect the Region's urban growth centres as well as connect a large portion of Ontario's population to Toronto, a major employment and commuter destination for the Region's residents.

As the transit network expands and becomes more reliable, this will minimize the number of people who are reliant on personal vehicles and aid in shifting the preferred travel mode as well as increase the number of people who live within proximity to high-order transit. Inducing modal shift will minimize greenhouse gas (GHG) emissions, support Regional climate goals, and also reinforce healthier transit modes (e.g. walking and cycling), which have been proven to prevent premature deaths, diabetes, heart and lung conditions, and other chronic diseases.[13] As more people can make healthier transportation choices, the Region's quality of life will improve and continue to rank as one of the highest in Ontario.

Table 2: Strategic outcomes and objectives

Strategic Outcomes	Strategic Objectives
Transportation	Support Future Regional Transportation Network (aligns with Ministry of Transportation priority outcomes, 2022)
	Improve Access to GO Transit
	Minimize Bus Traffic in Key Transit Corridors
	Leverage transit investments on the Kitchener GO Line and the Region ION Network
Housing	Support the Planned Intensification of Key Corridors/ Centres and Enable Development of Transit-Oriented Communities
Quality of Life	Improve Access to Transit
	Improve Quality of Life and Public Health
Economic & Regional Development	Connect Commuters to Jobs
	Catalyze Density with Urban Land Development
	Support Innovation and Prosperity
Sustainable Development	Minimize greenhouse gas (GHG) emissions
	Support the Region's TransformWR Climate Strategy and the UN's Sustainable Development Goals
	Protect and Maintain the Region's Natural and Rural Lands

[13] How to create vibrant transit-supportive communities: A Typology and Evaluation Tool, Evergreen & Pembina Institute, 2019

2.6 Transit-Oriented Development

The role of transit-oriented development (TOD) around the new Pinebush Station is of particular note. The emergence of a new station, paired with appropriate zoning and planning permissions to facilitate dense mixed-use development within the station's walkshed, would have significant effects on the success of the new rail service while also helping to combat the ongoing housing crisis.

The beneficial effects of TOD are well known. Co-locating thousands of new residents convenient to the station would achieve positive outcomes such as:

- Additional riders for the service, increasing fare revenue and thereby helping to offset the service's operating costs
- Distributing this new ridership across the day and the week, as they use it not merely for commuting but for a variety of trips, making off-peak and counter-peak service viable and thereby improving its value to the region as a whole
- Creating a new economic node centered in the area, generating new economic activity
- Helping Cambridge, Guelph, the Region, and the Province achieve their new housing goals in a way that does not also increase road congestion

While the effects of TOD are outside of this report's scope, their inclusion would only further buttress the case for the Cambridge GO Passenger Rail project.

2.7 Alignment with Broader Policy

The project stakeholders at the provincial, regional, and municipal levels of government are aiming to improve quality of life, safety, guide economic growth, and advance environmental sustainability for their respective jurisdictions. Table 3 displays alignment of the planned Cambridge to Union GO Passenger Rail with the following provincial, regional, and municipal policies and plans which are currently in force and effect:

- Provincial Policy Statement Under the Planning Act (2020)
- Growth Plan for the Greater Golden Horseshoe (2020)
- Metrolinx 2041 Regional Transportation Plan (RTP) (2018)
- More Homes Built Faster Act, 2022
- More Homes for Everyone Act, 2022
- Region of Waterloo Official Plan (2015)
- 2023-2027 Region of Waterloo Strategic Plan (2023)
- TransformRW (2023)
- The City of Cambridge Official Plan (2018)
- The City of Guelph Official Plan (2022)
- The City of Toronto Official Plan (2023)

Table 3: Project-related policy considerations

Stakeholder	Document	Specific Policy and Key Considerations
Government of Ontario – Ministry of Municipal Affairs and Housing	*Provincial Policy Statement under the Planning Act* (2020)	• Section 1.1 on Managing and Directing Land Use to Achieve Efficient and Resilient Development and Land Use Patterns lists the ways in which healthy, livable, and safe communities are sustained. Section e) includes the promotion of transit-supportive development, intensification, and infrastructure planning to achieve cost-effective development patterns, optimization of transit investments, and standards to minimize land consumption and servicing costs • Section 1.6.7.4 on Transportation Systems states that a land use pattern, density and mix of uses should be promoted that minimize the length and number of vehicle trips and support current and future use of transit and active transportation • Section 1.8.1 on Energy Conservation, Air Quality, and Climate Change promotes compact form and a structure of nodes and corridors as well as the use of active transportation and transit • Subsection e) also encourages transit-supportive development and intensification to improve the mix of employment and housing uses to shorten commute journeys and decrease transportation congestion
	Growth Plan for the Greater Golden Horseshoe (2020)	• The Growth Plan outlines a framework to manage growth in the Greater Golden Horseshoe (GGH), and articulates the need for an integrated, multi-modal, regional transit network as the key to economic growth, reduced air pollution, and improved public health • The Vision for the GGH is one that supports the achievement of complete communities with access to transit networks, protected employment zones, and an increase in the amount and variety of housing available • The Growth Plan outlines strategies to ensure an integrated transportation network that will allow choices for easy travel both within urban centres and throughout the region; transit and active transportation will be practical elements of urban transportation systems • Section 2.1 states that the Plan recognizes transit as a first priority for major transportation investments; sets out a regional vision for transit; seeks to align transit with growth by directing growth to major transit station areas and other strategic growth areas, including urban growth centres; and promotes transit investments in these areas. To optimize Provincial investments in higher order transit, The Growth Plan also identifies priority transit corridors. • Section 2.2.3 states that urban growth centres will be planned to accommodate and support the transit network at the regional scale and provide connection points for inter- and intra-regional transit • Schedule 5 of the Growth Plan identifies Cambridge as an urban growth centre

Stakeholder	Document	Specific Policy and Key Considerations
Government of Ontario Ministry of Municipal Affairs and Housing	*Growth Plan for the Greater Golden Horseshoe (2020) – Relevant Major Transit Station Area (MTSA) Policies*	• Section 2.2.4 states that MTSAs are to be planned for a minimum density target of 150 persons and jobs per hectare where they are served by the GO Transit rail network • All MTSAs will be planned and designed to be transit-supportive and to achieve multimodal access to stations and connections to nearby major trips generators by providing connections to local and regional transit services to support transit service integration • Decisions on transit planning and investment must consider facilitating improved linkages between and within municipalities from nearby neighbourhoods to urban growth centres, MTSAs and other strategic growth areas
	More Homes Built Faster Act (2022)	• The Bill proposes significant changes to the planning process in Ontario, with the explicit aim of helping to advance the Province's plan to address the housing crisis by building 1.5 million homes over the next 10 years • The proposed changes require municipalities to amend their zoning by-laws to conform with official plan policies that establish minimum densities and heights around transit, and to do so within one year of the official plan policies coming into effect (upon approval by the Minister)
	More Homes for Everyone Act (2022)	• Schedule 5 of the Bill makes changes to the *Planning Act* to expedite approvals and encourage timely decisions for zoning, plan of subdivision and site plan applications, and ensure provincial housing policies are implemented and priority projects are expedited by providing the province with new tools to address dispute resolution
Government of Ontario – Ministry of Transportation	Metrolinx RTP (2041)	• The GTHA will have a sustainable transportation system that is aligned with land use, and supports healthy and complete communities • This system will provide safe, convenient, and reliable connections, and support a high quality of life, a prosperous and competitive economy, and a protected environment • To pursue this vision, the RTP aims to build strong connections and complete travel networks • The RTP aims to work in conjunction other regional plans to encourage people to travel less by car, make shorter trips, live closer to work and use available resources more efficiently
Regional and Local Municipalities	2031 Official Plan, Region of Waterloo	• Chapter 2, Shaping Waterloo Region's Urban Communities, includes an overall goal of promoting balanced growth by directing a greater share of urban development towards the existing Built-Up Area and by contributing to the creation of complete communities in Urban and Township Designated Greenfield Areas

Stakeholder	Document	Specific Policy and Key Considerations
Regional and Local Municipalities	2023-2027 Strategic Plan, Region of Waterloo	• The Region's Climate Aligned growth strategy aims to foster car-alternative options through complete communities and expanded active transportation and public transit networks • Equitable access to critical goods and services, including active transportation and public transit, is crucial in ensuring that all community members can flourish and thrive The Plan aims to achieve "Homes for All" by unlocking more development opportunities and advocating with other levels of government, creating affordable, accessible, and equitable housing, and investing in upstream solutions to reduce housing and economic precarity to support the current and future community • The Plan aims to remain aligned with one of the focus areas of the previous Strategic Plan, a "Thriving Economy." To achieve this policy throughout The Plan will provide transit and transportation connections to growing employment zones such as the airport.
	TransformWR (2023)	• The Region's call to action is to transform the community, the ways in which the community builds and operate spaces, and the ways we relate to one-another. • One of the six ways the Region hopes to transform itself is to have most trips taken using active transportation by 2050, with the support of a robust public transit system
	City of Cambridge Official Plan	• Section 6.1 notes that one of Cambridge's objectives is to "provide, in partnership with the Province and Region, a safe, sustainable, effective, accessible and energy efficient transportation system". It also states that Cambridge will "protect rail corridors to allow for the provision of improved passenger and freight rail service". This section also reiterates Cambridge's goal to "reduce dependence on the automobile by increasing the number of people using public transit, walking and cycling".
	City of Guelph Official Plan (2022)	• The Guelph Official Plan delineates downtown as an Urban Growth Centre and states that downtown will be planned to accommodate a major transit station (Guelph Central Station) and associated multi-modal transportation facilities within Downtown, which facilitates both inter and intra-city transit service • Section 5.1 states that the City, in consultation with the Province and nearby municipalities shall plan, develop, and implement inter-city transit projects in conjunction with Provincial transportation projects to achieve a balanced transportation system
	City of Toronto Official Plan (2023)	• Chapter 2.1 discusses the importance of region-wide transport in building a liveable region. It is stated that the Region's prosperity depends on an excellent integrated regional transportation system, featuring direct, transfer -free regional transit service • It is stated that Toronto will work with neighbouring municipalities, the Province of Ontario and Metrolinx to address mutual challenges and recognizes the importance of Union Station as the major hub in the regional transit system

3. Investment Options

This chapter details the investment options under evaluation in the follow Strategic, Economic, Financial, and Deliverability and Operations Cases of the IBC.

3.1 Service Concept

The proposed Cambridge Passenger Rail offers bidirectional service with that will operate between Pinebush Station (in Cambridge) and Guelph Central Station. The IBC forecasts full-service build-out in 2041 – where this line would operate as a two-way all-day service on weekdays and weekends (timetable altered accordingly).

The investment options rely on trains that consist of four-car Electric Battery Multiple Units (EBMU). Discussion of rolling stock evaluation can be found in Section 7.1.3.

3.2 Investment Options Development

Through program development to date, two main investment options have been identified for analysis in the IBC (single track, and single track with a siding). Each service option includes a variant that features enhanced track infrastructure, to better understand its impact on train speed and travel time savings.

The IBC analysis compares these options to a 'Business As Usual' scenario. See Table 4.

Table 4: Initial Business Case investment options

Option	Track Type	Class 4 Track Enhancements (Y/N)	Train Quantity
Business As Usual	No GO Cambridge-Guelph Line built		0
Option 1A	Single Track	No	1 Running, 1 Spare
Option 1B	Single Track	Yes	1 Running, 1 Spare
Option 2A	Single Track with a Siding	No	2 Running, 1 Spare
Option 2B	Single Track with a Siding	Yes	2 Running, 1 Spare

The 2021 Phase 2 Feasibility Report had identified an alternative double track configuration; however, this option was not carried through for IBC analysis. The single-track options were determined to be optimal, in terms of ease of implementation and lower capital costs and to advance the Project, while matching the expected level of service at Guelph Central Station in the short/medium term. The double tracked corridor option is worth revisiting in a future phase of work as a long-term solution.

The options selected for analysis in this IBC are described in detail in the sections following. Service parameters shown in this IBC, including headways and journey times, represent an assumed average figure for the purpose of the IBC evaluation. Headways and journey times for specific trips will vary based on operational constraints and requirements, including station dwell times to accommodate passenger

volumes and train meets for opposing train movements. Detailed timetabling of train schedules should be developed at a later stage of analysis.

The analysis assumes that, given current understanding of EBMU technology, station dwell times to accommodate passenger alighting and boarding are sufficient to accommodate initiating, carrying out, and terminating the charging process, such that the EBMU would be able to undertake a one-way trip between Guelph and Cambridge (upon arrival, the process could be undertaken again). This assumption holds true for all options, even given the shorter headways anticipated in Options 2A and 2B discussed in Section 3.2.3. For more detail on EBMU charging, please see Section 7.2.3.

3.2.1 Business As Usual

In this scenario, no new rail service is added, and the status quo prevails. It is presented here to serve as a baseline against which the other scenarios may be judged.

3.2.2 Option 1A and 1B

Option 1A and 1B propose a single-track layout along the corridor that would allow for bidirectional service with one trainset operating on the line. The single-track layout (presented here as a component of input used for rail simulation following preliminary track layout work, completed and provided by the Hatch Track Design Team) is illustrated in Figure 2 and represented in the Track Layout Drawing found in Appendix D, and Appendix E (Section 3 – Track Layout).

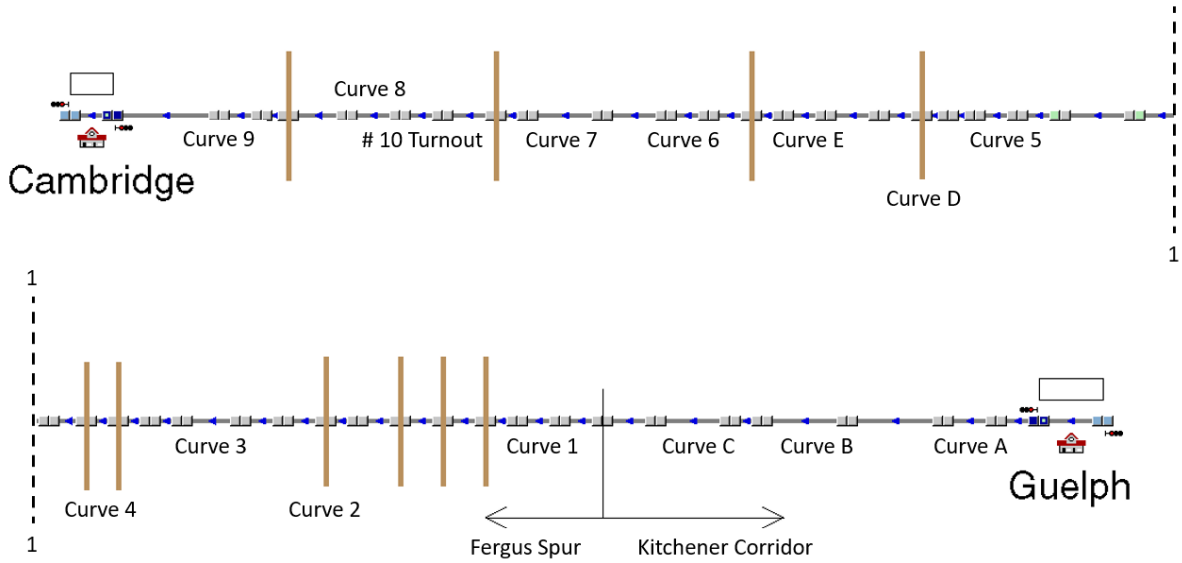

Figure 2: Cambridge Passenger Service Option 1A and 1B track layout

Options 1A offers the minimum service level and requires the minimum amount of additional track infrastructure. The single-track route is constructed with Class 3 track, allowing for average train speeds of 74.6 km/h. As summarized in Table 5, the average trip time from Pinebush Station to Guelph Central Station is 15 minutes and 31 seconds. The total headway time is 60 minutes, permitting a service frequency of 1 train per hour.

Option 1B also features this single-track configuration but includes sections of Class 4 track. Class 4 track is more expensive to build and maintain, but permits faster operation, meaning that Option 1B would

allow for a greater average trip speed of 77.9 km/h. This would shorten the average trip time to 14 minutes and 53 seconds. As summarized in Table 5, the headway time is about 45 minutes, permitting a service frequency of 1.5 trains per hour.

Table 5: Option 1A and 1B service summary

Option	Track Type	Track Classification	Train Quantity	Average Train Speed (km/h)	One-Way Trip Time (mins)	Frequency Per Hour
Option 1A	Single Track	Class 3	1 Running, 1 Spare	74.6	15:31	1
Option 1B	Single Track	Class 3; Some Class 4 track sections	1 Running, 1 Spare	77.9	14:53	1.5

3.2.3 Option 2A and 2B

Options 2A and 2B connect Pinebush Station and Guelph Central Station with a single-track bidirectional service, including a section of rail siding, as illustrated in Figure 3 (presented here as a component of input used for rail simulation following preliminary track layout work, completed and provided by the Hatch Track Design Team). The rail siding (i.e., passing track) allows for two trainsets to operate on the GO Cambridge to Guelph line at any given time. The Rail Simulation was performed on the assumption that the siding would be located at the site of an existing rail siding as shown in Appendix D, Drawing GRA_ILL_003.

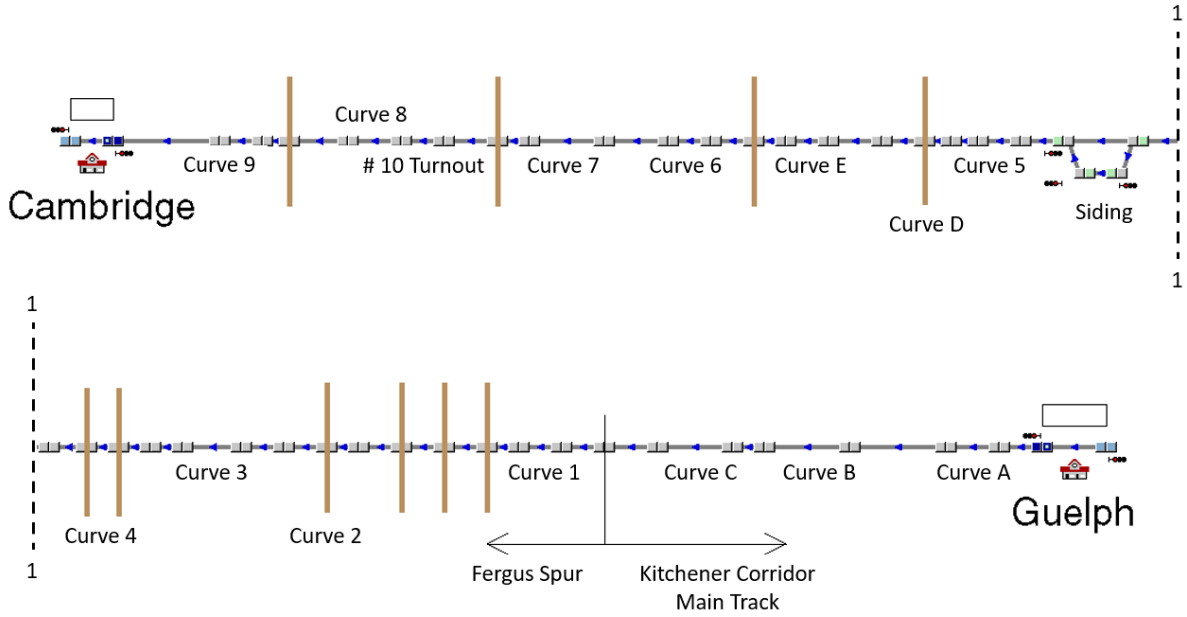

Figure 3: Cambridge Passenger Service Option 2 track layout

Option 2A proposes a Class 3 single-track alignment, with the inclusion of a section rail siding, allowing two trainsets to run at any given time. With two trains operating on the line simultaneously, the one-way

trip time is approximately 17 minutes. As summarized in Table 6, the headway time is about 30 minutes, meaning that there could be two trips between Cambridge and Guelph (and vice versa) each hour.

Option 2B similarly proposes a single-track corridor with a rail siding, including sections of Class 4 track to increase average train speeds and decrease trip times. Table 6 summarizes Option 2B's service. The one-way trip time is approximately 16 minutes and 30 seconds. As in Option 2A, headway time is about 30 minutes, permitting two trains to serve each station per hour.

Table 6: Option 2A and 2B service summary

Option	Track Type	Track Classification	Train Quantity	Average Train Speed (km/h)	One-Way Trip Time (mins)	Frequency Per Hour
Option 2A	Single Track with Siding	Class 3	2 Running, 1 Spare	68.7	16:59	2
Option 2B	Single Track with Siding	Class 3; Some Class 4 track sections	2 Running, 1 Spare	70.9	16:31	2

In Option 2's proposed layout, allowance for train meets will require one train to wait for approximately 2.5 minutes on the siding for clearance (see Figure 4). This decreases the average speed of a trip and increases average trip times for Option 2. Further refined planning work could have the siding's length extended to eliminate the 2.5 minutes of wait time, which would result in faster journey times and greater economic benefits realized.

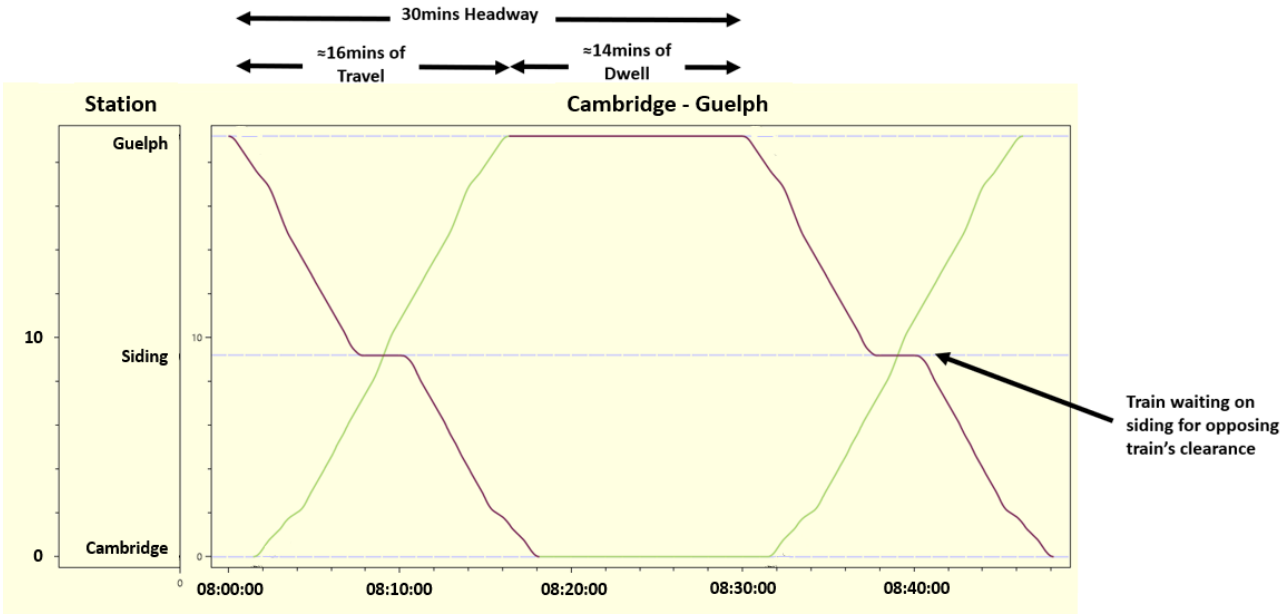

Figure 4: Option 2 headway illustration

The results of the rail simulation provide confidence in journey times by rail using reasonable assumptions for track and rolling stock, while indicating that a more in-depth optimization exercise

regarding the location and length of siding must be performed in the next phase of work. Train meets can also be timed for dominant travel flows, to minimize service interchange time between connecting services. With correct siding placement and train scheduling, Option 2's trip times could be comparable to those of Option 1.

3.3 Assumptions for Analysis and Travel Demand Modelling

The Phase 2 Feasibility Report completed in 2019 included ridership forecasts which considered ridership between the proposed Pinebush Station in Cambridge and each of the stations along the Kitchener GO Line between Guelph and Union Station. This methodology has been updated with new information released since the 2019 Feasibility Study was completed. Table 7 identifies the sources used for this report's travel demand modelling. Table 8 summarizes the assumptions used to forecast Cambridge to Guelph passenger line ridership.

Table 7: Key travel demand modelling sources

	Sources
Total Person Trips	Transportation Tomorrow Survey (2016) – University of Toronto
Population and Employment Forecast – Greater Golden Horseshoe	Greater Golden Horseshow Model v4 – Government of Ontario (Provided by Metrolinx)
GO Rail Network	GO Regional Express Rail Initial Business Case (2015) GO Expansion Full Business Case (2019) Kitchener GO Rail Service Expansion Preliminary Design Business Case (2021) Weekday Cordon Counts (2016)
Passenger Fare Information	GO Passenger Survey (2017) Distance-Based GO fare structure (2023)

Table 8: Assumptions used to forecast Cambridge to Guelph passenger line ridership

Variable	Assumptions
Population and Employment	The baseline forecast for Cambridge-Guelph passenger line assume the minimum density requirements for the Major Transit Station Areas within the applicable catchment area will be met by 2041. The applicable Major Transit Station Areas can be found in Appendix A-Table 27).
Connecting Transit Networks	ION does not extend past Pinebush Station. Significant intensification is anticipated around Pinebush Station. This level of intensification is expected to be met through transit-oriented development, supported by ION rapid transit. MTSAs associated with bus rapid transit stations have the same minimum density target as that which is prescribed for light rail stations. Therefore, the ridership assumptions are applicable should the Region elect for the implementation of either rapid transit mode to connect Pinebush Station. As per the 2021 Kitchener GO Rail Service Expansion Preliminary Design Business Case, the decommissioning of Etobicoke North GO Station and subsequent addition of Woodbine GO Station are assumed.
Passenger Trip Rate	Using a 50% increase of Kitchener GO Station trip rate (as per Transportation Tomorrow Survey), adjusted for travel time and frequency changes.

The ridership and travel time analysis considers future service levels as dictated in both the GO Expansion Full Business Case (2019) and the Kitchener GO Rail Service Expansion Preliminary Design Business Case (2021). With the future implementation of frequent two-way all-day service on the Weston Subdivision through the GO Expansion program, all trips to Bramalea GO Station and beyond are assumed to operate as express trips. Stopping patterns for express trips will be adjusted to provide stops at Malton and Woodbine GO Stations to improve connections to Pearson International Airport.

It is important to note that the Kitchener GO Line average service speeds in historic and even recent GO Expansion planning are quite slow; relative to GO equipment, tracks and other similar corridors connecting comparable cities. It is very likely further trip time savings will be found and developed in the medium and long term. Regardless, Metrolinx's slow forward-looking journey times have been used for this business case to be conservative and consistent with Metrolinx planning. Speeding up Kitchener GO journey times as expected would further improve this project's business case.

Appendix A presents the ridership forecasting methodology and results in detail. This IBC considers the baseline ridership forecast as the "Medium Projection" scenario referred to in Appendix A. "Low Projection" and "High Projection" are used to perform sensitivity tests.

It should be noted that the 2041 ridership projections for Options 2A and 2B are conservative given the increase in frequency to two trains per hour. Metrolinx elasticity impact assumptions indicate that investment to increase in off-peak frequency from one to two trains per hour can produce a 52% growth in off-peak demand.[14] However, this IBC ridership forecast conservatively estimates the difference in 2041 off-peak ridership between one train per hour (Option 1A) and two train per hour service (Options 2A and 2B). This conservative estimate will carry forward in the realization of travel time savings.

[14] Metrolinx GO RER Initial Business Case, 2015

4. Strategic Case

This chapter evaluates implementing passenger rail service connecting Cambridge to the GO Rail network, along the Fergus Subdivision against identified Strategic Outcomes and Objectives, to determine how the investment option addresses the Problem Statement (section 2.1) and the opportunities at hand.

4.1 Strategic Outcomes and Objectives

As previously introduced in Section 2.5, this section outlines a tailored list of Strategic Outcomes (Table 9) that follow the Metrolinx Business Case Guidance, with an additional fifth outcome that considers alignment with regional housing goals – being topically relevant to all levels of government.

Strategic Objectives have been identified for each Strategic Outcome area; the Strategic Objectives are the criteria against which each investment option will be evaluated.

Table 9: Summary of Strategic Outcomes and associated Strategic Objectives

Strategic Outcomes	Strategic Objectives
Transportation	Support Future Regional Transportation Network
	Improve Access to GO Transit
	Minimize Bus Traffic in Key Transit Corridors
	Leverage transit investments on the Kitchener GO Line and the Region's ION Network
Quality of Life	Improve Access to Transit
	Improve Quality of Life and Public Health
Economic & Regional Development	Connect Commuters to Jobs
	Catalyze Urban Land Development
	Support Innovation and Prosperity
Sustainable Development	Minimize GHG emissions
	Support the TransformWR Climate Strategy and the UN's Sustainable Development Goals endorsed by the Region
	Protect and Maintain the Region's Natural and Rural Lands
Housing	Support the Planned Intensification of Key Corridors and Enable Development of Transit-Oriented Communities

4.1.1 Outcome 1: Transportation

Since the 1960s, GO Transit has steadily been expanding their transit network throughout Toronto and across the Greater Golden Horseshoe (GGH). In 2011, the Georgetown GO Line, now renamed the Kitchener GO Line, was extended to Guelph and Kitchener, and is expected to service approximately 44.6 million annual riders by 2031.[15] In recent years, rapid population growth and traffic congestion has led to an increased demand for a safe, efficient, and connected rail transit system. Expanding the GO network to connect Cambridge to Union Station via Guelph, will not only provide better service, but it will also support current and anticipated growth in demand as well as ridership, provide linkages to the bus,

[15] GO Expansion Full Business Case, Metrolinx

ION rapid transit, and other GO services, fill service gaps, and promote future network expansion projects by contributing to the distribution of riders across Southern Ontario's municipalities.

4.1.1.1 Support Future Regional Transportation Network

The Kitchener GO Line will be provincially significant for the future regional transportation network, spanning municipalities and connecting riders across Southwestern Ontario and into the heart of Toronto (Figure 5). It is acknowledged in the Ministry of Transportation's (MTO), *Connecting the GGH: A Transportation Plan for the Greater Golden Horseshoe,* there are transit concepts and initiatives across the region that might not be indicated in some of the current and planned transit maps. The initiatives MTO recognizes include new passenger rail services to Bolton and Cambridge. While not currently integrated, MTO acknowledges they will work with municipalities to advance these network expansion projects. Thus, with MTO's awareness of the Cambridge Passenger Rail project, the Region is presented with the opportunity to prove east/west expansion projects can truly "transform the regional transit system from today's radial commuter network centred on Union Station to an expansive grid".[16]

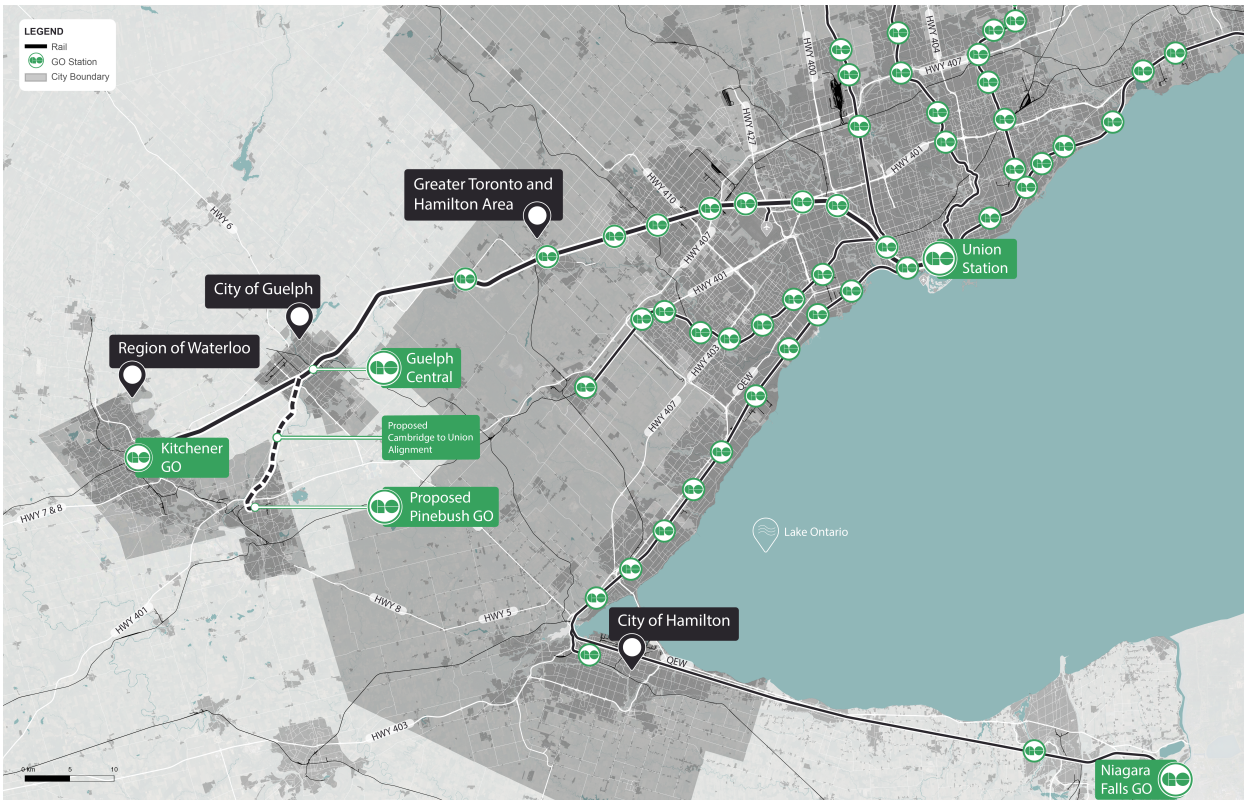

Figure 5: Regional GO train network in southwestern Ontario, with proposed Cambridge Passenger Service highlighted (dashed line)

[16] Connecting the GGH: A Transportation Plan for the Greater Golden Horseshoe, Ontario Ministry of Transportation

The Region's 2018 Regional Transportation Master Plan found there is an increasing amount of inter-regional travel to and from the Region (Figure 6) – key destinations for travel include Guelph, the Regional Municipality of Peel Region ('Peel Region'), Hamilton, Halton Region, and Toronto.[17]

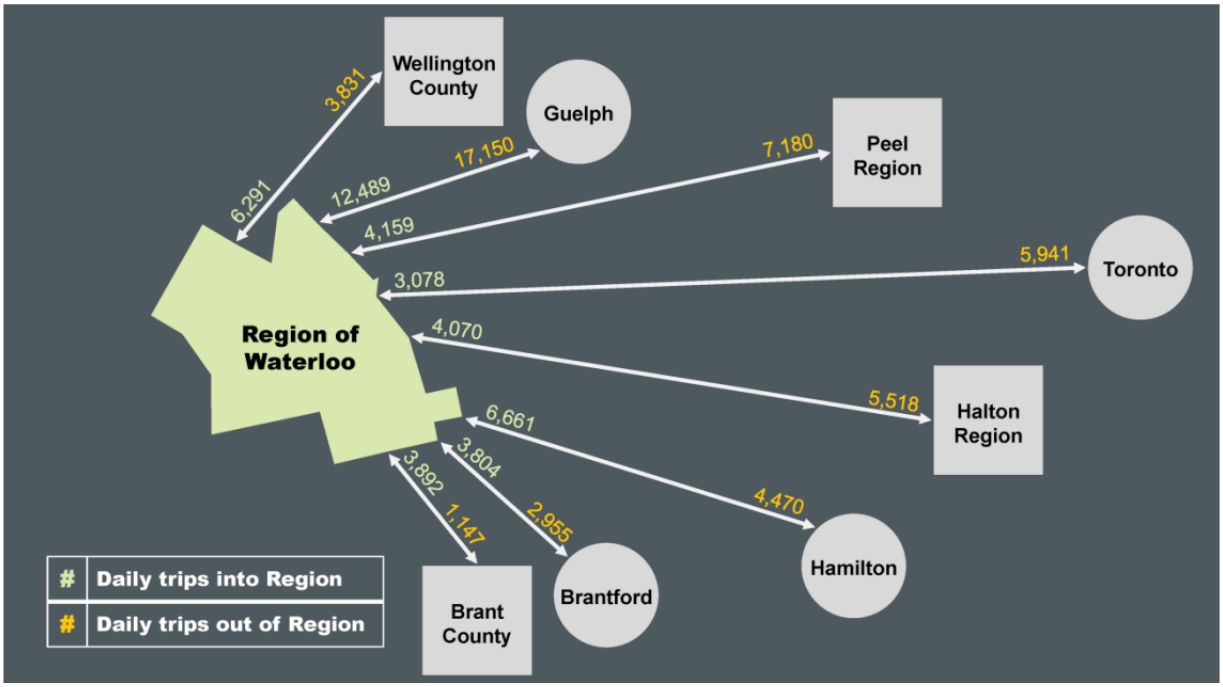

Figure 6: Most common places of origin/destination for inter-regional travel (Region of Waterloo, Transportation Tomorrow Survey 2016)

The Region also notes trips to Toronto are strong candidates for transit service due to concentrated employment near Union Station; dispersed employment sectors including Guelph and Peel Region also highlight the importance of improved connections. Expanding the transit network to each of these regions will enhance or create connectivity to the Kitchener GO Line and increase further potential for regional rail expansion projects.

In addition to the Region's opportunity to capitalize and enhance the existing GO transit network, Federal plans to link Southern Ontario between Toronto and Quebec City, paired with Provincial indication of a High Frequency Rail (HFR) Line running west towards Windsor, would position Cambridge and Guelph within a Western Ontario 'super-region' (see Figure 7).[18] The Government of Canada promises shorter travel times and faster trains would ensure a trip between Toronto and Montreal would not take longer than 4 hours. Current trips using VIA Rail between Toronto and Montreal take approximately 5 to 9 hours. Trips between Windsor and Montreal take approximately 11 to 13 hours. Thus, it can be assumed HFR would shorten trips within Ontario's primary transit corridor and have a direct impact on the Kitchener-

[17] 2018 Transportation Masterplan, Region of Waterloo
[18] Minister of Transport announces new actions to deliver on Government of Canada's commitment to improve passenger rail service in Southwestern Ontario Government, Transport Canada

Waterloo Region by enabling better connections to other economic centres and supporting more riders with improved travel times.

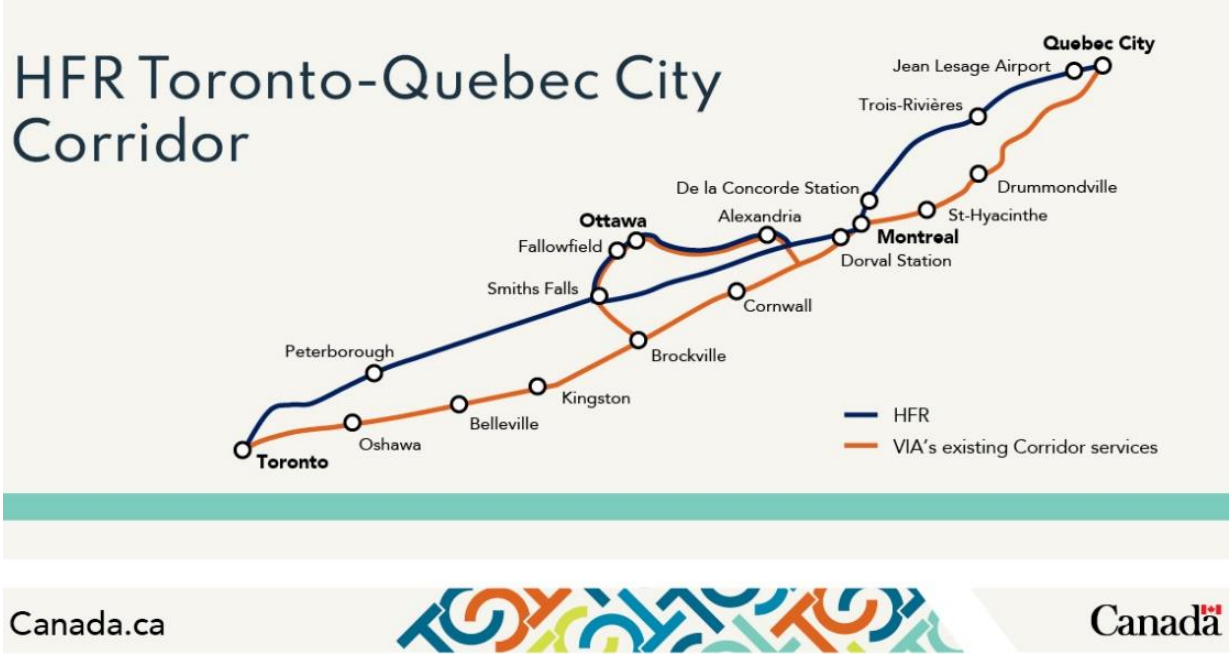

Figure 7: A highly conceptual trip route between Toronto and Quebec City, expanding on the concept presented by VIA HFR (Government of Canada)

4.1.1.2 Improve Access to GO Transit

The RTP establishes the strategic goal of positioning "the Region for new mobility by understanding new and emerging transportation options and developing a plan to leverage their benefits and the opportunities as they present".[19] Implementing a GO service from Cambridge to Union, via Guelph will support growing demand for an efficient and reliable transit network. The Region will be able to leverage the benefits of the new station and additional connections to Guelph as it will provide transit choice and improve access to transit for existing communities, minimize travel time between key locations, offer more connectivity, satisfy demand caused by a growing population, and create opportunities for sustainable TOD development pattern in the form of transit-oriented communities (TOC).

Developing a new station and service between Cambridge and Guelph will improve the community's access to GO transit and support more trips into/out of Cambridge during peak and off-peak times. As of 2023, 2.7 million annual auto trips are taken to travel between Cambridge and Guelph. There is an obvious market for reliable and efficient transit. It is anticipated travel between the key cities located along the line (Table 10) will be much more efficient taking travellers between 20 or 45 minutes less time than if they travelled by personal vehicle.

[19] 2018 Transportation Masterplan, Region of Waterloo

Table 10: Estimated travel time between Cambridge and key locations

Trip Start and Destination	In-Vehicle Travel Time Personal Vehicle	In-Vehicle Travel Time GO Train
Cambridge – Guelph	26 – 55 mins	14-17 mins
Cambridge – Union	60 – 110 mins	87 mins

More efficient travel time will attract new riders as the GO service becomes faster and more integrated with Southern Ontario's transit network. Attracting new riders will support Southern Ontario's growing population and limit additional vehicles utilising the road and highway system. It is also estimated after the GO service is implemented, ridership will continue to steadily increase. This will help alleviate growing congestions on many of Ontario's highways and within central cities. It is estimated the Cambridge Passenger Rail project will divert over 500,000 annual auto trips by 2041. Improved access to GO transit further supports the growing population and their travel behaviours through the opportunity for TOC. With a new station being implemented, opportunities for the Region to implement station area policies and higher residential density targets, as well as improved first/last mile connections, creating sustainable, transit focused development forms to accommodate population growth.

With reliable and efficient service and further network expansion projects, the GO service will become more attractive and generally contribute to more trips and user benefits.

4.1.1.3 Minimize Bus Traffic in Key Transit Corridors

Phase 1 of the 2020 Cambridge Rail Feasibility Report evaluated a rapid bus transit service as an alternative option to the proposed Cambridge Passenger Rail project. Although there were general travel time savings compared to the BAU transit routes, it was nevertheless determined the implementation of a new BRT would only further contribute to road congestion in the Region and within Guelph's more confined historic streets. During peak travel times, congestion may result in a less efficient and reliable service, which would negatively impact overall ridership.

The proposed Cambridge Passenger Rail service between Cambridge and Guelph will service a greater number of riders (with greater frequency) than the previously proposed BRT, and the existing bus service. It is estimated that the proposed 4-car EBMU GO train travelling between Cambridge to Guelph would take approximately 14.5 to 17 minutes and would have the capacity to transport over 500 riders per trip. With a dedicated track, this would not only be attractive to current transit users, but it would also attract new transit riders, and remove personal vehicles on the roads. Conversely, the previously proposed BRT service option (from Phase 1 Cambridge Rail Feasibility Report) would take approximately 17 minutes (without any traffic or delays) and only support 81 people per trip. A summary of the train and bus service options are summarized in below Table 11.

Table 11: Comparison of previous and improved bus service and the GO train

Trip Between Cambridge and Guelph	Current Bus Service	Phase 1 Cambridge Rail Feasibility Report BRT Service	Cambridge to Guelph GO Train Service
Travel Time	56 mins	17 mins	14.53-16.59 mins
Number of Passengers (per mode)	81 people (double decker)	40	162 people (per coach)

4.1.1.4 Leverage Transit Investments on the Kitchener GO Line and the Region of Waterloo ION Network

In 2021 the Region received Provincial approval for the Stage 2 ION Transit Project Assessment Process connecting Kitchener to downtown Cambridge. Stage 2 will extend the Region's rapid transit network by 17 kilometers. When complete, there will be 26 stations across a 36 kilometers network, that will help support travellers by increasing access to transit, reducing trip times, and supporting first/last mile sustainable transit connections. Additionally, the rapid transit network and the associated station areas will be subject to the Province's minimum target MTSA density policies (160 people and jobs per hectare at LRT stations): a catalyst for the realization of higher density and mixed-use development outcomes, creating capacity to accommodate future population growth.[20]

Introducing a GO service in Cambridge will complement the proposed extended ION rapid transit system by having key stations potentially planned in conjunction with the proposed GO station. For instance, the proposed Pinebush Station currently aligns with the Pinebush ION Station, as noted in the Region's 2019 Preferred Route map (Figure 8). This would create a central transit hub providing residents with access to inter-city services as well as any additional features of the transit hub and/or TOC including employment opportunities and other amenities. Should the Stage 2 ION not be in service, the built-up Pinebush Station hub would still be accessible to the community through the planned density, improved transportation networks, and the Region's traditional bus service.

4.1.2 Outcome 2: Housing

Ontario is currently experiencing a housing and affordability crisis. The population is projected to increase by 43.6%, i.e., almost 6.6 million new people over the baseline of 15.1 million, over the next 24 years. Even before this growth, the province has a shortage of housing supply, which is posing sharp pressure on housing costs, such that many people are unable to live within urban centers within the Greater Toronto Area (GTA) comfortably and affordably.

Extending Ontario's transit network will support population growth and Ontario's goal to build 1.5 million homes by 2031, particularly by reducing sprawl and focusing growth within existing and potential TOCs. As one of the fastest growing regions, with a population that is expected to grow to 923,000 by 2051, the Province has tasked the Region with building 19,000 homes in Cambridge, 16,000 homes in Kitchener, and 35,000 homes in Waterloo by 2031 in support of Ontario's More Homes Built Faster Act.[21]

In this context, planning a TOC around Pinebush Station would allow for a diverse range of housing options to accommodate the Region's demographics, with a focus on higher density as the Region continues to shift development to built up areas. Paired with appropriate mixed-use development, it could also offer substantial employment opportunities. In this way, Pinebush Station TOC could not only help support to achieve and exceed the Region's housing targets, but also contribute to future economic development strategies and real estate investment and development.

[20] Region of Waterloo
[21] Kitchener, Waterloo pass pledges that will see thousands of new homes built by 2031, CBC News

4.1.2.1 Support the Planned Intensification of Key Corridors and Enable Development of Transit-Oriented Communities

The Region has selected Pinebush as a proposed Protected Major Transit Station Area (PMTSA) in their updated Official Plan and plans for the minimum density target of 160 people and jobs per hectare.[22] Densification around a GO station will support additional growth and development and create a place that is safe, comfortable, convenient, and affordable.

The vision for a new TOC gives the Region the opportunity to position Cambridge as a connected city, establishing themselves as an important centre for innovation, a leader in mobility, and a flexible employment hub. The connected city could leverage infrastructure to build stronger ties within the city and to Guelph through new rail connections, including the Cambridge Passenger Rail and the Stage 2 ION rapid transit. A new TOC could also build and/or accentuate the Region's sectors in heritage & culture, education, and sports & entertainment.

[22] Region of Waterloo, Regional Official Plan Review, 2021

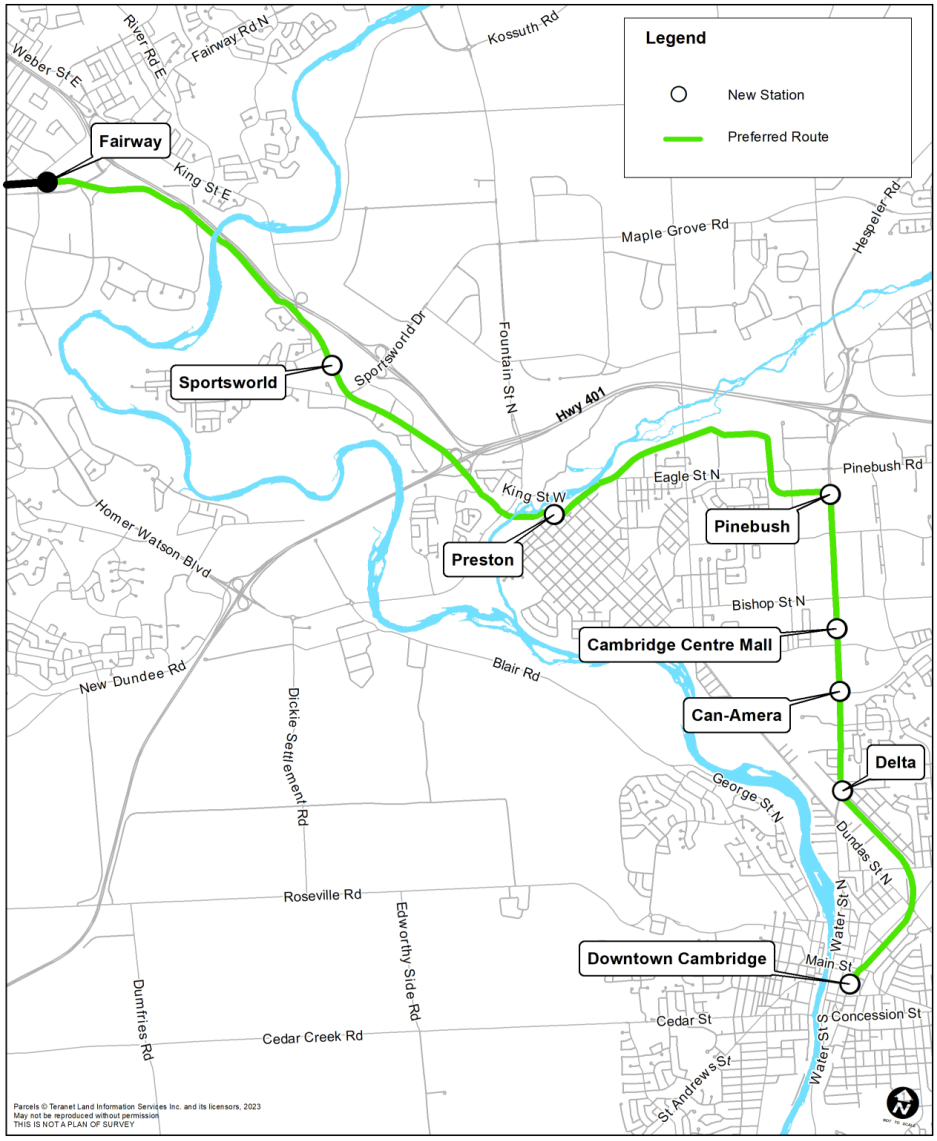

Figure 8: Stage 2 ION Preferred Route Map (Region of Waterloo)

4.1.3 Outcome 3: Quality of Life

Transit is a primary alternative to vehicle trips in many communities when destinations are further than a reasonable walking and cycling distance. Ensuring proximity to transit supports providing options other than driving. Moreover, living in proximity to daily needs is not only convenient – it can also provide multiple benefits to one's quality of life and well-being. TOCs help establish well-connected built and natural environments that offers many options for active living and connections between people including safe, inclusive, and universally accessible open spaces.[23]

[23] Complete Communities: A guide to geospatial land use assessments for British Columbia's communities, Government of British Columbia

The implementation of a new transit service accompanied by realization of sustainable development in the form of a TOC will provide benefits for a full socio-economic spectrum of residents and travellers. With diverse demographics and economic groups living in Southern Ontario, a safe and efficient transit service is vital to ensure people can reach their destination.

4.1.3.1 Improve Access to Transit

In Southern Ontario, there are various gaps in the existing transit network (Figure 5).

Locally, within the Region it was estimated that after the completion of Stage 1 of the ION network, more than 36,000 people would live within 600 metres of an ION station, and 64,000 people would work within the same area.[24] Should Stage 2 be implemented it is likely more people would live and work within proximity of a transit station. A GO station would contribute to further densification. However, without the planned Stage 2 ION, opportunity exists for improved transit connectivity from Cambridge to the broader region.

The existing gaps make it more difficult for people to travel efficiently and economically to services, amenities, and places of employment, thus forcing many people to either travel with their personal vehicles or spend an overwhelming amount of time on transit to reach their destination (100 minutes by bus between Cambridge and Toronto). However, the implementation of a new GO Station in Cambridge would both minimize travel time and the total costs associated with travel. Instead of spending approximately 120 minutes (or more) and $30 (or more) travelling from Cambridge to Toronto via personal vehicle, a traveller may take a maximum of 96 minutes and spend $18 when the service is first implemented. However, cost of travel will increase annually with inflation, whether a person travels personal vehicle or by train.

4.1.3.2 Improve Quality of Life and Public Health

By implementing a new station in Cambridge, residents commuting or travelling between Cambridge to Guelph, or Cambridge to Toronto, will have shorter travel/commute times, therefore giving travellers more personal time. Travellers would also be able to access more amenities, services, entertainment, and employment options, which would result in improved quality of life and wellbeing. Connecting Cambridge to the rest of Southern Ontario will provide users with improved trip times and more personal time, which improves overall mental and physical health.

The construction of a new GO transit station will further support local populations and growth through planning for a TOC. A new TOC will contribute additional housing, community amenities/ facilities and public servicing infrastructure to the existing Cambridge community. A range of land uses and housing densities could be accommodated, assisting in the city's transformation from a locality primarily categorized by its industrial sector. Cambridge's potential TOC will also help support regional goals by promoting a healthy community through the implementation of active transportation. Active transportation considerations will improve the first and last mile connections within Cambridge, as well as could directly connect transit users to the Region's ION network via walking and cycling.

The Region is home to a larger proportion of children, teenagers, and young adults (0 to 29 years old) compared to the rest of the province.[25] Post-secondary students (University of Waterloo, Wilfrid Laurier

[24] The ION Story, Region of Waterloo, 2016
[25] A Demographic Profile, Region of Waterloo

University, and Conestoga College) now make up nearly 9% of the Region's population.[26] These groups rely heavily on active transportation, transit, or other sources of transportation as they may not have a driver's license or access to a personal vehicle.

Improving first and last mile connections, transit accessibility and the delivery of new TOCs that accommodate a variety of uses, including social infrastructure (schools, cultural spaces, etc.) and other public spaces (parks, community centres, etc.), will support a large portion of the Region's population. Not only will a TOC improve quality of life and public health by enhancing connectivity within the Region to varying uses, but a community that prioritizes transit improves road safety outcomes. By minimizing reliance on personal vehicles and increasing the number of trips on transit, the number of traffic collisions or fatalities often decreases.[27]

4.1.4 Outcome 4: Economic and Regional Development

Ontario's transit network is an important regional connector responsible for delivering thousands of people to their places of work and other destinations daily. The GO Network is responsible for over 200,000 daily passengers and the number of trips is expected to increase to 630,000 daily riders as the GO rail network grows through the GO Regional Express Rail project.[28] Future connections would not only contribute to transporting people to jobs and employment opportunities within Cambridge and Guelph but would also transport people to key economic districts, including Toronto's downtown core, catalyze urban land development, and support innovation and prosperity.

4.1.4.1 Connect Commuters to Jobs

The Kitchener GO Line, a key component of Ontario's transit network, is responsible for delivering hundreds of people to their jobs and other destinations daily. In 2016, a typical demand profile emerged as commuters and students travel from home to work or school in the morning and return in the evening.[29] Guelph, Peel Region, and Toronto were identified as the three most common destinations to travel. For example, there were about 17,100 trips being made to Guelph from the Region and 12,500 to the Region from Guelph.

A connected and reliable service will remove a number of vehicles on roads minimizing congestion and travel time. Even though the COVID-19 pandemic altered typical commute patterns, a recent push to return to the office from corporate leadership has more Canadians commuting to their jobs in 2023 compared to previous years; with the largest proportion belonging in Ontario.[30] Between May 2021 and 2023 there was a 63.6% increase in people using transit. In relation to the Region, it has been found that commuting via transit will minimize travel time during peak travel periods. During peak times of the day, a person commuting from Cambridge to Toronto with their personal vehicle will spend about the same amount of time to 80 minutes more than commuting by train (Figure 9). Therefore, commuting by train will not only minimize travel time, but it will support the key areas of employment, like downtown Toronto.

[26] Transportation Master Plan, Region of Waterloo
[27] Invest in public transit to create healthy, green and just communities, Canadian Public Health Association, 2021
[28] GO Expansion Full Business Case, Metrolinx
[29] Transportation Master Plan, Region of Waterloo
[30] Commuting to work by car and public transit grows in 2023, Statistics Canada

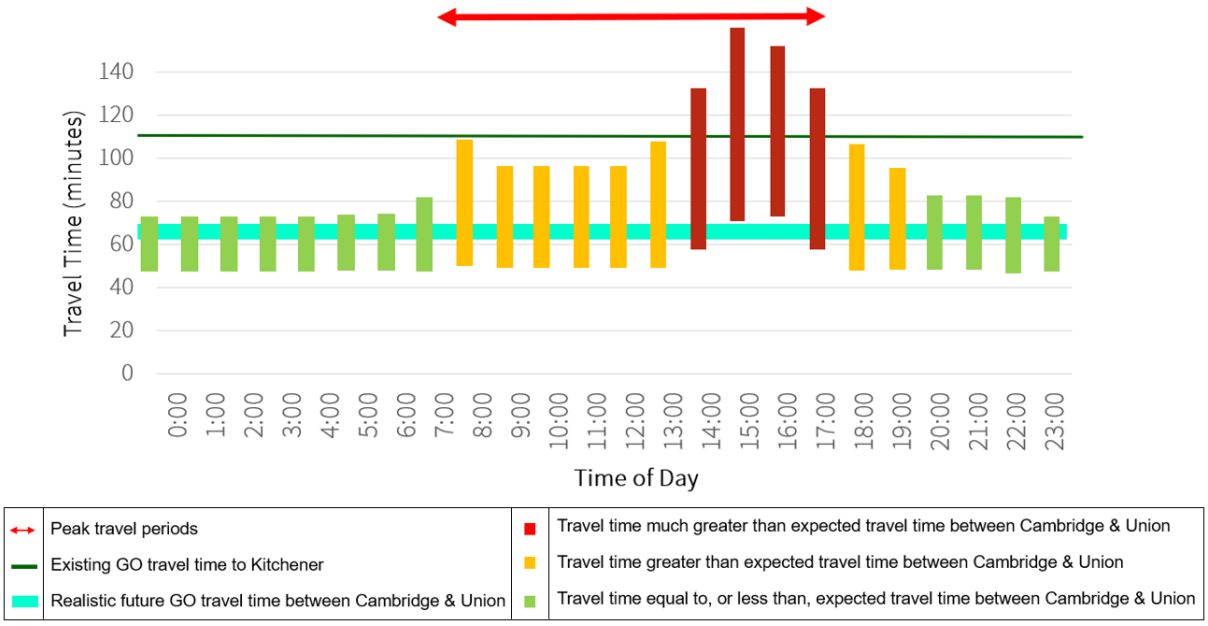

Figure 9: Travel time to Cambridge by personal vehicle at different times of the day (derived from Google Maps, 2023)

4.1.4.2 Catalyze Density and Urban Land Development

Transit stations have the ability to transform local economies and communities by catalyzing urbanization and development. Cambridge's economic base is diversified with strengths in manufacturing, automotive, textiles, plastics, agrifood, and the technology sectors. The implementation of transit may continue to diversify the employment sectors with the locality becoming more attractive to new residents and employers. As access is improved, jobs and other uses become more viable with people travelling into and out of the area. A more activated space will increase attraction and help drive future job creation and innovative use of space.

4.1.4.3 Support Innovation and Prosperity

With a prominent student population, the Region has the opportunity to retain and attract talent through the creation of homes and new places of employment. As of November 2022, there were 78,100 post-secondary students enrolled in full-time programs at Conestoga College, the University of Waterloo, and Wilfrid Laurier University, on the campuses that are located in Waterloo Region.[31] In 2019, prior to the COVID-19 pandemic, of the full-time students studying on local campuses, it is estimated that over 56,200 reside in the Region, while almost 12,960 students live outside the Region but commute to the local colleges and universities.[32] With future population growth, the number of students can only be expected to increase. Transit will not only help transport students to and from campus more efficiently through GO and ION services, but a new station in Cambridge that is planned and designed as a TOC, can position the city as a new hub for innovation. This would offer current and future students (e.g. University of Guelph, Conestoga College, Wilfred Laurier University, the University of Waterloo) a place to live and support internship and employment opportunities both, during and after their educational careers.

[31] 2022 Population and Households Estimates for Waterloo Region, Region of Waterloo
[32] Transportation Master Plan, Region of Waterloo

The University of Waterloo is number one in Canda for entrepreneurial learning and driving innovation.[33] A TOC that accommodates a student's needs (services, amenities, access to culture and greenspace, etc.) could become an attractive place for students to foster that innovation and therefore grow with the City of Cambridge.

4.1.5 Outcome 5: Sustainable Development

The extension of the GO network and the implementation of the Cambridge Passenger Rail service would not only support the economic growth and development of the Southern Ontario, but it would also minimize GHG emissions, support the Region's strategic goals, support the UN's Strategic Development Goals, as well as protect and maintain the Region's natural and rural lands.

4.1.5.1 Minimize GHG Emissions

TransformWR, the Region endorsed community-wide response to global climate change, has leveraged reducing GHG emissions to increase equity, prosperity, and resiliency for all by 2050.[34] To reduce GHG emissions, the development of TOCs is a primary way in which the Region can reallocate trips from personal vehicles to trains. Providing a new GO station in Cambridge will connect travellers to Ontario's regional transit network and the local ION network. A TOC with a strong mobility network and various land uses enhance a traveller's first and last mile by ensuring they can have more flexibility in determining how they will reach their destination. Flexibility supports decarbonized city centres by making it easier for travellers to choose between modes of transportation, including the ION, GO trains, active transportation, and micro-mobility modes (i.e., e-bikes and e-scooters).

This report did not conduct an analysis of GHG reductions; however, it should be noted the implementation of the Cambridge Passenger Rail project will have a much larger impact by shaping the development of the community, reducing the overall GHG footprint – which is out of scope of this study.

4.1.5.2 Support the Region's TransformWR Climate Strategy and the UN's Sustainable Development Goals

TransformWR and The Region's 2023-2027 Strategic Plan include several climate goals and targets that aim to transform the community and the ways they move, build, and operate spaces. One of the six goals outlined in TransformWR include having most trips taken using active transportation, with the support of a robust public transportation system by the year 2050. To do this, the Region will need to make fewer trips, shorter trips, and lower energy trips. As noted in TransformWR, public transit is crucial for making most trips using active transportation and community active transportation hubs are one important tool that can contribute to change. If the Region planned and constructed a new TOC in Cambridge, travellers will have more flexibility in selecting their mode of transportation due to a more efficient and connected mobility network. Moreover, a new TOC in Cambridge has potential to offer a variety of employment opportunities, amenities, and services, minimizing the distance people would be required to travel to reach the destinations they require on a day-to-day basis.

Similarly, the Region's Strategic Plan outlines the use of a climate adaptation lens to re-imagine infrastructure, land, and services for growth. In addition to delivering a new station, a TOC in Cambridge

[33] Quick Facts, University of Waterloo
[34] Climate action strategy for Waterloo Region's transition to an equitable, prosperous, resilient low carbon community, whose framework was endorsed by the Region of Waterloo

would support more creative connections and reduced carbon emissions and carbon intensity, between key areas within and outside of Cambridge, as well as Guelph, and across Southern Ontario.

Finally, by constructing a new GO station and expanding the GO transit network, Cambridge will actively become more sustainable and more directly follow the framework set out by the United Nations. Expanding the Kitchener GO Line by connecting to Cambridge via the Fergus and Guelph GO Subdivisions, will help Southern Ontario meet several of the United Nation's Sustainable Development Goals (SDGs) including:

- *Good Health and Well-Being* – Providing people of various demographics and economic statuses with the ability to access transit, giving travellers access to employment and services.
- *Affordable and Clean Energy* – GO trains contribute to the reduction of GHG and minimize the total number of personal vehicles on roads.
- *Decent Work and Economic Growth* – The GO network connects people to various employment sectors contributing to the Region's and Southern Ontario's overall economic growth.
- *Industry, Innovation, and Infrastructure* – With an efficient and reliable system, Southern Ontario is able to promote inclusive and sustainable industrialization through connected sectors and foster innovation.
- *Sustainable Cities and Communities* – A strong, safe, and reliable transit network will promote development as TOC providing more people with access to services and amenities.

4.1.5.3 Protect and Maintain the Region's Natural and Rural Lands

The Region has an extensive network of natural heritage and rural lands. To ensure this environmental network is protected and maintained for future generations, the Region's Official Plan notes that they will need to take a balanced approach for growth. This balanced approach for growth aims to direct growth to built-up areas in the community and make better use of land, existing infrastructure, and services. A new Cambridge TOC would help the Region unlock more urban land and stimulate more creative use of space, thereby protecting the natural and rural lands that are often impacted by increased demand for new amenities and sprawl. Moreover, when accompanied by an Environmental Assessment, the implementation of a new rail line will ensure that any negative impacts on the environment are mitigated and/or avoided.

4.2 Strategic Case Summary

Table 12 summarizes the Strategic Case for each investment option.

As the table demonstrates, for each of the five categories – Transportation, Quality of Life, Economic & Regional Development, Sustainable Development, and Housing – Options 1 and 2 both strongly outperform the BAU scenario. Comparing Options 1 and 2 to each other, the table shows that Option 2 outperforms Option 1 in Transportation; slightly betters it for Quality of Life and Economic and Regional Development; and is functionally identical for Sustainable Development and Housing. Comparing Options 1B and 2B to Options 1A and 2A respectively, the table shows that each pair of options is functionally identical from a strategic perspective.

The Strategic Case therefore makes a strong recommendation for any option over the BAU scenario (i.e., no investment), and a weak recommendation for Options 2A and 2B over Option 1A or 1B.

Table 12: Strategic case summary

Strategic Outcomes	Strategic Objectives	Business as Usual	Option 1A Single Track Class 3	Option 1B Single Track Class 3, some Class 4	Option 2A Single Track with a Siding Class 3	Scenario 2B Single Track with a Siding Class 3, some Class 4
Transportation	Support Future Regional Transportation Network	Cambridge Passenger Rail does not get built; future expansion projects are slowed down	New line promotes new ridership and with improved trip time between Cambridge and Guelph and Cambridge and Union	New line with shorter headway time and trip time promotes ridership and future network expansion	Slightly longer trip time than Options 1A and 1B, however, more trains promote more riders and trips	
	Improve Access to GO Transit	Cambridge residents do not have efficient and direct access to a GO station making travel to Kitchener, Guelph, and Toronto longer	More people take GO transit with new transit station and TOC implementation		Increased frequency increases the number of people taking transit	
	Minimize Bus Traffic in Key Transit Corridors	Bus and personal vehicles are relied on for inter-city travel. Once constructed the ION may contribute to a slight decrease in traffic	Efficient and reliable services minimize the number of buses required, alleviating congestion		Increased train frequency further reduces the number of buses required on roads	
	Leverage transit investments on the Kitchener GO Line and the Region ION network	Once constructed ION, bus, and personal vehicles will be the primary methods of travel. Some development and investment along the existing and future ION network will occur.	ION and GO Transit improve regional transit network; fewer personal vehicle trips are needed within the Region	Faster service between ION and GO supporting future Regional investment	Increased frequency and service, will support more investments in transit within the Region and their GO and ION stations	
Quality of Life	Improve Access to Transit	GO station is not constructed, residents will rely on existing transit options and the Stage 2 ION extension	More people are within proximity to high-order transit, minimizing reliance on personal vehicles		More people can access transit and access transit more frequently with the newly implemented GO line	

Strategic Outcomes	Strategic Objectives	Business as Usual	Option 1A Single Track Class 3	Option 1B Single Track Class 3, some Class 4	Option 2A Single Track with a Siding Class 3	Scenario 2B Single Track with a Siding Class 3, some Class 4
	Improve Quality of Life and Public Health	General quality of life and public health remains the same within the Region. Slight improvements following the completion of the Stage 2 ION	Improved transit network minimizes total air pollutants and reinforces active transportation		A new GO line will reinforce transit use within the region and active mobility	
Economic & Regional Development	Connect Commuters to Jobs	Commuters must rely on existing transit or personal vehicles. Commute times are lengthy due to congestion. Trip times only expected to increase as congestion increases.	2,300 people use the services daily connecting more people to local and regional	2,400 people use the new trains, transporting people to more local and regional jobs	2,700 people use the new trains, transporting people to more local and regional jobs	2,800 people use the new trains, transporting people to more local and regional jobs
	Catalyze Urban Land Development	Land development and anticipated projects remain the same.	Improved and connected transit service supports diverse land development opportunities			
	Support Innovation and Prosperity	Innovation and prosperity are supported through the universities and colleges. Current students remain within the campus regions and graduates move out of the Region.	With a new TOC and improved access to the Region, more students and creative classes will be enticed to live in Cambridge and the Region		More students and creative class workers are able to utilize transit supporting more innovation and prosperity within the region	
Sustainable Development	Minimize GHG Emissions	Car usage increases as population increases also increasing the amount of GHGs. Some personal vehicle trips are diverted following the completion of ION Stage 2.	40 million annual vehicle kilometers travelled diverted to rail travel	43 million annual vehicle kilometers travelled diverted to rail travel	47 million annual vehicle kilometers travelled diverted to rail travel	48 million annual vehicle kilometers travelled diverted to rail travel

Strategic Outcomes	Strategic Objectives	Business as Usual	Option 1A Single Track Class 3	Option 1B Single Track Class 3, some Class 4	Option 2A Single Track with a Siding Class 3	Scenario 2B Single Track with a Siding Class 3, some Class 4
	Support the Region's TransformWR Climate Strategy & the UN's Sustainable Development Goals	Minimal TOC opportunities to further support densification and active transportation goals. Region must rely on current and future development plans.	More TOC opportunities, re-enforcing transit and active transit mode Establish complete communities			
	Protect and Maintain the Region's Natural and Rural Lands	Less dense development allows for more sprawl and use of Regions natural and rural lands.	More dense development is permitted within MTSA area, minimizing sprawl			
Housing	Support the Planned Intensification of Key Corridors and Enable Development of Transit-Oriented Communities	Intensification must rely on existing projects and strategies. Future growth will require more housing support.	Line implementation supports TOC development as more people will want to live in proximity to reliable, high-order transit	Increased housing opportunities and densification		

5. Economic Case

The Economic Case is one of two chapters in this IBC that focuses on the rationale for pursuing the Cambridge Passenger Rail project, the other being the Strategic Case. While the Strategic Case evaluates options within a project specific policy/plan-oriented evaluation framework, the Economic Case determines if the expected benefits of this investment exceed the costs required to deliver it and articulates the overall benefit to society of pursuing each investment option.

The Economic Case compares costs and benefits to all users, and to society at large, to determine the overall economic viability of an investment. The values presented in the Economic Case are representative of total lifecycle costs and benefits of the project. This analysis considers the magnitude of costs and benefits over a 60-year lifecycle (the evaluation period) to determine:

- Benefit Cost Ratio (BCR) – the net benefits divided by the net costs, which is used to indicate benefits that are realized per dollar spent
- Net Present Value (NPV) – the net benefits minus net costs, which is used to indicate total net benefits to the region

If the BCR is less than 1, costs exceed benefits. If the BCR equals 1, the project's costs are completely offset by its benefits. The more the BCR exceeds 1, the more the project's benefits exceed its costs, and the more attractive an investment it becomes.

5.1 Economic Case Assumptions

To determine the investment's overall economic impact, the benefits associated with ridership are compared with the costs required to deliver the investment. The model makes use of assumptions and parameters throughout the social cost benefit analysis, as noted in Table 13.

The Economic Case analysis considers the real price of capital and operating costs, based on the year they are incurred, and converted to present value with a social discount rate. That is, it considers real values that aim to reflect the value of goods based on escalation without general inflation applied**.** As per Metrolinx practice, the financial model ceases to apply multipliers for growth and escalation beyond Year 30 of the analysis, to reflect the great uncertainty of conditions that far into the future. For similar reasons, the model only forecasts ridership to 2041, with a simple 1% increase applied annually until Year 30.

Metrolinx economic case multipliers are provided by the Metrolinx Business Case Guidance in $2021 format. As applicable in the economic analysis, these values are converted to $2026 (representing the first year of lifecycle analysis); however, they are not subject to effects of inflation or escalation (as previously mentioned) throughout the 60-year evaluation period. All NPV economic costs are reported in real terms ($2023).

Table 13: Economic Case assumptions

Input	Value	Source
Analysis Approach	All benefits/costs are expressed in **real terms** ($ 2023)	Metrolinx
Evaluation Period	60 years, starting from opening year (2026–2086)	Hatch; industry standard expected useful life of longest-lived project element (track)
Social Discount Rate	3.5%	Metrolinx
Capital, Operating and Maintenance Cost Escalation	1% applied for the 30 years after opening year (2026–2056) 0% applied between 2056–2086	Metrolinx
Travel Time Weighting Factors	In-vehicle time: 1.0 Walk time: 2.0 Wait time: 2.5 Interchange time: 5-minute penalty	Metrolinx
Travel Time Perception Factors (by mode)	Bus: 1.0 GO Rail: 0.85	Metrolinx
Value of Time	$18.79 ($ 2021)	Metrolinx *(Converted to $ 2023)*
Value of Time Growth Rate	0%	Metrolinx
Ridership Growth Rate	Appendix A features ridership estimates Ridership growth is assumed at 1% between 2041–2056, i.e., 30 years after base year of project evaluation)	Dillon Consulting Metrolinx
Reliability Ratio	1.76	Metrolinx
Unperceived Auto Operating Costs Savings	$0.10 / VKT reduction ($ 2021)	Metrolinx *(Converted to $ 2023)*
Decongestion Benefit	Peak Period: 0.01 hours / VKT reduction Off-Peak Period: 0.00125 hours / VKT reduction	Metrolinx
Road Safety Benefits (Road Accident Mitigation)	$0.09 / VKT reduction ($ 2021) (reduced by 5.3% per year)	Metrolinx *(Converted to $ 2023)*
GHG Emissions	$0.01 / VKT reduction ($ 2021)	Metrolinx *(Converted to $ 2023)*
Air Quality	$0.002 / VKT reduction ($ 2021)	Metrolinx *(Converted to $ 2023)*

All analysis in this section uses real values and a social discount rate, as opposed to nominal values and a financial discount rate. Real values include the impact of growth but not general inflation; that is, they distinguish between changes in value and changes in price. The social discount rate reflects society's time value preference for consumption, which is that a benefit or cost incurred tomorrow holds less weight in our expectations and calculus of value than the same benefit or cost incurred today.

Some elements have been excluded from the analysis. Property costs are excluded, for example, on assumption that land does not amortize; that is, its value (unlike its price) does not change over time and when included as part of a government project is bought and retained as an asset – therefore it has zero cost. Land is neither used up, as goods are, nor does it need to be maintained, as capital equipment does, meaning that, in accounting terms, its value as an asset is constant.

Further, while the potential for building new mixed-use TOC adjacent to the new rail station is great, it falls outside the scope of this exercise as currently constituted; if it was included, it could contribute substantially the project's anticipated benefits (see Section 2.6 for more on this subject). Furthermore, the strategic advanced purchase of lands and its inclusion in the project, particularly at/around Pinebush Station, could generate value for the project which would make land purchase activities a negative cost to the project, in other words, a revenue source. This upside has not been included in the quantitative analysis to date.

5.2 Economic Costs

The analysis divides the economic costs required to deliver the Cambridge Passenger Rail project into two categories: firstly, capital costs, and secondly, operating and maintenance costs. Table 14 explicates the assumptions regarding these categories.

Metrolinx accounts for uncertainty in project costing in a standard fashion that it applies to all projects, adjusting only as necessary to recognize the nature of the project and its position in the design development process. In accordance with this standard approach, all cost estimates, excluding fleet, include contingency of 30% to cover unknown risk events. For fleet expenses, neither contingency nor optimism bias was applied.

Unlike the Financial Case, all analyses completed in this economic analysis use real values ($2023) and a social discount rate, as opposed to nominal values and a financial discount rate. Real values do not include the impact of general inflation but consider real growth (escalation).

Table 14: Project cost categories

Cost Category	Descriptions and Assumptions

Capital Costs	• Capital costs include:
	  ○ Track infrastructure costs, e.g., linear track infrastructure, switches, crossovers, addition of new and upgrading of old signals, and a storage and light-maintenance facility
	  ○ Equipment costs, e.g., rolling stock, and charging infrastructure
	  ○ Beside-track costs, e.g., platforms, stations, utilities
	• Assumes 30-year rolling stock replacement costs, i.e., at the end of design life. These include locomotive, coach, and major infrastructure replacement costs
	• Model applies a 15% soft cost factor for design and professional services and a 30% contingency factor for non- rolling-stock costs

Operating and Maintenance Costs	• Operating and maintenance costs include ongoing costs required to operate the service, provide day-to-day maintenance, and perform rehabilitations throughout the lifecycle of the project • Model assumes two mid-design life rolling stock overhaul events valued at 50% of initial vehicle purchase costs • Model applies a 30% contingency factor

See detailed breakdown of capital, operating and maintenance costs in Appendix C.

Table 15 lists the economic capital and operating and maintenance costs for the 60-year lifecycle of the Cambridge Passenger Rail project. These costs are incremental to the Business as Usual (BAU) scenario and have been discounted based on the approach defined earlier in this chapter. A fare resource adjustment has been taken into consideration.

Table 15: Summary of economic project costs

	Economic Net Present Value ($M, $2023)			
	Option 1A	Option 1B	Option 2A	Option 2B
Capital Costs	$304	$315	$371	$382
Operating and Maintenance Costs	$69	$82	$153	$153
Mid-Life Rolling Stock Overhaul Activities	$59	$59	$88	$88
Total Net Present Value of Economic Costs	**$431**	**$455**	**$613**	**$623**

All values are present value $M, $2023.

Economic analysis does not consider impact of inflation; however, applies cost escalation factor

5.3 Economic Benefits

The economic case considers four categories of economic benefits:

(i) *Transit user impacts* include travel time savings, reliable trip times, lack of crowding, and journey amenities, especially as compared to automobile use. There are also wellbeing benefits, i.e., the opportunity to work, relax, and engage in other activities rather than the act of driving; the encouragement of healthy lifestyles through increased walking; and reduction of road-safety incidents.

(ii) *External impacts* include changes in congestion on the roads, which benefit drivers who cannot take transit, as well as reduced GHG and pollutant emissions, reduced noise, and other unperceived costs of travel.

(iii) *Wider economic impacts* recognize that the existence of a good transit option provides benefit to the broader economy, as people can travel to previously difficult-to-reach or impossible-to-reach employers and businesses; and in turn, businesses are able to reach new pools of potential employees and customers.

The user impacts in this analysis are net impacts, meaning that they are incremental to the BAU scenario and only attributed to the proposed Cambridge Passenger Rail project's new service.

5.3.1 Transit User Impacts

The user benefits capture the social benefits, changes in generalized travel costs, and changes in the welfare of transport network users. The classification of users impacted by the proposed Cambridge Passenger Rail project include:

(i) *Existing Transit Users*: This considers the group of travellers who currently use transit, and whose generalized cost of travel decreases because of the realization of the Cambridge Passenger Rail project;

(ii) *New Transit Users:* The reduced cost of travel that will result from the Cambridge Passenger Rail project will attract new transit users that previously travelled by other modes of transportation (primarily by automobile). The new user benefit is an incremental benefit between what they are willing to pay and the new generalized cost of travel. The rule of half is applied to estimate the new user benefits associated with a change in consumer surplus. The travel demand modelling accounts for the perceived fare cost for new transit users when calculating their generalized cost. A fare revenue correction is made to account for the fare cost as a transfer benefit for the service provider.

The Cambridge Passenger Rail service will offer significant travel time savings and superior reliability for passengers. As the proposed rail line attracts new users, including existing auto users who will be diverted from the road network, perceived and unperceived auto operating cost will be reduced (including fuel consumption, licensing, insurance, and financing costs). Moreover, this transit investment will mitigate increases in congestion and reduced road maintenance costs as travellers who previously travelled by auto chose to use transit instead.

This IBC also considers fare resource adjustments in its analysis, to ensure the total user benefit considers fares paid.

Table 16 summarizes the net present value of the IBC transit user impacts.

Table 16: Summary of transportation user impacts

	Net Present Value ($M, $2023)			
Category	**Option 1A**	**Option 1B**	**Option 2A**	**Option 2B**
Travel Time Savings	$74	$77	$84	$85
Reliability	$81	$89	$99	$102
Congestion	$79	$88	$99	$101
Direct Costs	$79	$87	$98	$100
Fare Resource Adjustment	$187	$208	$232	$238
Total 60-Year NPV of User Impacts*	**$500**	**$549**	**$612**	**$626**

All values are present value $M, $2023

5.3.2 External Impacts

The external or social impacts are a result of the negative impacts from auto trips to society through GHG emissions, and injuries or fatalities that can result from collisions. Through investment in the Cambridge Passenger Rail project's new rail service, external impacts can be reduced by inducing more users to switch to public transit which decreases the overall number of auto trips being taken. This modal switch will result in decreased emissions and collisions, creating external benefits when compared to the BAU option.

External impacts are assessed based on the incremental automobile Vehicle Kilometres Travelled (VKT) between the proposed options and the BAU scenario. Table 17 below displays the present value of external impacts by option.

Table 17: Summary of external impacts

	Net Present Value ($M, $2023)			
	Option 1A	**Option 1B**	**Option 2A**	**Option 2B**
Road Safety	$25	$28	$32	$33
GHG & Other Air Pollutant Reduction	$11	$11	$13	$13
Total 60-Year NPV of External Impacts*	**$36**	**$40**	**$45**	**$46**

All values are present value $M, $2023

5.3.3 Wider Economic Impacts

Each transport investment has the opportunity to offer benefits to society beyond those afforded to travellers (user impacts) and those realized by reducing the social cost of travel (external impacts). New transit investments can improve accessibility to work, leisure, customers, and suppliers, which in turn can trigger new economic activity. Some of the wider economic benefits that the Metrolinx Business Case Guidance considers, as a response to an investments contribution to greater regional connectivity are:

(i) Productivity impacts due to agglomeration economies

(ii) Imperfect competition, and

(iii) Expanding commute shed and labour market supply

The quantification of these wider economic impacts (Table 18) can be difficult at a high-level phase. Based on literature review of other wider economic benefits and recognizing that wider benefits are higher for longer distance high speed rail projects and lower for urban metro and slower speed transit projects, 30% for wider economic benefits was seen as a good initial estimate for a regional rail project connecting cities and greater regions, i.e., Cambridge, Guelph, and Cambridge and the Greater Toronto Area. On this basis, the wider economic impacts were estimated to be 30% of benefits associated with travel time savings, reliability, and congestion relief.

Table 18: Summary of wider economic impacts

	Option 1A	Option 1B	Option 2A	Option 2B
Wider Economic Benefits	$70	$76	$85	$86

All values are present value $M, $2023

5.4 Economic Case Summary

Table 19 contains the findings of the Economic Case.

Table 19: Economic Case summary

Item	Option 1A	Option 1B	Option 2A	Option 2B
Total 60-Year NPV Economic Benefits	$606	$665	$742	$759
Total 60-Year NPV Economic Costs	$431	$455	$613	$623
Benefit-Cost Ratio (BCR)	**1.2 to 1.5**			

All values in the first two rows are net present value $M, $2023

All options have a BCR greater than 1, indicating that the costs of all investment options are offset by their benefits of implementation and operation, and are superior to the BAU scenario. Updated ridership forecasts and optimized train meet times are expected to significantly increase the BCRs of Options 2A and 2B.

Secondly, the positive NPVs indicates a net benefit for the region. These outputs indicate that the region, and the future passengers and residents within it, will realize benefits that will outweigh the fiscal costs of constructing and operating the line.

Finally, it is noted that as part of Metrolinx's new market-driven and TOC development strategy, the agency may partner with third parties to deliver new transit infrastructure. In such an arrangement, third parties could make contributions to station development as part of TOC development. If this approach was used at Pinebush Station, the cost of each option would decrease, improving the BCR for all options.

Other market-driven strategies and cost-sharing initiatives could also densify and intensify station sites, thereby bringing additional benefits to the system. These benefits should be explored in future stages of the business case development timeline.

5.5 Sensitivity Tests

Sensitivity tests are used to determine how variations in project assumptions could impact overall project performance. A range of tests were conducted to explore the effects of:

(i) Ridership (through associated MTSA population and employment projections, quality of connecting transit networks, and overall trip rates)

(ii) Value of time growth rate

(iii) Economic discount rate

(iv) Operating cost growth rate

5.5.1 Ridership Sensitivity

Low and high ridership projections (relative to the base ridership used in the above IBC analysis) were developed, reflecting the potential for ridership growth. The two scenarios reflect three important inputs: population and employment growth, connecting transit networks, and overall trip rates. Table 20 summarizes the parameters of the low and high ridership forecast scenarios. The resulting ridership forecasts for high and low scenarios can be found in Appendix A.

Table 20: Parameters for ridership sensitivity tests

Projection Scenario	Population and Employment	Connecting Transit Network	Passenger Trip Rate
Low Ridership	The population and employment forecasts were overlaid without changes from the 2041 GGHMv4 projections over all applicable station catchment areas (see Appendix A – section 1.2.1), using the population forecasts for auto catchment areas. Therefore, only some MTSAs (as listed in Appendix A – Table 27) will reach minimum densities.	This scenario assumes the ION service terminates at Pinebush Station (i.e. not continuing south to Cambridge).	The existing trip rate at Kitchener GO used (per Transportation Tomorrow Survey), adjusted for travel time and frequency changes.
High Ridership	Major Transit Station Areas (as listed in Appendix A – Table 27) will exceed density targets.	This scenario assumes the Region extends the ION service to downtown Cambridge.	The existing trip rate at Guelph Central Station (per Transportation Tomorrow Survey) used as a proxy, adjusted for travel time and frequency changes.

Ridership fluctuation will influence economic benefits (user impacts, external impacts, and wider economic impacts), as well as associated operation and maintenance costs. As shown in Table 21, low ridership assumptions lower the BCRs of all options below 1.0. High ridership assumptions raise BCRs above 1.5. Therefore, the policy adoption of MTSA density requirements, through transit-oriented development, is significant to the success of the Cambridge Passenger Rail project.

Table 21: Ridership sensitivity test results

Projection Scenario	Benefit-Cost Ratios (All Options)
Low Ridership	<1.0
Base Ridership (IBC Analysis)	**1.2 to 1.5**
High Ridership	>1.5

5.5.2 Value of Time Growth Rate Sensitivity

A sensitivity test was conducted to evaluate the impact of the value of time annual growth rate. This IBC analysis followed Metrolinx's recommendation of a 0% growth rate. This test considers a growth rate of 0.75% (capped after 30 years from base analysis year). As summarized in Table 22, the BCR range for all options slightly increases to 1.3 - 1.5. Allowing the value of time to grow on an annual basis further strengthens the IBC.

Table 22: Value of time growth rate sensitivity test results

Value of Time Growth Rate (capped at 30 years)	Benefit-Cost Ratios (All Options)
0% (IBC Analysis)	**1.2 to 1.5**
0.75%	1.3 to 1.5

5.5.3 Economic Discount Rate Sensitivity

A sensitivity test was conducted to investigate the impact of a lowered economic discount rate. This IBC analysis followed Metrolinx's recommendation of 3.5%. This test considers an economic discount rate of 2.5%. As summarized in Table 23, the BCR range for all options slightly increases to 1.4 - 1.8.

Table 23: Economic discount rate sensitivity test results

Economic Discount Rate	Benefit-Cost Ratios (All Options)
3.5% (IBC Analysis)	**1.2 to 1.5**
2.5%	1.4 to 1.8

5.5.4 Operating Cost Growth Rate Sensitivity

A sensitivity test was conducted to investigate the impact of an operating cost growth rate. This IBC analysis followed Metrolinx's recommendation of 0%. This test considers operations and maintenance cost growth rates of 1%, 2%, and 3% (capped after 30 years from base analysis year). Higher operation and maintenance cost growth rates account for uncertainty and risk pertaining to potential changes in electricity costs, increases in labour or commodity prices, unanticipated physical or environmental risks, disruptions in supply chains, etc. The changes reflected in the IBC BCRs are summarized in Table 24. Higher operations and maintenance growth rates lower the BCRs for all options.

Table 24: Operating and maintenance growth rate sensitivity test results

Operating Cost Growth Rate (capped at 30 years)	Benefit-Cost Ratios (All Options)
0% (IBC Analysis)	**1.2 to 1.5**
1%	1.1 to 1.4
2%	1.1 to 1.3
3%	1.0 to 1.3

6. Financial Case

The Financial Case assesses the overall financial impact of the proposed investment options.

While the Strategic Case and Economic Case outline how the Cambridge Passenger Rail project could achieve organizational goals and social value, the Financial Case focuses on the requirements to successfully deliver this investment. This includes a review of total revenue (fares) gained and expenditures (capital, operating, maintenance, and refurbishment) required over the lifecycle of the investment, incremental to the BAU scenario.

6.1 Financial Case Assumptions

The Financial Case relies on a series of assumptions – the majority of assumptions are shown in Table 25.

The Financial Case considers not only the nominal capital and operating costs, but also their expected rise over time, reflecting the expected cost of a good or service in the year of expenditure based on both inflation and escalation. Consistent with Metrolinx practice in business casing, inflation is applied to represent general increases in the price of goods and services across the economy as a whole, and escalation to represent transit-sector-specific increases, based on the empirical observation that prices in this sector often exceed the general inflation rate.

Table 25: Financial Case assumptions

Input	Value	Source
Evaluation Period	60 years, starting from opening year (2026 - 2086)	Hatch; industry standard expected useful life of longest-lived project element (track)
Design Life of Rolling Stock	30-year assumption. Repurchase of fleet required after 30 years. Mid-design life overhaul events required.	Hatch, best practice
Financial Discount Rate	5.5%	Metrolinx
Inflation Rate	2%	Metrolinx
Annualization Factor	280	Hatch, best practice
Capital, Operating and Maintenance Cost Escalation	1% applied for the 30 years after opening year (2026 - 2056) 0% applied between 2056 - 2086	Metrolinx
Growth Cap	All growth, escalation and inflation stop (0%) after 30 years of operation (after 2056)	Metrolinx
Assumed GO Train Fare Structure	Distance-based	Metrolinx GO Train Fare Calculator
Average GO Trip Fare (Pinebush Station to Guelph Central Station)	$12.70 See Appendix A for methodology	Dillon Consulting
Proportion of Ridership by Fare Type	98.6% PRESTO 1.4% Single-Ride Ticket	Metrolinx GO Rail Passenger Survey (2017)
Labour Required	Five (5) full-time staff	Hatch, assumption based on best practice

Input	Value	Source
Labour Benefits	25% of salaries	Metrolinx
Cost of Electricity	$0.15/kWh, conservatively assuming residential consumer rates	Ontario Energy Board

6.2 Capital Costs

Fleet procurement and 30-year replacement make up a considerable proportion of initial and replacement capital cost requirements. All initial capital costs developed, except for fleet requirements and property acquisition costs, include a 15% markup to account for engineering design and construction allowance; as well as a 30% contingency allowance.

Two caveats apply to the computation of capital costs. Firstly, if the project purchased property around the station and developed it such that commercial and especially residential uses were integrated with the station, the project's capital costs might be significantly offset. While determination of such value is out of scope for this assignment, further work in this regard to forecast the revenue potential and strategize how to achieve it should be considered.

Secondly, the outstanding, non-depreciated value of the capital investments at the close of analysis – notably the rolling stock – has not been subtracted from the capital costs of the options. If this was done, the net capital costs would be lower across all options. See a summary of financial capital costs in Table 26 below.

Table 26: Summary of financial capital costs

	Net Present Value ($M, $2023)			
	Option 1A	Option 1B	Option 2A	Option 2B
Total 60-Year NPV of Financial Capital Costs	396	407	494	505

6.3 Operating and Maintenance Costs

The operation and maintenance of a GO rail service will incur costs for staffing, fuel, vehicle and track maintenance, and other state of good repairs. The analysis assumed two mid-design life rolling stock overhaul events, valued at 50% of initial vehicle purchase cost occurring halfway through the useful life of each vehicle (2041 and 2071). The financial model applies a 30% contingency factor to operating and maintenance costs.

The Financial Case assumes with the opening of new rail service and the shifting of consumer demand from the former bus service to rail, Metrolinx would not dispose of then-surplus rolling stock assets (buses) and human resources, but instead redeploy them to other operations. The overall cost savings from the elimination of parallel GO Bus services are very small, if any. Consequently, no savings of this sort have been assumed in this analysis.

Where costs of electricity have been modelled, these rely on expected prices for residential consumers. This is a conservative estimate, as Metrolinx would have access to a lower industrial discount.

The operating and maintenance costs (Table 27) may potentially include track access fees to CN to utilize the Fergus Subdivision. These fees have not been specifically modeled in this analysis as further consultation with CN is required.

Table 27: Summary of financial operating and maintenance costs

	Net Present Value ($M, $2023)			
	Option 1A	Option 1B	Option 2A	Option 2B
Total 60-Year NPV of Financial Operation & Maintenance Costs	**149**	**162**	**273**	**273**

6.4 Incremental Revenue Impacts

The Cambridge Passenger Rail project will generate fare revenue from net new riders on the service. A summary of the project fare impacts is shown in Table 28. Average fares are applied to the forecasted annual ridership derive the incremental change in fare revenues. An average fare for the GO train trip between Cambridge and Guelph was determined by:

- Defining the proportional ridership by age group and concession type based on the Kitchener GO Line; and
- Determining the cost by distance and concession type.

Further discussion on fare revenue analysis can be found in Appendix A.

Table 28: Summary of incremental revenue impacts

	Net Present Value ($M, $2023)			
	Option 1A	Option 1B	Option 2A	Option 2B
Total 60-Year NPV of Fare Revenue Impacts	**106**	**117**	**129**	**132**

6.5 Funding Sources

The Phase 2 Feasibility Report presented a few potential options for both championing the planning of the new rail service and funding the necessary capital improvement, capital costs and operations. The Phase 2 report suggested a joint partnership-based model with collaboration from the proponent municipalities in conjunction with Metrolinx as likely most efficient. This recommendation would line up well with the recently legislated Ontario Government's Bill 131, whereby the Province enables a formal mechanism for municipalities to apply a charge to developments surrounding the proposed stations/transit which would be used to build the station and station infrastructure. Beyond Bill 131 proceeds, the Canada Infrastructure Bank remains a potential funding (or below-market cost finance) mechanism as well as the recently announced Ontario Infrastructure Bank (similar to Canada Infrastructure Bank), which could be leveraged to deliver the project.

There remains likely upside, efficiency, and potential to work with private landowners and/or developers adjacent to, or near the stations (particularly Pinebush Station) to leverage their increase in real estate value or development that would come from increased transit services, whether through integrated station access and recoup significant station development infrastructure costs by integrating station and station area infrastructure into the adjacent property directly.

Overall, there are several sources of funding and finance that together, could reasonably deliver the line.

For example, Bill 131 could be used to implement a modest area charge on new developments to allow for early-stage project funding for additional studies (with the expectation of eventual financing from the Canada Infrastructure Bank similar to the Calgary-Banff rail project). Federal, Provincial, and Municipal funding could be leveraged, the overall cost of the project would be manageable to all parties and the project could proceed.

A more detailed economic analysis, to be completed in the following phases of the project, will comprehensively identify the financial benefits to the Federal Government and the Province, and will help show why grant dollars are an attractive investment for merely financial return reasons.

6.6 Financial Case Summary

The overall NPV of the transit investment is negative over the 60-year time horizon, indicating the project requires financial subsidy to operate. Options 1A and 1B are functionally identical to each other, as are Options 2A and 2B; but 1A and 1B have superior R/C ratios, with 1A being very slightly better as shown in Table 29.

Further refinement of the financial project costs is required as the project advances (see Figure 10 – Proposed Cambridge Passenger Rail project schedule).

Table 29: Financial case summary

	Net Present Value ($M, $2023)			
	Option 1A	**Option 1B**	**Option 2A**	**Option 2B**
60-Year NPV of Capital Costs	396	407	494	505
60-Year NPV of Operations and Maintenance	149	162	273	273
60-Year NPV of Fare Revenue Impacts	106	117	129	132
Total 60-Year NPV of Financial Impact	**(439)**	**(453)**	**(638)**	**(646)**
Net Operating Cash Flow	**(43)**	**(45)**	**(144)**	**(141)**
R/C Ratio	**0.7**	**0.7**	**0.5**	**0.5**

7. Deliverability and Operations Case

The Deliverability and Operations Case forms an analysis of project delivery, service plans, operations and maintenance, and primary foreseeable technical constraints (including grade crossings, track infrastructure, terminus stations, maintenance, and storage facility) to implementing the options, based on information available. The Deliverability and Operations Case builds on the potential issues highlighted for further review and analysis in the Phase 2 Feasibility Report. The Deliverability and Operations Case will continue to develop as the Region and Metrolinx continue to advance the project post-IBC, in particular the project implementation plan.

It is important to note a critical project milestone would be to formally include this Project in the upcoming Metrolinx RTP update. Metrolinx is a key stakeholder and together, Metrolinx and the Region will need to collaboratively work to advance this Cambridge Passenger Rail project further towards the design and delivery stages. Additionally, the Region and Metrolinx might want to consider approaching Canada Infrastructure Bank to explore financing opportunities through obtaining low-cost and long-term capital (or a portion of) required to execute the Project. The Region would need to make a formal submission of IBC material for consideration to Metrolinx. In parallel, the Region should start to formally engage the Province of Ontario in order to obtain an official status for the Project.

7.1 Delivery

7.1.1 Project Sponsor and Project Governance

In one scenario, Metrolinx would act as the overall project sponsor, while CN will be a key technical stakeholder. As the Fergus Subdivision is owned by CN, all decisions on infrastructure and services require working with CN to agree and deliver the optimal solution. Negotiations would be required to determine further responsibilities related to project sponsorship and delivery.

The development of new rail projects can follow several scenarios, three of which are summarized below (where order of scenarios does not indicate preference):

(i) **The Province of Ontario, as the owner of Metrolinx and regional rail authority, will champion the project and take it over through development**. This style of project delivery, whereby a municipality brings a rail infrastructure project to higher-order government has occurred in places like London, England, where there has been considerable dynamism and change in governance and championing of projects. For example, the Overground (a sub-regional suburban rail network for outer London, connecting across jurisdictions) was originally Network Rail and has become part of Transport for London; and the initial idea and concept was developed and championed at a local level.

(ii) **The Region continues to lead and champion the Project, by advancing planning, design, and further pre-implementation work**. The Region has taken a leading role in the planning, and delivery of the ION rapid transit system – a system which makes use of both roads and traditional railway rights of way for its rail corridor rights-of-way and operation. Similar to the Region's ION rapid transit system, the Regional Municipality of York's ('York Region') advanced design and engineering work ahead of Metrolinx's ability to take a position on the project (in 2006 and 2007),

and the York Viva system's implementation is a result of York Region's leadership, which eventually compelled the Province and Metrolinx to become partners in delivering the program. Delivery of York Viva was, particularly in its early years, led and driven by York Region Rapid Transit, a corporation set up by York Region to deliver the York Viva system.

(iii) **A joint partnership-based model with collaboration from the proponent municipalities in conjunction with support and feedback from Metrolinx**. Today, the Ontario urban rail network is undeveloped and there are several projects that could be advanced with some consortia of stakeholders coming together to advance ideas and analysis that could lead to projects. The Metrolinx RTP and MTO's Greater Golden Horseshoe Plan are largely top-down and do not widely consult on the opportunity for projects. Furthermore, rail projects can come from unexpected places. REM, in Montreal, might be the largest and most significant transit project that came from a new source for rapid transit planning, and was implemented (by CDPQ Infra, a specifically set up organization by the Caisse de Depot en Placement, in Montreal). Metrolinx has been focused on delivering the core interior GO network, which was originally identified as a high performing priority in 2014-2015 (Province of Ontario including MTO direction). While, in parallel, the Government of Canada has prioritized the development of a High Frequency Rail network linking Quebec City, Montreal, Ottawa and Toronto, with intermediate stations at Peterborough and Trois Rivieres. In the absence of higher-order of government leadership, it is appropriate for regional and municipal governments, like the Region, to continue to take a leadership role to drive the future of their infrastructure and the ambitions of their communities (e.g. to be connected for reasons of environment, economic, and social-community growth, and achievement).

7.1.2 Project Schedule

The following Figure 10 provides a likely schedule/timeline for the Project. From a process perspective, the roadmap diagram shown in Figure 10 provides an overview of the potential directions to move the Study through subsequent stages of design and implementation to make the Cambridge Passenger Rail Project a reality. The roadmap highlights five key areas of the rail service phasing which consist of: Design and Planning, Contracting and Procurement, Financial Planning and Considerations, Legal and Business, Stakeholder Engagement.

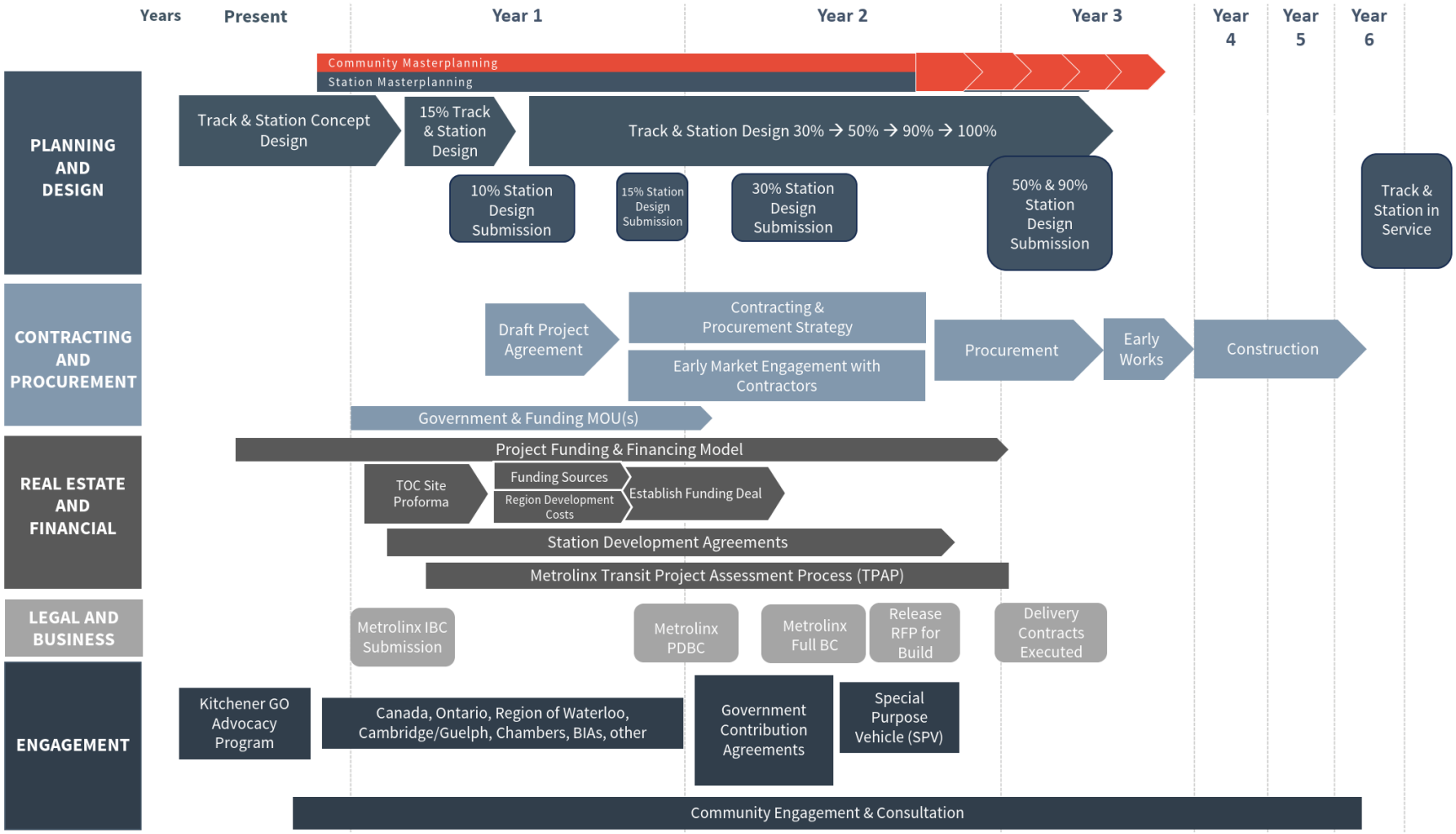

Figure 10: Cambridge Passenger Rail project schedule

7.1.3 Rolling Stock Recommendation

The 2021 Phase 2 Feasibility Report recommended the carrying forward of three options: Electric Battery Multiple Unit (EBMU), Diesel Multiple Unit (DMU), and Electric Multiple Unit (EMU). At the time, it appeared a number of smaller regional routes with somewhat similar characteristics as the Cambridge Passenger Rail project were adopting Electric Battery Multiple Unit (EBMU) rolling stock, and the combined economics, cleanliness, and efficiency of this kind of motive power likely made the most sense. Conversely, diesel motive power would be carbon-emitting, and Electric Multiple Unit (EMU) rolling stock would require the stringing of wires along the line, which could be difficult given the interface with freight in this territory. Given the smaller trains being used, it was seen as a good place to trial the technology in Ontario. It is important to note this study is not recommending EBMUs for bigger and heavier trains on other parts of the Ontario network – that is out of scope of this study.

An EBMU is an electrically driven multiple car unit whose energy is derived from rechargeable batteries that drive its traction motors. While this technology is deployed on more corridors, it is expected that new boundaries of performance will be achieved. Today, the generally accepted maximum speed this technology will run at is approximately 140 km/h and units typically would be expected to have an approximate battery range of 80 kilometres, which is ideally suited to this corridor. The estimated energy usage per trip is 17 kWh. A typical 250 kW charger will allow for a charge time of approximately 4-minutes at either end of the corridor to support EBMU. Since it is possible for the trains to charge at either end of the route between journeys, no external power supply is required. Therefore, no wires are required along the corridor and no traditional diesel fueling stations are needed. This alternative technology eliminates the cost of corridor electrification and associated maintenance.

EBMU technology has reasonable climate adaptability, operational reliability, and some delivery risk, and offers a reduction in runtime when the train operates at a speed is 85 km/h or greater. Additionally, operation and maintenance costs for EBMU are low relative to EMU rolling stock. Standard EMU trains can be difficult to operate as a stand-alone service, as there would be no connection to a heavy rail maintenance facility along the Cambridge Passenger Rail project.

The EMBU concept on this corridor for planning purposes has been assumed to consist of a four-car train which should provide appropriate capacity and room for growth and accommodate cost-effective platforms and station facilities. Other rolling stock options could be implemented on this corridor, but EBMU appears to be a promising candidate for the corridor.

7.1.4 Major Infrastructure Requirements

As part of the proposed connection between Cambridge and Guelph off the existing Kitchener GO Line, the scope of work for this project includes two GO stations. The first station is the Guelph Central Station, which will be converted into a transfer station by potentially adding a third track or accommodating within the station and south track/south platform (currently under construction/ development by Metrolinx). The second station, Pinebush Station, will be a new station built along an existing rail corridor. Appendix D and Appendix E illustrate and discuss in further detail the conceptual design analysis completed for major infrastructure requirements in parallel with this IBC and summarized in this Section 7.1.4.

7.1.4.1 Pinebush Station

The Pinebush Station is planned to be a comprehensive transit hub, incorporating various modes of transportation and promoting active travel by connecting with nearby infrastructure and bike lanes, which are part of the proposed redevelopment under the “Draft Hespeler Road Corridor Secondary Plan” (See Appendix D: with focus on Drawing GRA_ILL_008, Drawing GRA_ILL_009, GRA_ILL_010). The design of the Pinebush Station, as part of the Cambridge Passenger Rail project, will include an entrance building, a passenger pick-up and drop-off area, and a side platform on the north side of the existing rail corridor. The station’s integration with local transit networks could be achieved through the inclusion of bus loops and car parking facilities or, importantly, achieved through integration with future development adjacent to the site (which could enable better urban design outcomes with an integrated multi-modal transport hub and mixed-use development: a new centre for Cambridge, anchoring additional urban development that is walkable, cyclable, and transit-oriented). In other words, a model TOC. The expected plans for the new Stage 2 ION route incorporate needed platforms serving the ION network and can enhance integration with the neighboring properties to the south. This station could play a critical role in shaping and linking future growth in Cambridge and enhancing the innovation and education hub in the Region and Guelph.

7.1.4.2 Guelph Central Station

The Guelph Central Station is expected to play a significant role in the expansion of the Kitchener GO Line and the proposed Cambridge to Guelph connection (see Appendix D: with focus on Drawing GRA_ILL_004, Drawing GRA_ILL_005, Drawing GRA_ILL_006, Drawing GRA_ILL_007). As part of Metrolinx’s plan to extend the GO train service on the Kitchener GO Line, a new side platform and pedestrian connection is being constructed along the southern side of the existing rail corridor. For the proposed Cambridge Passenger Rail connection, the initial phase is to utilize the south track and the new side platform at the Guelph Central Station. For a possible future phase, only if necessary due to train service and pathing planning not yet available (as illustrated in the preliminary concept design), adding a new track on the south and transforming the side platform into an island platform was considered to ensure feasibility in any event. Additionally, the on-going south platform/track scope of work by Metrolinx assumes a new south access building with an extension to the pedestrian tunnel connection and a passenger pick-up and drop-off (PUDO) area. Additional coordination (beyond scope of IBC) is required to leverage Metrolinx on-going south platform and track work.

The Drill Hall, a historic building at the south side of the tracks, will not be affected with the introduction of a Cambridge passenger rail service. There is potential for development integration to enhance Guelph Central as a TOC.

7.1.4.3 Track Infrastructure Improvements

The design of the Cambridge Passenger Rail connection is based on the framework of a low-cost deliverability and operations system, while achieving reasonable performance for passenger service.

In support of the Deliverability and Operations analysis, and furthering recommendations made in the Phase 2 Feasibility Report, conceptual design thinking and analysis has been completed for the use and required upgrade of the existing Fergus Subdivision single-track and siding (currently operating freight with CN) to run daytime passenger service based on options 1A/1B, 2A/2B, onto the Metrolinx Guelph

Subdivision into Guelph Central Station. The current use of the Fergus Subdivision is freight, and the tracks are owned by CN, while the Guelph Subdivision is owned by Metrolinx. Appendix D provides additional commentary, analysis in the form of preliminary track layout drawings, and associated design brief (Appendix E). Appendix E provides additional analysis about the require signal crossing upgrade considerations which have been used to update capital cost tables shown in Appendix C.

As previously mentioned in Section 3.2.3, further refinement of Option 2A/2B track alignment is required in a subsequent phase of work. This refinement should aim to achieve faster journey times and the corresponding increase to the project's economic benefits by optimizing the location and length of the proposed siding.

7.1.5 Rail Crossings

Identification of the impacted at-grade and grade separated crossings along the alignment are summarized further in Appendix B. Figure 11 illustrates the public rail crossings (at-, below-, and above-grade); however, does not include all crossings (i.e. private crossings). See Appendix B for the full list.

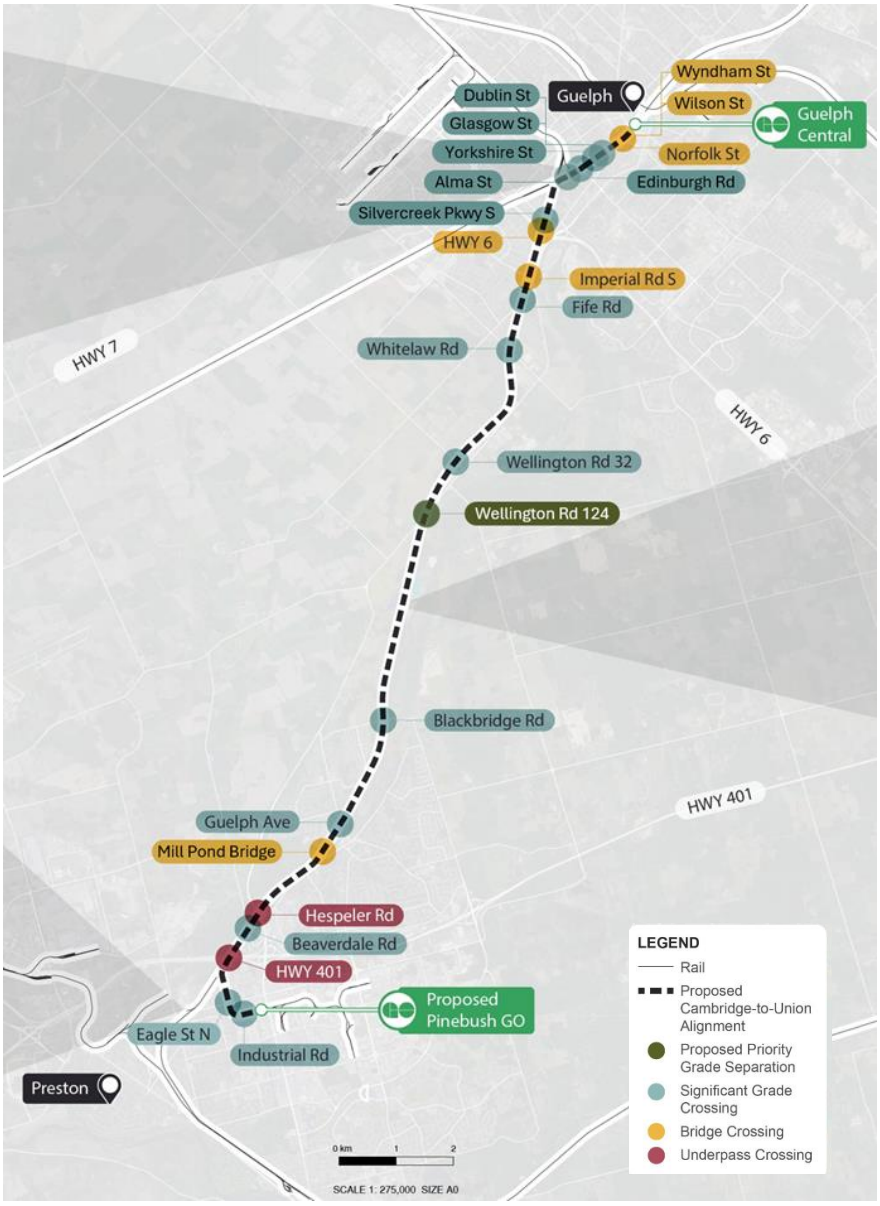

Figure 11: Public rail crossings along the proposed alignment. (See Appendix B for full list)

When considering potential infrastructure improvements, an environmental assessment of the crossings along the proposed corridor will be required, as well as consideration for utility relocation, property impacts, construction staging, groundwater table effects, visual impacts, and future road capacity requirements.

Some crossings are subject to cost-prohibitive construction constraints such as adjacent hydro corridors, nearby private driveways, underground utilities, or neighbouring property impacts. Each of the crossings would need to be assessed if the train speed or frequency is to be raised above its current level to ensure compliance with rail safety standards. Additionally, if in a future condition, double tracking was pursued, the

feasibility of double tracking the corridor would need to be examined separately to identify the additional construction and costs implications.

7.1.6 Signals

No changes are considered to signalling along the existing Guelph Subdivision; the system is expected to operate under current signalling system along Guelph Subdivision with negligible design updates. No signalling cost provisions have been considered for proposed new track at Guelph Central Station. Further coordination would be required for tie-in to existing signalling system along the Guelph Subdivision.

Modifications at Guelph Junction will be required to facilitate a signalled corridor along the Fergus Spur track. This will require rework of the current interlocking bungalow, which requires wiring modifications and testing to be performed directly on site.

New signalled locations will be provided along the spur track, including two control locations and up to three intermediate (automatic) signals. One control location will be required at the existing switch along the Fergus Spur, and a second is anticipated for managing the departure from Pinebush Station.

If a new siding is introduced, a further two control locations will be required to manage train pass moves. This will likely reduce the number of intermediates required, depending on final siding location.

It is assumed the overarching signalling control will be provided as an extension of the existing control centre for the Guelph Subdivision.

The analysis for the purposes of this IBC has not attempted to cost an independent Central Train Control system, nor determine if one is required for this project.

Additional commentary about signal requirements can be found in Appendix E.

7.1.7 Storage and Light Maintenance Facility

A small storage facility will be required to support the Cambridge Passenger Rail project. There are several potential locations nearby the proposed Pinebush Station, that could provide train storage and light maintenance facilities, and also increase revenue operating time. For all operating service scenarios, it is assumed that one spare trainset will be stored at the location (recommended near Pinebush Station), but revenue trainsets will vary over time. The light maintenance facility initially can be built to accommodate three trainsets for rail service in all options.

While the light maintenance facility site will only offer light maintenance services such as cleaning, all heavy maintenance is assumed to be completed at the GO Transit Willowbrook Rail Maintenance Facility in Etobicoke. The rolling stock and supporting equipment is expected to cycle periodically to the Willowbrook Rail Maintenance Facility. Further, it is important to confirm the rolling stock equipment used on this line is compatible with other Metrolinx corridors, such as electric battery- or diesel-powered trains operating between Guelph Central and Bramalea GO Stations.

A refined site selection and evaluation exercise is recommended for subsequent phases of work.

7.1.8 Construction Impacts

The infrastructure improvements will involve work on the existing shared rail corridor and municipal roads. The proposed infrastructure scope primarily involves rehabilitation and upgrade of existing infrastructure and construction of and station platforms adjacent to the existing track. These works are not expected to require long term closures of the railway, and can be conducted under planned protections, or during overnight or weekend closures. Works would need to be planned to maintain safety of construction and railway operations.

7.2 Operations and Maintenance

7.2.1 Roles and Responsibilities

It has not yet been determined who the appropriate party is that should generally be responsible for the delivery, maintenance, and operation of infrastructure on the Guelph and Fergus Subdivisions. Today CN owns the corridor and Metrolinx operates GO Rail services in the area. VIA Rail also operates services in the area. It is conceivable that a third party on behalf of the Region or of Metrolinx could operate services. A detailed assignment of roles and responsibilities, as well as apportionment of related costs, will be established as part of future discussions between Metrolinx and CN. This includes decisions regarding CN track access.

7.2.2 Freight Operation Interaction

It is recommended that all freight activities will be rescheduled to the night hours. This will allow the freight operators to serve their clients without impacting the passenger service operations. As part of the IBC, continuing from previous feasibility study, key stakeholder engagement discussions with CN, have continued, and CN is open to further discussion.

7.2.3 EBMU Charging Dwell Time & Train Meet Considerations

Based on a literature review of EBMU deployed elsewhere, the battery capacity and charging technology (as of 2023) typically allows the train to run for 160 kilometres with 15 minutes of charging. Factoring in a conservative buffer and time for crew to prepare the charging process, 4 minutes is believed to be sufficient to charge a one-way trip on this corridor (19.3 kilometres). The terminus dwell time of approximately 13 to 14 minutes in the simulated scenarios will be sufficient to charge the train for one direction.

In Option 1, with only one train operating on the line, there is an opportunity to charge the trainset for two trips (i.e., a round-trip) at one of the two stations, factoring in a longer dwell time (conversely shorter dwell at the non-charging terminus).

The optimization of both the estimated charge time and the service timetable should be studied in subsequent phases of work. Further development of service patterns will allow for immediate boarding of Kitchener GO Line trains from the Cambridge Passenger Rail trains.

7.2.4 Other Project Interfaces

This IBC assumes the delivery of the Kitchener GO Rail Service Expansion Program as well as the supporting GO Expansion Program, to provide the required connecting service levels and infrastructure on the Kitchener GO corridor and the Union Station Rail Corridor. The infrastructure investments will enable half-hourly two-way all-day service to Mount Pleasant GO station and hourly two-way all-day service to

Kitchener GO station, as well as improved peak period peak direction frequencies. These initiatives are assumed to be relevant to all IBC investment options, including the BAU scenario. They contribute to the operation of the proposed service levels on the Kitchener corridor and the realization of the Cambridge Passenger Rail project's benefits. Delays in advancing the project dependencies may result in delays or adjustments to the Cambridge Passenger Rail project, its associated service level, and the total benefits of the program.

This IBC does not consider or propose changes to the existing GO Bus network.

7.3 Deliverability and Operations Case Summary

Table 30 summarizes the key findings of the Deliverability and Operations Case. The deliverability and operations analysis will need to be further refined in subsequent phases of work to advance the Business Case.

Table 30: Deliverability and operations case summary

Risk Category	Option 1A	Option 1B	Option 2A	Option 2B
Deliverability	• Program is dependent on confirming an agreement with CN • Delays in advancing any project dependencies may result in delays or adjustments to the Cambridge Passenger Rail service and the total benefits of the program • Typical constructability challenges associated with a rail corridor program • Further refinement of light maintenance and storage facility location required			
Operations	• Operations and maintenance agreement required with CN • Timetable optimization required in later project phase for most efficient interchange with Kitchener GO Line service		• A delay on one train could result in a delay for the opposing train movement since train meet operation is reliant on a track siding • Timetable optimization required in later project phase for most efficient interchange with Kitchener GO Line service	

8. Business Case Summary and Next Steps

This chapter summarizes the findings of the four-case evaluation, provides a recommendation on the options to be advanced for procurement, and highlights additional work or investigations that are required to confirm the findings of this IBC.

8.1 Case Review

Chapter 1 introduced the need to serve the Region with better rapid transit; the Cambridge Passenger Rail project, a proposal for a new GO service between Cambridge and Guelph as an extension of the Kitchener GO Line, as a possible answer to this need; and the Metrolinx Business Case Guidance, which has become the standard for evaluating transit investments in Ontario, as a tool for evaluating the project's merits.

Chapter 2 outlined the case for change, which rests on the significant population growth expected in the Region in coming decades; the crippling congestion that such growth would impose it if was served entirely by automobile trips; and the lack of expected alternatives, while highlighting the opportunities to leverage and improve forthcoming projects that are in plan, such as two-way, all-day GO service on the Kitchener GO Line; integration with the Region's ION Stage 2 project, and the potential for TOD at the new stations.

Chapter 3 described the substance of the IBC: the contrast between a Business-as-Usual scenario, in which no new rail service is implemented, against the introduction of a new Cambridge Pinebush Station, connected to GO's Kitchener GO Line, and other investments necessary for the introduction of passenger-rail service. Options 1A, 1B, 2A, and 2B were presented as possible instances of such service, with Option 2 adding a siding to the track to facilitate *more* service, and each Option B adding segments of improved track to facilitate *faster* service. Chapters 4 through 7 reviewed the findings of the Strategic, Economic, Financial, and Deliverability and Operations Cases respectively.

The Strategic Case found that any option outperforms the Business-As-Usual scenario, because the Cambridge Passenger Rail project is strongly aligned with the existing plans and aspirations of the City of Cambridge, City of Guelph, the Region, and the Province.

The Economic Case compared costs and benefits of the project for and to all users, and to society at large. It found that all investment options were viable and outperformed the BAU scenario. Therefore, the Cambridge Passenger Rail project's benefits exceed its costs.

The Financial Case compared the capital and operating requirements to successfully deliver the project across all scenarios and the BAU scenario. It found that all investment options have a revenue/cost ratio of below 1, indicating that all options would require subsidy to operate. This is a reasonable outcome for any public-transit project, which typically operates at a loss to deliver non-financial benefits.

The Deliverability and Operations Case analyzed project delivery, service plans, operations and maintenance requirements, and the primary foreseeable technical constraints to implementing the options. It was determined that project would require major capital works and service updates; however, would be feasible for delivery of all options.

8.2 Recommendations

Based on the findings of the four cases, **the IBC recommends the Cambridge Passenger Rail project should proceed**.

This recommendation rests on the findings of the four cases, which find that the project has a strong planning rationale, a reasonable cost, and benefits that exceed those costs; and that it can be delivered with reasonable certainty.

The IBC further recommends that the project be advanced and options for optimization, consistent with the options presented here be carried for further design and analysis. At present, all investment options outperform the BAU scenario significantly.

As such, the IBC recommends that:

- **Metrolinx**, following best practices of business casing and prioritization, adopt and advocate for this project, while including it in the upcoming Regional Transportation Plan update;
- The **Ministry of Transportation of Ontario** direct Metrolinx to include this project in its planning, given the solid business case and clear alignment with the agency's plans;
- The **Province of Ontario** acknowledge the project's potential to help address the ongoing housing crisis by providing opportunity for significant residential growth without a corresponding increase in road congestion.

The IBC proposes that the next steps for this project should include:

- Further design and engineering to take the project to a Preliminary Design Business Case. This includes a rail simulation assessment to determine optimal location and length of track siding, future service analysis involving double tracks and/or an additional station;
- Refined ridership forecasting for Options 2A and 2B to investigate demand response to greater service frequency;
- Further consultation with CN to establish strategy for use of the Fergus Subdivision;
- Planning of a TOC study for Pinebush Station;
- Engagement with Metrolinx to ensure that Kitchener GO Line speed improvements proceed and better establish project planning and delivery responsibilities.

Appendix A
Ridership and Revenue Forecasting Methodology

DILLON CONSULTING

CITY OF CAMBRIDGE

Ridership Forecast Update - Cambridge to Union Rail Feasibility Study

December 2023 – 23-6906

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Tables and Figures

1.0 Ridership Forecast

The Cambridge to Union GO Rail Feasibility Study completed in 2019 included ridership forecasts which considered ridership between the proposed Pinebush GO Station in Cambridge and each of the stations along the Kitchener GO Rail line between Guelph and Union Station. This methodology has been updated with new information released since the 2019 Feasibility Study was completed. This report outlines the methodology and results in more detail.

1.1 Changes in the Landscape Since 2019

The Cambridge to Union GO Rail Feasibility Study was completed in 2019. Since that time, a number of reports and policies have been released regarding the future landscape of the GO Rail network, local transit networks, and population and employment estimates. The following reports and data were found to have the potential to impact the assumptions used in the Cambridge to Union GO Rail ridership forecast:

- Kitchener GO Rail Service Expansion Initial Business Case (2019) and Kitchener GO Rail Service Expansion Preliminary Design Business Case (2021);
- 2019 GO Rail Passenger Survey;
- Establishment of MTSAs at all major transit stations;
- The planned decommissioning of Etobicoke North GO and subsequent addition of Woodbine GO Station;
- GO Rail Station Access report (2022-2023); and
- ION Stage 2 planning.

A number of these reports consider the impact of the COVID-19 pandemic, which occurred following the completion of the 2019 Feasibility Study, and had an impact on population growth, ridership and travel patterns.

While the ROPA 6 amendments identifies changes to the Waterloo Region's population projections, these adjusted forecasts were not available at the traffic analysis zone level and therefore did not provide an adequate level of detail to identify the impact on the transit catchment areas. As such, previous projections were to calculate a conservative estimate of the potential ridership.

1.2 Forecasting Preparation

Two forecasting methodologies were used to determine the ridership between stations:

- The methodology used for forecasting trips between Pinebush GO to Union Station uses a passenger trip rate from comparable GO stations and applies the rate to population in the Pinebush GO Station catchment area.

- All other trips between Pinebush GO Station and any mid-line GO station use a different methodology that accounts for how the stations are expected to change over the horizon period, based on existing and future expected mode shares.

Across the entire forecasting process, different ridership projections were developed reflecting the potential for ridership growth. The three ridership projections reflect three important inputs: Population and employment growth, connecting transit network, and trip rates. The application of these variables to the projections are identified in **Table 1**, and will be further explained in this section and the following sections.

Table 1: Projection Ranges and Correlation with Key Variables

Projections	Population / Employment	Transit Network	Trip Rate
Low	Population / employment growth as per the Greater Golden Horseshoe Growth Model (2011)	ION does not extend past Pinebush Station	Existing trip rate from Kitchener GO as per TTS, adjusted for travel time and frequency changes
Medium	MTSA population / employment targets met	ION extends to downtown Cambridge	50% increase in standard trip rate using Kitchener GO as a proxy station, adjusted for travel time and frequency changes
High	MTSA population / employment targets exceeded	ION extends to downtown Cambridge	Standard trip rate using Guelph Central as a proxy station, adjusted for travel time and frequency changes

Both methodologies have the same initial steps, outlined in this section:

1. Establish catchment areas for all stations, under the existing network and future network
2. Calculate population coverage in auto catchment areas, and employment coverage in transit catchment areas, to 2041 under different forecasts.

1.2.1 Catchment Areas

The first step in the analysis was to identify the growth in the catchment area population and employment at the proposed Pinebush GO Station. The following measures were used to define each of these catchment areas:

- Walking: 800 metre distance or a 10-minute walk away from the subject station;

- Transit: average speed of 20.79 km/hr[1] at 15 minutes away from the station, and an 800-metre distance or 10-minute walk away from any Stage 2 ION station (Sportsworld and further south); and
- Auto: 15-minute travel radius based on speed limits and generalized traffic information.

At Pinebush GO Station, the auto catchment area was adjusted to exclude any overlap with existing and planned GO stations, including Kitchener, Guelph Central, and proposed Breslau GO stations. There are also currently multiple alternatives to determine the final length of the ION extension under Stage 2. As a result, two transit catchment areas were created, a smaller area which reflects the ION extending to the Pinebush GO Station, and a larger area which considers the ION to be extended to Downtown Cambridge Station (located on Bruce Street as currently under review).

Two sets of auto and transit catchment areas were used for this analysis: an existing set reflecting the current stations (**Figures 1 and 2**), and a future set reflecting the planned network as identified in the 2021 Kitchener GO Rail Service Expansion Preliminary Design Business Case (**Figures 3 and 4**). In the future network, service extending west of Bramalea GO Station would operate on diesel service, running express between Woodbine GO Station and Union Station. Stations in between Woodbine GO Station and Union Station would only operate on a more frequent electric service running between Bramalea GO Station and Union Station. The differences in the existing and future set of catchments are therefore:

- Etobicoke North GO Station is replaced with Woodbine GO Station;
- Weston GO and Bloor GO Stations are moved to a combined "inner service" catchment, which reflects areas where people are more likely to need to transfer to a separate higher frequency train service which is expected to operate between Bramalea GO and Union Station.

The 2021 Kitchener GO Rail Service Expansion Preliminary Design Case identifies a number of stations which will be served by an electric train operating between Bramalea and Union Station. The diesel train which will continue to serve the outermost stations on the Kitchener Line will skip stations between Woodbine GO Station and Union Station. Due to the additional transfer required and the implications on travel time the stations between Woodbine GO Station and Union Station are considered separately. Bloor GO, Mount Dennis GO, and Weston GO Stations were used to approximate the catchment for those passengers who would transfer between the electric train and diesel train along this corridor. The average fare for these passengers was projected by considering passengers near King-Liberty GO to be in the Bloor GO or Union Station catchment (depending on distance from Union) and therefore having a similar fare and those in the St. Clair-Old Weston GO Station to be in the Mount Dennis GO and Weston GO Station catchment areas and have a similar fare.

[1] The transit catchment speed is based on the average bus travel speeds from Grand River Transit, and was used in any transit forecasts

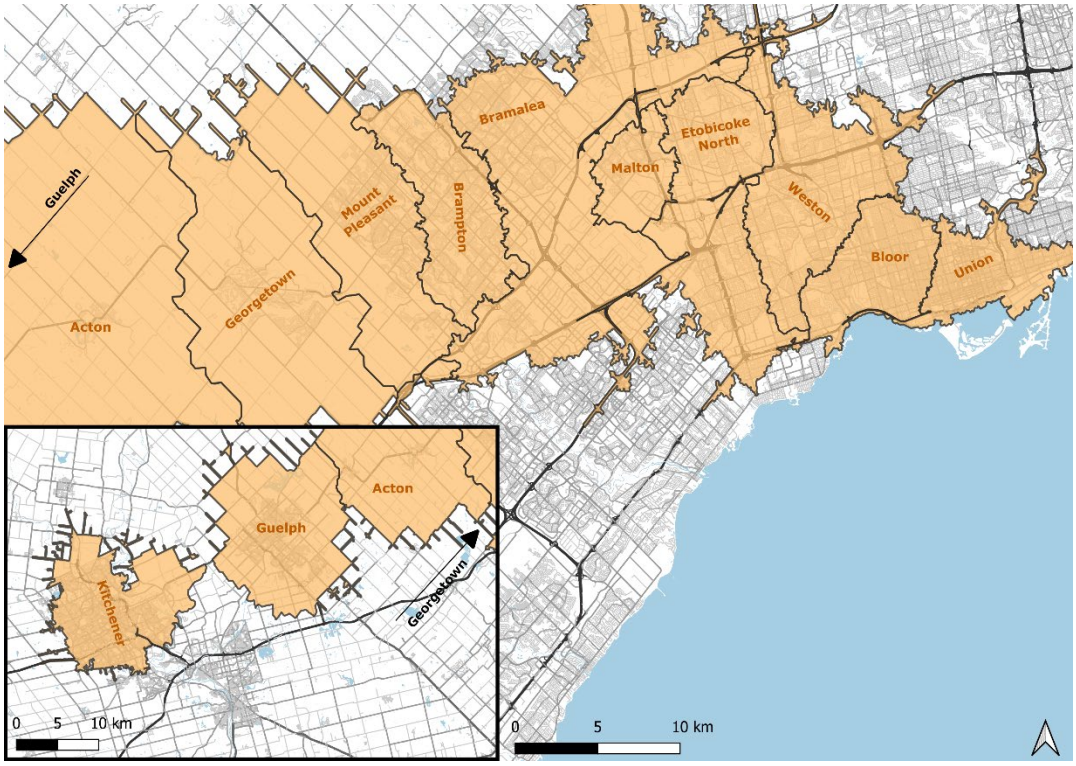

Figure 1: 15-Minute Auto Catchment Areas for Existing Stations

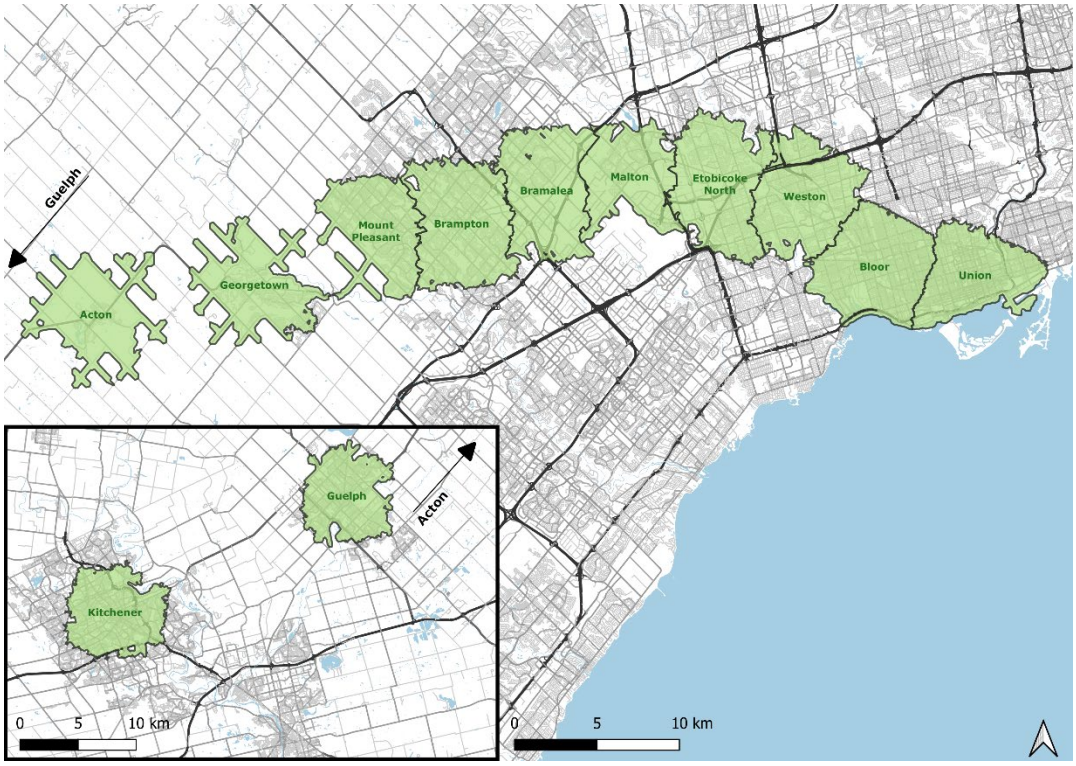

Figure 2: 15-Minute Transit Catchment Areas for Existing Stations

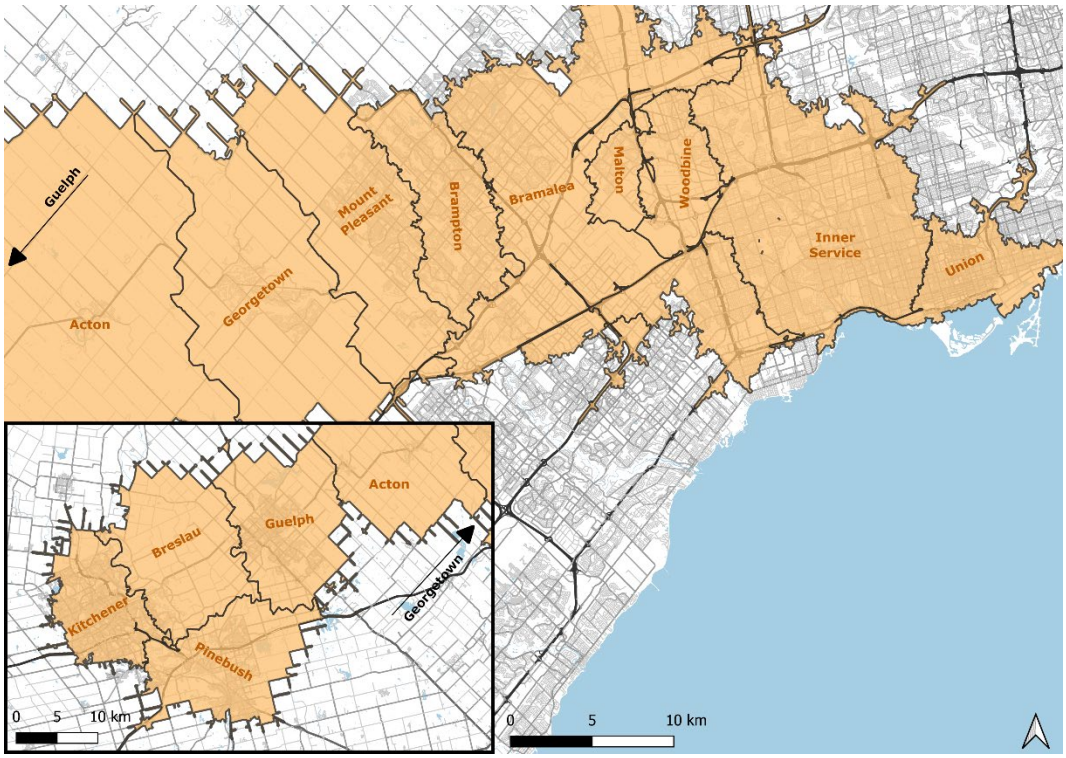

Figure 3: 15-Minute Auto Catchment Areas for Future Stations

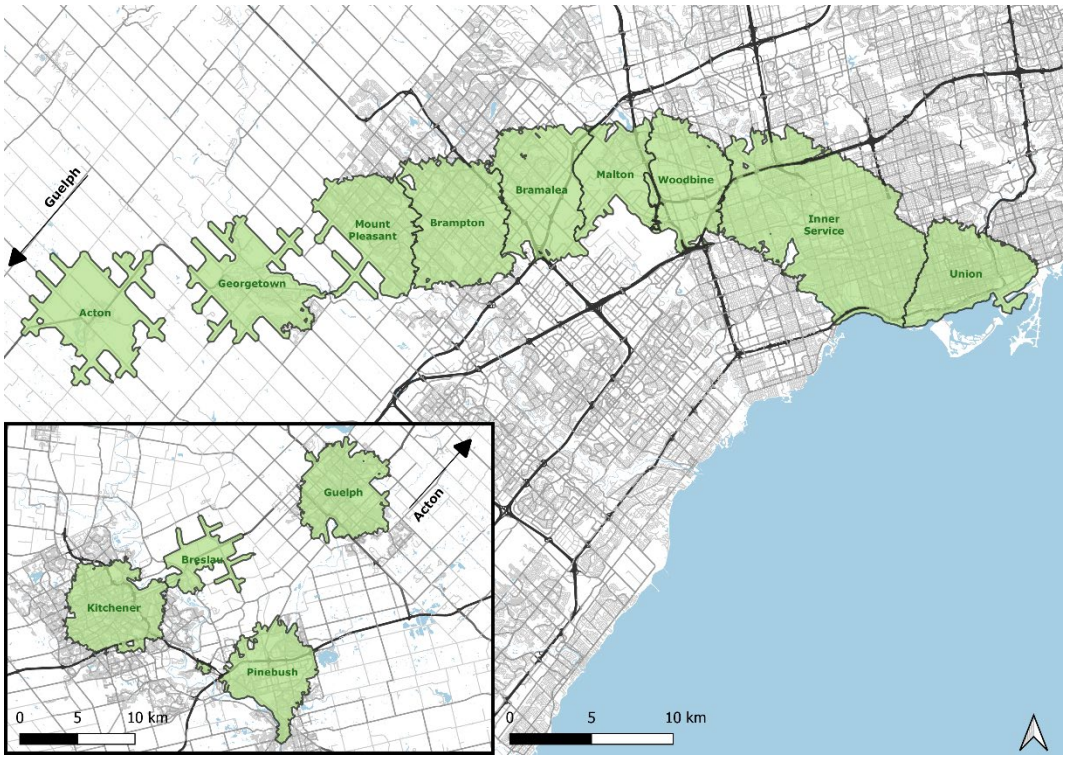

Figure 4: 15-Minute Transit Catchment Areas for Future Stations

1.2.2 Population and Employment Forecasts

Existing and forecasted population and employment forecasts across the study area used the 2011 and 2041 Greater Golden Horseshoe Model (GGHMv4) projections as a baseline. The areas around each GO Rail, LRT, BRT, and subway station are expected to intensify significantly over the horizon because they are recognized as major transit station areas (MTSAs) as identified in provincial planning guidance, with designated minimum density targets. Municipalities in the study area have either drawn or are in the process of drawing boundaries for each MTSA where higher density development is expected, and have identified updated targets for most or all of their MTSAs. In cases where no publicly available MTSA boundaries were available, a conservative buffer of 500 m was drawn around the station. The full list of MTSAs considered in the catchment areas is in **Table 27.** Using these forecasts and the known or estimated forecasts, three different population and employment and ION extension inputs were included in the High, Medium and Low ridership scenarios:

- Low: The population and employment forecasts were overlaid without changes from the 2041 GGHMv4 projections over all station catchment areas, using the population forecasts for auto catchment areas. This scenario assumes the Region extends the ION only to Pinebush Station and some MTSAs will reach the target density.
- Medium: The forecasts for all stations were adjusted assuming the minimum densities for the MTSAs will be met by 2041, using the larger transit catchment area for Pinebush GO Station. This scenario assumes the Region extends the ION to Downtown Cambridge Station.
- High: The forecasts were adjusted assuming the MTSA densities will be exceeded by 2041, using the larger transit catchment area for Pinebush GO Station. This scenario assumes the Region extends the ION to Downtown Cambridge Station.

Significant intensification is anticipated around Pinebush GO Station. This level of intensification is expected to be transit oriented development supported by higher order transit, either ION light rail or bus rapid transit. Bus Rapid Transit Stations have a minimum density target which is the same as that for light rail, therefore the assumptions above are applicable should the Region elect to use a different higher order transit mode to connect Pinebush station.

The resulting population forecasts for the proposed Pinebush GO Station auto and transit catchment areas are illustrated in **Figure 5** and **Figure 6.**

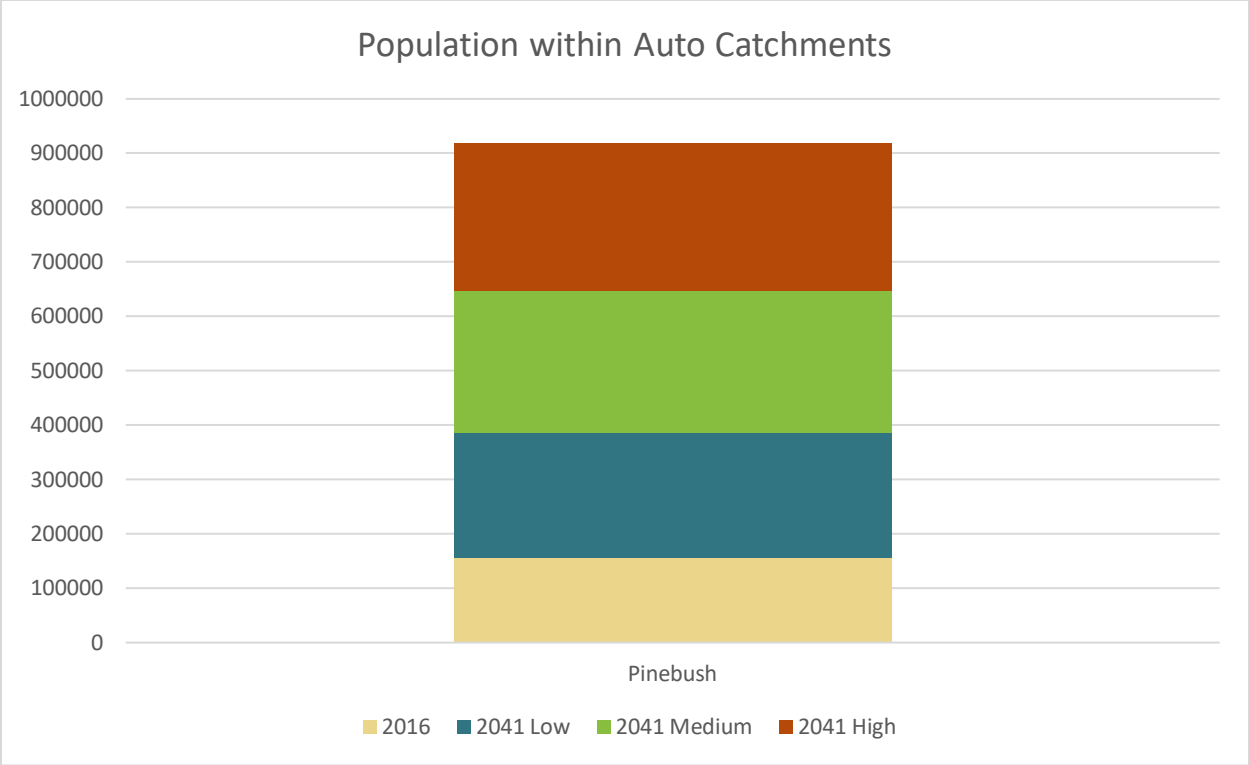

Figure 5: Population within Pinebush Auto Catchment

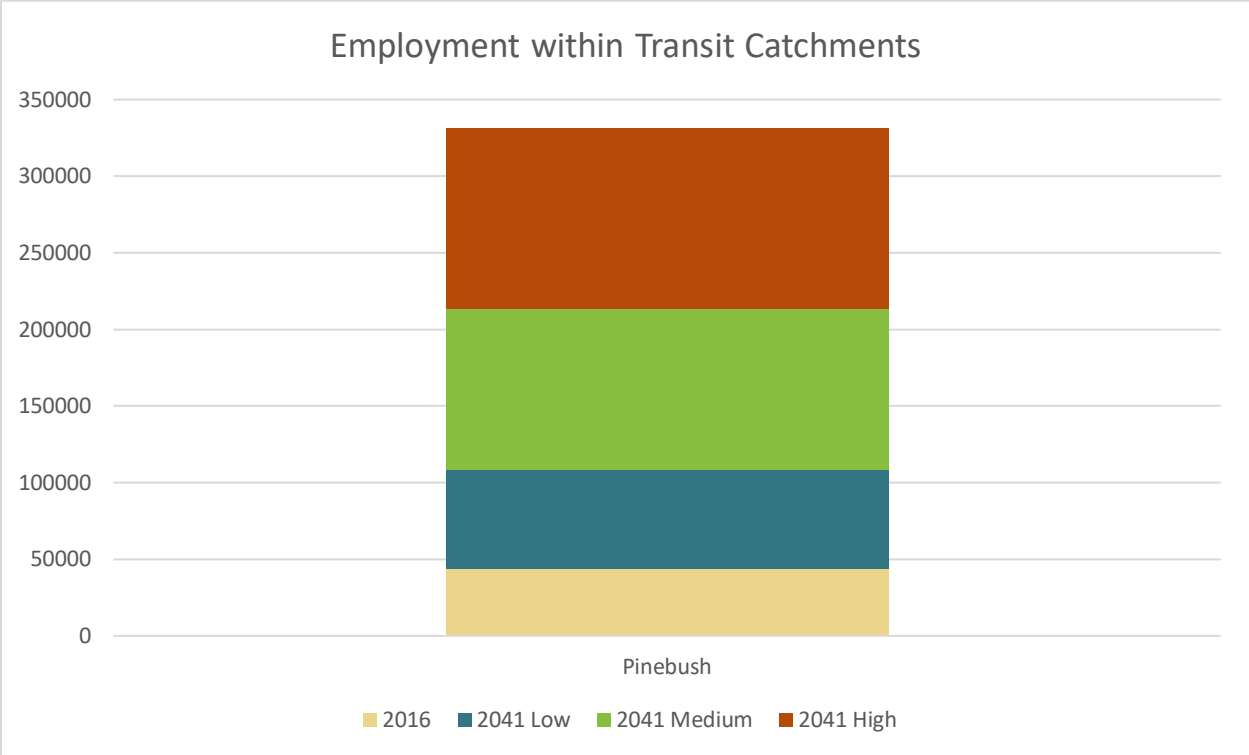

Figure 6: Employment within Pinebush Transit Catchment

1.3 Forecasting Methodology to Union Station

The following section describes the methodology used to forecast ridership from Pinebush GO Station to Union Station. The methodology used the following steps:

1. Establish trip rates to estimate ridership growth based on the existing ridership and population around a proxy GO Station.
2. Determine the future service levels, including number of trains and travel time to Union Station on both the Fergus Subdivision and the Kitchener Line.
3. Adjust the low and high trip rates based on differences in travel time and service levels over the horizon.
4. Estimate travel demand from Cambridge to Union Station for the horizon period by applying the rates to the catchment area population around the proposed Pinebush GO Station.

The assumptions for each of these steps are outlined in further detail below.

1.3.1 Trip Rates

1.3.1.1 Baseline Trip Rates

The GO Rail Station Access document classifies stations into four typologies: active priority, transit priority, mixed modal, and interchange (**Table 2**). The Pinebush GO Station aligns with the transit priority interchange typology due to the limited walkshed around the station, limited parking expected, and the availability of transit including the planned Stage 2 ION stopping at Pinebush GO Station. This typology also applies to the Kitchener GO Station as it is intended to be a transit priority interchange station with minimal parking facilities. **Table 2** illustrates the expected mode shares for each station typology. The mode shares for Interchange stations will be higher than the typology assigned as they must also support access to, and transfers between higher order transit services such as subway and light rail.

Table 2: Station Access Typology (GO Rail Station Access, 2023)

Station Access Typology	Active Priority Stations	Transit Priority Stations	Mixed Modal Stations
Mode share	More than 28% walk or bike	More than 25% transit, and less than 29% walk or bike	More than 40% drive-and-park
Overlay	Interchange stations: Any station that connects with higher-order transit (subway or light rail) services		

Based on the similar expected access and ridership profiles, a baseline trip rate for the Pinebush GO Station catchment area was defined using the Kitchener GO Station as a proxy. The baseline trip rate (2016) was derived by using the existing (2016) cordon counts at the Kitchener GO Station provided by Metrolinx. The total expected trips were divided by the 2016 population within the catchment area.

1.3.1.2 Baseline Trip Rates Estimate

Given the high-level nature of this forecast, the variability in the trip rate per population at different GO Stations, and the volatility of transit ridership growth following the COVID-19 pandemic, three different trip rate estimates were calculated and applied to the Low, Medium and High ridership scenarios.

Future transit ridership demand was based on estimated trip rates. A baseline trip rate for the proposed Pinebush GO Station catchment area was defined using Kitchener GO Station and Guelph Central Station as proxies. These stations were chosen because they have similar travel times to Union Station and service levels of a proposed GO Rail service from Cambridge.

Baseline estimates for the Low ridership scenario are based on existing travel patterns from Kitchener and do not consider potential changes in travel behaviours due to the COVID-19 pandemic, technology, new mobility options, societal attitudes on sustainability or increasing road congestion.

A 50% increase in the baseline trip rates from Kitchener to generate a medium ridership scenario. The 50% increase considers the increased propensity to use transit between 2016 and 2041 given environmental and societal changes in the Greater Golden Horseshoe. This was chosen as it represents the same increase to the trip rate used in the 2014 Business Case for GO Train service between Cambridge and Milton and the 2019 Cambridge to Union Rail Feasibility Study. The High trip rate scenario uses the same methodology but uses the Guelph Central Station as a proxy instead of the Kitchener GO Station and does not include a 50% increase as the trip rate in Guelph is expected to approximate future travel patterns to Cambridge.

1.3.2 Future Trip Rates

Frequency of service and travel time of service can have a significant impact on people's choice of transportation. A number of different service models are being considered throughout the main report; the service details of which are included in the table below, reflecting different components of the generalized journey time:

Table 3: Cambridge to Union Service Characteristics

	Business as Usual	Scenario 1A	Scenario 1B	Scenario 2A	Scenario 2B
Service Level (Kitchener Line)	No new train service, bus service only between Guelph and Cambridge	Two-way, all-day	Two-way, all-day	Two-way, all-day	Two-way, all-day
Headway (minutes)	60	60	45	30	30
Average Travel Time (minutes)	141-147	91.5	91	91.5-94.5	91-94
Cambridge to Guelph (in-vehicle time)	43-44	15.5	15	15.5-18.5	15-18
*Transfers**	27-32	5	5	5	5
Guelph to Union	71	71	71	71	71

**Includes transfers along route in BAU case, 0-minute transfer time between Guelph and train, plus a 5-minute transfer penalty for each transfer (due to the perceived inconvenience of passengers having to transfer vehicles)*

The difference in travel time in each of the scenarios (except the BAU case) is quite small and is not expected to significantly impact the ridership. The BAU case represents a scenario where no train service is added between Cambridge and Guelph, and passengers would take the existing GO Bus service. Please see the Kitchener GO Rail Service Expansion Initial Business Case for commentary on the likelihood that train travel between Guelph Central Station and Union Station will be 71 minutes in 2041. Today, VIA trains travel this distance in 71-72 minutes, representing an average speed of less than 80km/h. There are many ways to increase speeds of conventional services in the corridor and it is expected that trip times will be less than 71 minutes. Therefore, 71 minutes as reported is considered very conservative.

The baseline trip rates were adjusted, to reflect the impact of service improvements on the line, based on the following:

- Changes in travel time: For travel time, it was assumed that a 10-minute change in travel time would have an inversely proportional impact on ridership by 30 percent (i.e. a 10-minute decrease in travel time would increase ridership by 30 percent); and
- Change in number of trains (frequency): Service elasticity method was used to estimate the impact that a frequency change would have on ridership. A conservative approach was used for change in service levels. It was assumed that changes in service levels on GO Train services is fairly inelastic, therefore a 0.3 elasticity rate was used. For example, a 10% increase in service frequency during each operation period would yield a 3% increase in ridership.

These factors were applied to the baseline trip rates based on the changes in the proposed service.

1.3.2.1 Off-peak Trips Rates

Midday and evening trips rates were also estimated for the 2041 horizon period as the Kitchener Line is planned to be upgraded from a peak-period, peak direction to a two-way all-day service. To understand off-peak ridership potential, passenger boardings and alightings from a proxy station from the 2016 Metrolinx cordon count data was used to determine the ratio of ridership during the AM peak, midday, PM peak and evening periods relative to all-day ridership. This ratio was applied to the AM peak period trip rates (inbound) and PM peak period trip rates (outbound) for the proposed Pinebush GO Station to estimate a trip ratio the other three periods in each direction. Aldershot GO Station was used as a proxy because it is the station with the furthest distance from Union Station that also has two-way, all-day service. The proposed Pinebush GO Station trip rates calculated from this analysis are illustrated in **Table 4**, **Table 5** and **Table 6**. The trip rates are lower than were presented in the 2019 study in part because the travel time in all scenarios is higher than the previous best-case scenario. This is considered a conservative estimate because we would expect travellers on Highway 401 to experience more delays than those using the QEW.

Table 4: Low Estimate – Trips Rate Forecast to Union Station

	INBOUND				OUTBOUND			
	AM PEAK	MID-DAY	PM PEAK	EVENING	AM PEAK	MID-DAY	PM PEAK	EVENING
2016 (baseline)	0.69	N/A	N/A	N/A	N/A	N/A	0.64	N/A
2041 BAU	0.34	0.11	0.07	0.03	0.02	0.04	0.26	0.04
2041 Scenario 1A	1.12	0.36	0.23	0.11	0.09	0.18	1.04	0.16
2041 Scenario 1B	1.22	0.39	0.25	0.12	0.10	0.19	1.14	0.18
2041 Scenario 2A	1.40	0.44	0.28	0.14	0.10	0.21	1.24	0.19
2041 Scenario 2B	1.41	0.45	0.28	0.14	0.10	0.21	1.25	0.20

Note: all trip rates reflect the number of trips per 1,000 people

Table 5: Medium Estimate - Trips Rate Forecast to Union Station

	INBOUND				OUTBOUND			
	AM PEAK	MID-DAY	PM PEAK	EVENING	AM PEAK	MID-DAY	PM PEAK	EVENING
2016 (baseline)	0.69	N/A	N/A	N/A	N/A	N/A	0.64	N/A
2041 BAU	0.53	0.17	0.11	0.05	0.03	0.07	0.40	0.06
2041 Scenario 1A	1.75	0.56	0.35	0.18	0.14	0.28	1.62	0.25
2041 Scenario 1B	1.90	0.61	0.38	0.19	0.15	0.30	1.77	0.28
2041 Scenario 2A	2.17	0.69	0.44	0.22	0.16	0.33	1.93	0.30
2041 Scenario 2B	2.19	0.70	0.44	0.22	0.16	0.33	1.95	0.30

Note: all trip rates reflect the number of trips per 1,000 people

Table 6: High Estimate - Trips Rate Forecast to Union Station

	INBOUND				OUTBOUND			
	AM PEAK	MID-DAY	PM PEAK	EVENING	AM PEAK	MID-DAY	PM PEAK	EVENING
2016 (baseline)	1.54	N/A	N/A	N/A	N/A	N/A	1.59	N/A
2041 BAU	0.53	0.17	0.11	0.05	0.03	0.07	0.40	0.06
2041 Scenario 1A	2.10	0.67	0.43	0.21	0.18	0.37	2.18	0.25
2041 Scenario 1B	2.30	0.73	0.46	0.23	0.20	0.40	2.38	0.28
2041 Scenario 2A	2.62	0.83	0.53	0.27	0.21	0.43	2.56	0.30
2041 Scenario 2B	2.64	0.84	0.53	0.27	0.22	0.44	2.59	0.30

Note: all trip rates reflect the number of trips per 1,000 people

These trip rates were multiplied by the forecasted population in the Pinebush GO Station auto catchment area to determine the ridership to Union Station in each scenario (**Section 1.5**).

1.4 Forecasting Methodology for Service to Mid-line Stations

The following section outlines the methodology and results of future ridership forecasts between mid-line stations and Cambridge. While ridership forecasted to Union Station is based on the historic pattern of observed travel behaviour (based on the use of existing trip rates), the projected ridership forecast for mid-line stations trips was based on number of key factors that typically influence the long-distance transit demand. This considers the growing importance of mid-line stations as destination stations on the network as the MTSAs continue to be planned around each GO station. The *A Place to Grow: Growth Plan for the Greater Golden Horseshoe* outlines that these MTSAs will be subject to increased employment and population density and transit-oriented development.

When considering Pinebush GO Station as a destination, employment data was considered only within the walking and transit catchment areas as commuters travelling to work are less likely to transfer from the train to an automobile to complete their trip.

The following steps were undertaken to estimate ridership forecast for mid-line stations:

1. Establish catchment areas for mid-line stations;
2. Calculate proportional population and employment in each of the mid-line station catchment areas and population at Union Station;
3. Establish total person trips between midline stations to estimate ridership growth based on the existing ridership;
4. Calculate baseline transit mode share at each station;
5. Assess existing and future mid-line station characteristics;
6. Estimate future mode-share based on future mid-line station characteristics; and
7. Estimate the future ridership under future conditions.

The assumptions for each of these steps are outlined in further detail below.

1.4.1 Catchment Areas for Mid-Line Stations

For midline stations it was assumed that passengers could travel by any mode to the origin station. Travel from the destination station to their desired location has a higher propensity to be performed using local transit or other sustainable mode shares as the passenger would no longer have access to their personal vehicle. As such, the following measures were used to define each of these catchment areas:

- Transit: average speed of 20.79 km/hr[2] at 15 minutes away from the station; and
- Auto: 15-minute travel radius based on speed limits and generalized traffic information.

[2] The transit catchment speed is based on the average bus travel speeds from Grand River Transit, and was used in any transit forecasts

1.4.2 Population and Employment Forecasts

The 2016 total person trips between the proposed Pinebush GO Station and each of the mid-line stations on the Kitchener Line was increased to 2041 levels using the corresponding population and employment growth forecasts from the *2020 Growth Plan for the Greater Golden Horseshoe* (provided by Metrolinx). Trips to the planned Woodbine GO Station used the current Etobicoke North GO ridership as a proxy for the existing case.

The Growth Plan identifies population and employment forecasts for the 2041 horizon year. This is reflected in the Low forecast noted in **Section 1.2.2**.

Two additional forecasts were developed which consider the impact of intensification within the MTSAs. The Medium forecast assumes that all MTSAs will be intensified meet the minimum densities. As such, the Greater Golden Horseshoe Growth Plan projections were adjusted to reflect this growth.

The High growth scenario assumes that growth exceeds these MTSA targets and the density within all MTSAs. The density assumptions for the medium and high forecasts are included in **Table 22**.

The resulting population and employment assumptions for each scenario are summarized by station in **Figure 7** and **Figure 8.**

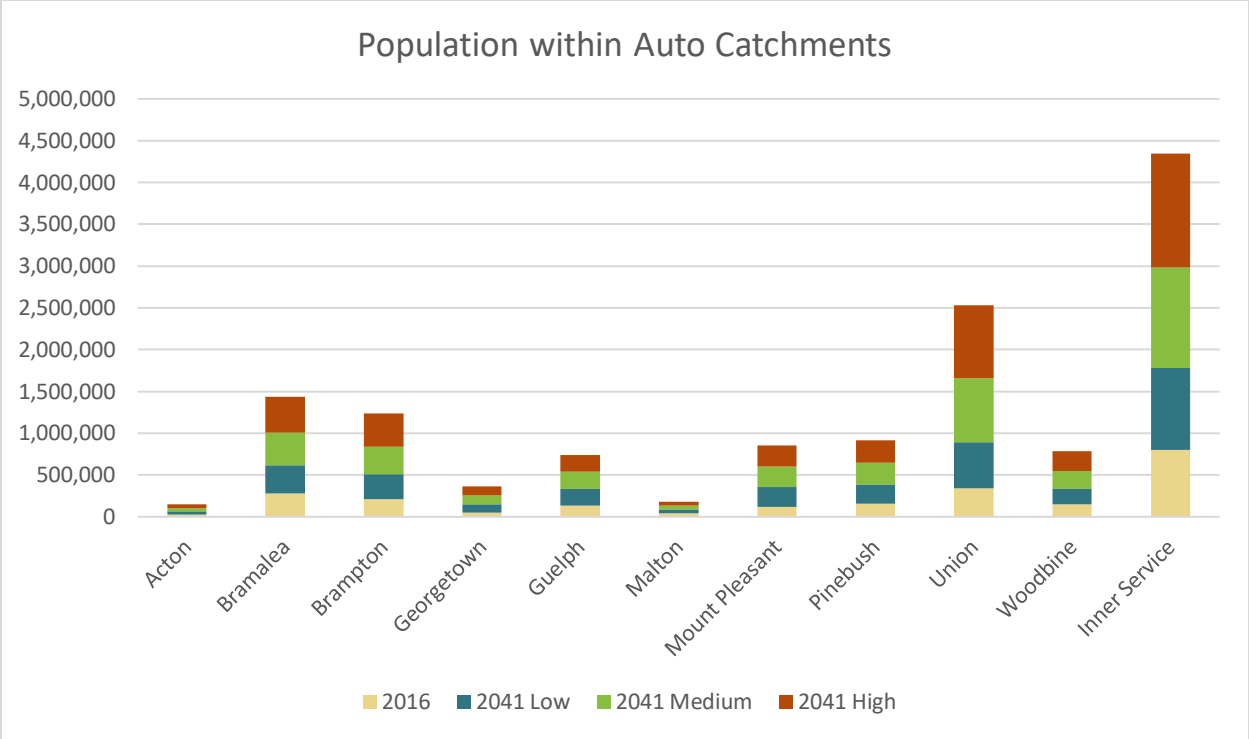

Figure 7: Auto Catchment Area Population Forecast

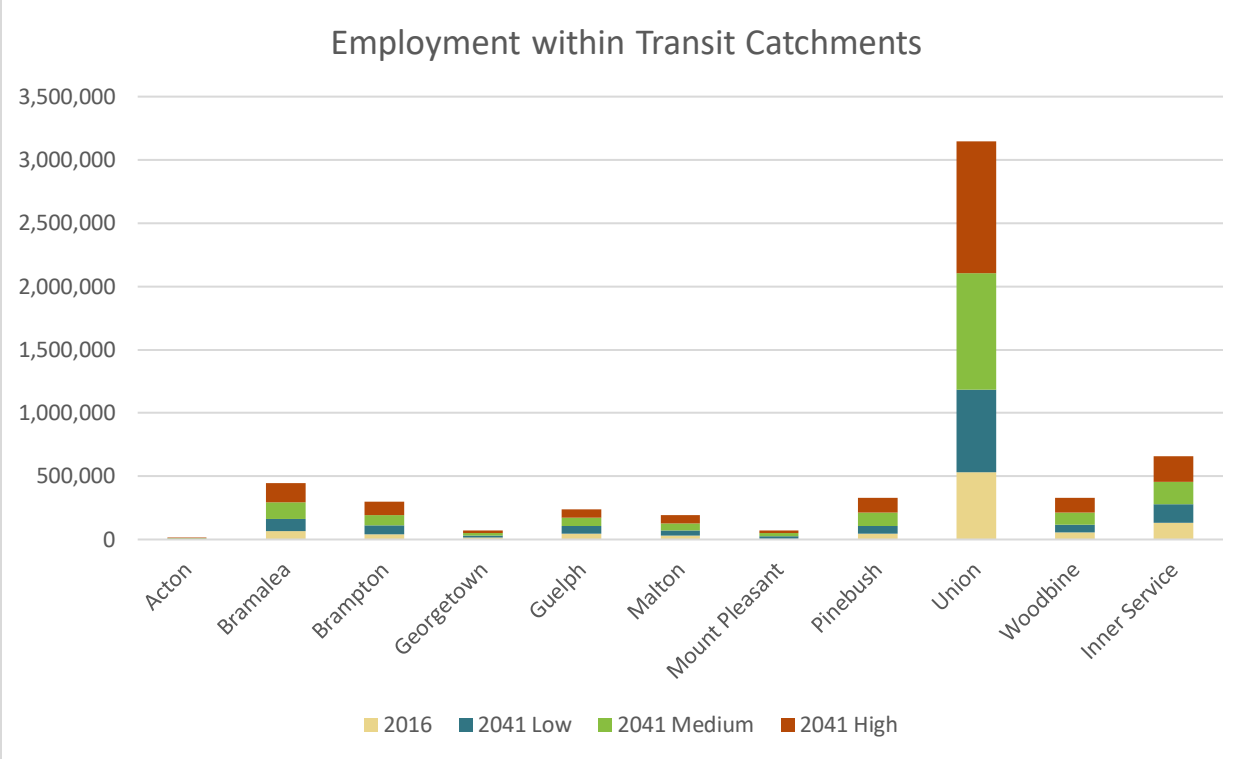

Figure 8: Transit Catchment Area Employment Forecast

1.4.3 Total Person Trips

The total person trips between the Pinebush GO Station catchment area and each of the mid-line station catchment areas on the Kitchener Line was estimated using the 2016 TTS. The growth in total person trips between each station will consider both population (trip generation) and employment (trip attraction). The number of total person trips is expected to grow at the same rate as population/ in the catchment area of the proposed Pinebush GO Station and each of the mid-line stations. The catchment area is expected to differ between trips which originate at a station versus those destined for a station. Passengers are able to make an auto trip from their home to the origin station and as such, the population growth within the auto catchment would be applied to trips originating at the station. Once arriving at their destination, passengers would not have access to their vehicle and therefore it is expected that the catchment would be smaller. Therefore, the employment growth within the transit catchment has been applied. Trip growth was distributed based on the following for each direction of travel:

- Eastbound: Population growth within the auto catchment at Pinebush GO Station and employment growth within the transit catchment at mid-line stations; and
- Westbound: Population growth within the auto catchment at mid-line stations and employment growth within the transit catchment at Pinebush GO Station

Table 7 illustrates the 2016 total person trips between the proposed Pinebush GO Station and each of the mid-line stations while **Table 8** illustrates the same for the 2041 horizon in the low scenario.

Table 7: 2016 Daily Total Person Trips between Pinebush GO Station and Mid-Line Stations

	INBOUND				OUTBOUND			
	AM PEAK	MID-DAY	PM PEAK	EVENING	AM PEAK	MID-DAY	PM PEAK	EVENING
Guelph	2,402	1,547	2,959	836	1,860	1,196	2,175	405
Acton	55	16	45	-	75	145	19	-
Georgetown	33	27	97	-	27	9	98	-
Mount Pleasant	167	5	75	18	54	42	108	-
Brampton GO	516	75	116	26	11	20	220	-
Bramalea	235	31	98	0	123	208	657	33
Malton	51	59	13	-	-	-	-	-
Etobicoke North	226	53	39	-	45	45	240	25
Weston	82	0	40	27	10	14	44	-
Bloor	39	12	27	-	40	28	11	1

Table 8: 2041 Low Scenario Daily Total Person Trips between Pinebush GO Station and Mid-Line Stations

	INBOUND				OUTBOUND			
	AM PEAK	MID-DAY	PM PEAK	EVENING	AM PEAK	MID-DAY	PM PEAK	EVENING
Guelph	3,315	2,271	4,246	1,227	2,670	1,687	3,051	603
Acton	92	29	80	-	133	253	33	-
Georgetown	52	46	159	-	45	15	155	-
Mount Pleasant	477	17	233	58	169	125	319	-
Brampton GO	910	145	218	51	21	37	398	-
Bramalea	362	52	159	0	200	330	1,032	55
Malton	76	95	20	-	-	-	-	-
Woodbine	265	64	47	-	54	53	284	30
Inner Service	134	111	86	122	53	48	120	1

As illustrated in the two tables above, there will be a significant increase in travel demand between Cambridge and Guelph in both directions by 2041. The medium and high scenarios reflect even higher total person trips due to the expected MTSA increases.

1.4.4 Baseline Mode Share

The ridership distribution between the proposed Pinebush GO Station catchment area and each of the mid-line stations on the Kitchener GO Line was calculated using passenger boardings and alightings at mid-line stations taken from the Kitchener GO Station as a proxy. Since origin-destination pairs are not identified in the cordon counts provided by Metrolinx, 95% of trips were assumed to be destined for Union Station and the remaining 5% of trips were distributed between the mid-line stations based on their relative attraction based on population or employment.

Table 9: 2016 Baseline Transit Mode Share to Mid-line Stations

	Inbound	Outbound
Station	***AM Peak***	***PM Peak***
Guelph	0.90%	1.35%
Acton	0.13%	0.89%
Georgetown	0.21%	0.38%
Mount Pleasant	0.00%	2.75%
Brampton	6.02%	7.87%
Bramalea	3.71%	0.72%
Malton	3.37%	0.73%
Inner Service	1.24%	0.46%

It should be noted that these mode shares are based on total person trips to the midline transit catchments as the majority of persons travelling by train will be destined for this area. This increases the baseline mode shares from the 2019 Cambridge to Union Rail Feasibility Study.

1.4.5 Mid-line Station Characteristics

Growth in transit mode share on GO Rail service is typically influenced by a number of factors, including level of congestion on the corresponding highway and arterial roadway network between the origin and destination, availability and price of parking near the destination station, accessibility to final destination (by walking, ease of transfers to local transit and the level of service on local transit) and the availability of unique employment opportunities or post-secondary institutes near the destination station. These factors are assessed to establish a profile of all mid-line stations and the potential to grow transit mode share.

The expected mode of access to each station was also compared between 2019 and 2041, using the updated GO Rail Station Access Plan. The percent increase in active transportation and transit access to each of the mid-line stations identifies the potential to access the station or destinations near the station by active transportation or local transit. This also provides an indication of the potential to use the GO Rail service between Pinebush GO Station and one of the mid-line stations. The base mode share for 2041 was adjusted by this increase, then changed further using the following methodology.

Changes to the mode share for each mid-line station was based on the review of station area improvements over each horizon year. For example, mid-line stations that have planned rapid transit improvements and/or increases in employment opportunities will result in an increase in transit mode share. Since the previous study, MTSAs have been established for each station, which defines higher levels of density around each midline station and a number of surrounding areas. This will increase the projected transit mode share from that included in the previous study. The MTSAs considered within this analysis are outlined in **Table 22**. The forecasted boardings to each mid-line station were then checked against the growth in projected boardings expected within the GO Rail Station Access Plan document, to ensure the improved attraction has been captured in the forecasts.

Table 10 outlines each of the existing mid-line stations on the Kitchener GO Line and the station area characteristics that have influenced the forecasted growth in transit mode share for each station. This was used as an input to forecast future transit mode share for mid-line stations and the reverse commute demand to the proposed Pinebush GO Station from each of the stations on the Kitchener Line.

Table 10: Mid-line Station Characteristics

Destination Station	Distance *(from Cambridge)*	Congestion along the Corridor *(from Cambridge)*	Parking *(at that station and at employment / education opportunities near station)*	Key Destinations *(near Station)*	Station Access Report 2041 Active Transportation Mode Share *(ability to walk/bike to key destinations)*	Station Access Report 2041 Transit Mode Share *(ability to access key destinations via local transit)*	MTSA Density *(combined people and jobs per hectare)*
Pinebush	N/A	(Considering travel to Cambridge) Significant congestion in west Toronto and Peel Region. Lower but still large congestion west of Brampton Station.	No parking on site however, the Region of Waterloo is providing offsite parking as part of the King-Victoria Transit Hub. Free and abundant parking at nearby employment areas.	Within a 15-minute drive there is a 46% increase in employment between 2016 and 2041 (~20,200 jobs). Areas throughout the City of Cambridge are accessible within 15 minutes on transit: downtown Galt, Preston, Hespeler, major hospitals, Conestoga College and the University of Waterloo's School of Architecture.	N/A	N/A	160
Guelph	22km	Some congestion on Highway 124. Constrained access to downtown.	Planned expansion to 70 parking spaces by 2041, offsite shared parking also being considered. Limited availability of low cost parking for employment due to downtown location.	Numerous cultural, employment and commercial destinations within 5 minute walk. Within a 15-minute drive there is a 33% increase in employment between 2016 and 2041 (~15,100 jobs).	32%	32%	150

Destination Station	Distance *(from Cambridge)*	Congestion along the Corridor *(from Cambridge)*	Parking *(at that station and at employment / education opportunities near station)*	Key Destinations *(near Station)*	Station Access Report 2041 Active Transportation Mode Share *(ability to walk/bike to key destinations)*	Station Access Report 2041 Transit Mode Share *(ability to access key destinations via local transit)*	MTSA Density *(combined people and jobs per hectare)*
Acton	43km	Heavy congestion on Highway 401	Parking to be expanded to 190 parking spaces. Free and abundant parking at nearby employment.	Rural area, low density residential hamlet with limited employment opportunities near the station. Within a 15-minute drive there is a 60% increase in employment between 2016 and 2041 (~1,600 jobs).	25%	4%	96 (Estimated to be similar to that of Georgetown)
Georgetown	53km	Minimal congestion on Highway 6. Heavy congestion on 401	Parking to be expanded to 850 parking spaces. Free or low cost and reasonable parking at nearby employment.	Primarily an origin station and is surrounded by mainly residential uses and rural farmland, with little employment. Within a 15-minute drive there is a 48% increase in employment between 2016 and 2041 (~6,000 jobs).	11%	5%	96
Mount Pleasant	61km	Heavy congestion on Highway 401. Little congestion on Highway 407.	Parking to be expanded to 1,650 parking spaces. Free and abundant parking at nearby employment.	Located on outskirts of the urban area. An origin station surrounded by low density residential development. Within a 15-minute drive there is a 162% increase in employment between 2016 and 2041 (~12,600 jobs).	18%	27%	150

Destination Station	Distance *(from Cambridge)*	Congestion along the Corridor *(from Cambridge)*	Parking *(at that station and at employment / education opportunities near station)*	Key Destinations *(near Station)*	Station Access Report 2041 Active Transportation Mode Share *(ability to walk/bike to key destinations)*	Station Access Report 2041 Transit Mode Share *(ability to access key destinations via local transit)*	MTSA Density *(combined people and jobs per hectare)*
Brampton	66km	Congestion on Highway 407 and Highway 410.	Currently 1,122 spaces, no plans to expand. Limited availability of low-cost parking for employment due to downtown location.	Located in the heart of Downtown Brampton with pedestrian friendly access to employment uses, including Brampton City Hall. Within a 15-minute drive there is a 67% increase in employment between 2016 and 2041 (~28,500 jobs).	21%	30%	200
Bramalea	72km	Congestion on Highway 401, Highway 407 and Highway 410.	Currently 4,228 spaces, no plans to expand, may exceed parking requirements. Free or low cost and reasonable parking at nearby employment.	Located in the middle of a major industrial area with residential areas to the north. Within a 15-minute drive there is a 67% increase in employment between 2016 and 2041 (~28,500 jobs).	3%	39%	150
Malton	76km	Highway 401 and 427 typically congested and Highway 407 somewhat congested during peak times.	Currently 698 spaces, no plans to expand on-site parking, may consider alterative parking solutions to support growth. Free or low cost and reasonable parking at nearby employment.	Closest station to Pearson Airport and just north of the major, unique employment area surrounding the Airport. Within a 15-minute drive there is a 43% increase in employment between 2016 and 2041 (~12,300 jobs).	13%	33%	100

Destination Station	Distance *(from Cambridge)*	Congestion along the Corridor *(from Cambridge)*	Parking *(at that station and at employment / education opportunities near station)*	Key Destinations *(near Station)*	Station Access Report 2041 Active Transportation Mode Share *(ability to walk/bike to key destinations)*	Station Access Report 2041 Transit Mode Share *(ability to access key destinations via local transit)*	MTSA Density *(combined people and jobs per hectare)*
Woodbine	79km	Highway 401 and 427 typically congested and Highway 407 somewhat congested during peak times.	Free or low cost and reasonable parking at nearby employment and attractions.	Within a 15-minute drive there is a 15% increase in employment between 2016 and 2041 (~8,400 jobs). Near Pearson Airport supporting travel to both the airport and surrounding employment.	N/A	N/A	150
Weston (Inner Service)	86km	Highway 401 typically severely congested.	Currently 325 spaces, no plans to expand, parking may be reallocated to offsite parking. Parking opportunities limited as area is densely built. Drive & park access expected to reduce significantly. Significant levels of parking at employers near St. Clair-Old Weston station which is included in this catchment.	Located in a residential area with limited employment destinations. Service area includes a portion of the catchment for the St. Clair-Old Weston station which has a catchment mainly industrial and commercial in nature. Within a 15-minute drive there is a 1% decrease in employment between 2016 and 2041 (~300 jobs).	52%	26%	200

Destination Station	Distance *(from Cambridge)*	Congestion along the Corridor *(from Cambridge)*	Parking *(at that station and at employment / education opportunities near station)*	Key Destinations *(near Station)*	Station Access Report 2041 Active Transportation Mode Share *(ability to walk/bike to key destinations)*	Station Access Report 2041 Transit Mode Share *(ability to access key destinations via local transit)*	MTSA Density *(combined people and jobs per hectare)*
Mount Dennis (Inner Service)	88km	Highway 401 typically severely congested.	No dedicated parking, no plans to add dedicated parking. Low cost and reasonable parking at nearby employment however this is expected to reduce as the area becomes more dense.	Area mainly residential and industrial. Service area includes a portion of the catchment for the St. Clair-Old Weston station which has a catchment mainly industrial and commercial in nature. Within a 15-minute drive there is a 3% increase in employment between 2016 and 2041 (~8,400 jobs).	59%	28%	160
Bloor (Inner Service)	93km	Highway 401, 427, Gardiner Expressway, and surrounding arterial network highly congested.	No dedicated parking, no plans to add dedicated parking. Parking opportunities are limited and not free as in this dense mixed-use area.	Area mainly residential with some office and retail destinations. Service area includes area of King-Liberty station which has a similar profile and is in close proximity to existing station. Within a 15-minute drive there is a 23% increase in employment between 2016 and 2041 (~15,400 jobs).	68%	19%	300

1.4.6 Future Travel Demand

Changes to the mode share for each mid-line station was based on the increase in service frequency as described in **Section 1.3.2**, station characteristics and a review of planned station area improvements. For example, mid-line stations that have planned rapid transit improvements and/or increases in employment opportunities would result in an increase in long-distance transit mode share.

A summary of the criteria used to determine the transit mode shares include:

- Transit connectivity – The ability for GO Rail passengers to get off at the station and conveniently access employment or educational opportunity outside of the walking distance catchment area;
- Mode of Access – The mode of access to the GO Station based on the results of the GO Station Access Report;
- Change in employment – The attraction to station based on an increase in employment;
- Congestion to and from the station from Cambridge – increase in congestion on the parallel roadway network over time; and
- Parking availability – Changes to parking pricing and availability over time.

A low, medium or high score was identified for each criterion, horizon year and station, depending on anticipated transit service or area improvements. It should be noted that congestion and free parking availability were based on a perceived future conditions and available data.

Table 11 illustrates the projected transit mode share for each of the mid-line stations using a low and a high range (similar to the Union Station ridership forecast). In this case the low value reflects the current mode share to Kitchener Station as a proxy, based on station cordon counts and the total number of trips reported in the TTS. The high value includes both the increase in sustainable modes reported in the Metrolinx GO Rail Station Access Plan and additional adjustments due to planned population growth, employment growth, congestion, parking and planned transit connectivity. **Table 12** illustrates the transit mode share for trips inbound trips to the proposed Pinebush GO Station.

The increase in transit mode share identified in **Table 11** and **Table 12** was added to the baseline transit mode share illustrated in **Table 9** to get a total transit mode share. This is illustrated in **Table** 13 and **Table 14**.

Table 11: Anticipated Increase in Transit Mode Share Improvements (inbound direction)

Stations	Transit Connections	Percentage Change of Jobs (transit catchment, low scenario)	Congestion	Parking Availability	Overall	Low Mode Share Improvement	High Mode Share Improvement
Guelph	High	Moderate (33%)	High	Moderate	High	1.5%	3.5%
Acton	Low	High (60%)	Moderate	Low	Low	0.0%	0.5%
Georgetown	Low	Moderate (48%)	Moderate	Low	Low	0.0%	0.5%
Mount Pleasant	High	High (162%)	Moderate	Low	Moderate	1.0%	2.5%
Brampton	High	High (67%)	Moderate	Low	High	1.5%	3.5%
Bramalea	High	Moderate (47%)	Moderate	Low	Moderate	1.0%	2.5%
Malton	Moderate	Moderate (43%)	High	Low	Moderate	1.0%	2.5%
Woodbine	Moderate	Moderate (15%)	High	Moderate	High	1.5%	3.5%
Inner Service	High	Low	High	High	High	1.5%	3.5%

Table 12: Anticipated Transit Mode Share Improvements (outbound direction)

Stations	Transit Connections	Congestion	Parking Availability	Change in Population (auto catchment, low scenario)	Overall	Low Mode Share Improvement	High Mode Share Improvement
Guelph	High	High	Moderate	Moderate (46%)	High	1.5%	3.5%
Acton	High	Moderate	Moderate	Moderate (39%)	Moderate	1.0%	2.5%
Georgetown	High	Moderate	Moderate	High (87%)	Moderate	1.0%	2.5%
Mount Pleasant	High	Moderate	Moderate	High (104%)	High	1.5%	3.5%
Brampton	High	Moderate	Moderate	Moderate (42%)	Moderate	1.0%	2.5%
Bramalea	High	Moderate	Moderate	Moderate (21%)	Moderate	1.0%	2.5%
Malton	High	High	Moderate	Low (10%)	Moderate	1.0%	2.5%
Woodbine	High	High	Moderate	Moderate (20%)	Moderate	1.0%	2.5%
Inner Service	High	High	Moderate	Moderate (20%)	Moderate	1.0%	2.5%

Table 13: Transit Mode Share Forecast to Mid-line Stations (Inbound)

Stations	BAU		Scenario 1A		Scenario 1B		Scenario 2A		Scenario 2B	
	Low	High	Low	High	Low	High	Low	High	Low	High
Guelph	1.0%	1.0%	2.8%	5.3%	3.1%	5.9%	3.3%	6.3%	3.4%	6.6%
Acton	0.1%	0.1%	0.1%	0.8%	0.1%	0.9%	0.1%	1.0%	0.1%	1.0%
Georgetown	0.3%	0.3%	0.3%	1.0%	0.3%	1.1%	0.3%	1.2%	0.3%	1.2%
Mount Pleasant	0.0%	0.0%	1.5%	3.7%	1.6%	4.0%	1.8%	4.5%	1.9%	4.6%
Brampton	7.9%	7.9%	10.2%	13.2%	10.4%	13.8%	10.7%	14.5%	10.8%	14.6%
Bramalea	5.4%	5.4%	6.9%	9.2%	7.1%	9.6%	7.3%	10.2%	7.3%	10.2%
Malton	5.3%	5.3%	6.8%	9.1%	7.0%	9.5%	7.2%	10.1%	7.2%	10.1%
Woodbine	1.8%	1.8%	4.1%	7.2%	4.3%	7.7%	4.7%	8.5%	4.7%	8.6%
Inner Stations	6.5%	6.6%	8.4%	11.1%	8.6%	11.5%	8.9%	12.2%	9.0%	12.3%

Table 14: Transit Mode Share Forecast to Mid-line Stations (Outbound)

Stations	BAU		Scenario 1A		Scenario 1B		Scenario 2A		Scenario 2B	
	Low	High	Low	High	Low	High	Low	High	Low	High
Guelph	1.3%	1.3%	3.1%	5.6%	3.4%	6.3%	2.9%	5.1%	3.0%	5.3%
Acton	0.9%	0.9%	2.3%	4.4%	2.5%	4.8%	2.4%	4.7%	2.5%	4.8%
Georgetown	0.4%	0.4%	1.8%	4.0%	2.0%	4.4%	2.0%	4.4%	2.0%	4.5%
Mount Pleasant	2.8%	2.8%	5.0%	7.9%	5.2%	8.5%	5.3%	8.6%	5.3%	8.7%
Brampton	7.9%	7.9%	9.4%	11.7%	9.6%	12.1%	9.7%	12.3%	9.7%	12.3%
Bramalea	0.7%	0.7%	1.9%	3.7%	2.0%	4.0%	2.0%	4.1%	2.1%	4.1%
Malton	0.7%	0.7%	1.9%	3.7%	2.0%	4.0%	2.1%	4.2%	2.1%	4.2%
Woodbine	0.9%	0.9%	2.1%	4.0%	2.2%	4.3%	2.3%	4.4%	2.3%	4.5%
Inner Stations	20.6%	20.6%	21.9%	23.9%	22.0%	24.2%	22.1%	24.4%	22.1%	24.5%

These transit mode shares were applied to the total person trips between the origin and destination with the high mode share being used in both the Medium and High ridership scenario to forecast the ridership.

1.5 Detailed Ridership Forecasts by Scenario

This section contains tables with the forecasted 2041 daily weekday ridership for each scenario.

1.5.1 Business As Usual (BAU)

Table 15: BAU Weekday Ridership Forecast

		INBOUND				OUTBOUND			
		AM PEAK	MID-DAY	PM PEAK	EVENING	AM PEAK	MID-DAY	PM PEAK	EVENING
LOW	Trips to/from Guelph	34	23	43	12	36	23	41	8
	Mid-line Trips	109	27	34	11	13	17	88	1
	Trips to/from Union	79	25	16	8	5	10	60	9
	Total Trips	**222**	**75**	**93**	**32**	**54**	**49**	**189**	**18**
MEDIUM	Trips to/from Guelph	35	25	48	14	40	24	42	9
	Mid-line Trips	132	36	44	14	16	20	101	1
	Trips to/from Union	138	44	28	14	9	18	105	16
	Total Trips	**306**	**104**	**120**	**42**	**64**	**62**	**249**	**27**
HIGH	Trips to/from Guelph	35	25	48	14	40	24	42	9
	Mid-line Trips	156	43	55	18	18	22	118	2
	Trips to/from Union	144	46	29	15	9	19	109	17
	Total Trips	**335**	**114**	**132**	**46**	**67**	**65**	**269**	**27**

1.5.2 Scenario 1A

Table 16: Scenario 1A Weekday Ridership Forecast

		INBOUND				OUTBOUND			
		AM PEAK	MID-DAY	PM PEAK	EVENING	AM PEAK	MID-DAY	PM PEAK	EVENING
LOW	Trips to/from Guelph	93	64	119	35	84	53	96	19
	Mid-line Trips	153	36	48	16	23	29	121	2
	Trips to/from Union	260	83	53	26	20	41	241	38
	Total Trips	**506**	**183**	**220**	**77**	**128**	**123**	**459**	**59**
MEDIUM	Trips to/from Guelph	183	130	251	73	166	101	176	37
	Mid-line Trips	259	66	88	27	48	58	201	5
	Trips to/from Union	456	145	92	46	35	72	423	66
	Total Trips	**898**	**341**	**432**	**146**	**250**	**231**	**800**	**108**
HIGH	Trips to/from Guelph	183	130	251	73	166	101	176	37
	Mid-line Trips	300	80	107	33	53	64	227	6
	Trips to/from Union	570	182	115	58	50	100	592	69
	Total Trips	**1054**	**391**	**474**	**164**	**269**	**265**	**995**	**112**

1.5.3 Scenario 1B

Table 17: Scenario 1B Weekday Ridership Forecast

		INBOUND				OUTBOUND			
		AM PEAK	MID-DAY	PM PEAK	EVENING	AM PEAK	MID-DAY	PM PEAK	EVENING
LOW	Trips to/from Guelph	103	71	132	38	92	58	105	21
	Mid-line Trips	157	37	49	16	24	30	124	2
	Trips to/from Union	283	90	57	29	22	45	263	41
	Total Trips	**543**	**198**	**238**	**83**	**138**	**133**	**492**	**64**
MEDIUM	Trips to/from Guelph	204	145	280	81	187	113	198	41
	Mid-line Trips	272	70	93	28	52	63	211	6
	Trips to/from Union	496	158	100	51	39	78	461	72
	Total Trips	**972**	**372**	**473**	**160**	**277**	**254**	**870**	**119**
HIGH	Trips to/from Guelph	204	145	280	81	187	113	198	41
	Mid-line Trips	315	84	113	35	57	68	238	7
	Trips to/from Union	622	198	126	63	54	109	646	75
	Total Trips	**1141**	**426**	**518**	**179**	**298**	**291**	**1082**	**123**

1.5.4 Scenario 2A

Table 18: Scenario 2A Weekday Ridership Forecast

		INBOUND				OUTBOUND			
		AM PEAK	MID-DAY	PM PEAK	EVENING	AM PEAK	MID-DAY	PM PEAK	EVENING
LOW	Trips to/from Guelph	110	75	141	41	79	50	90	18
	Mid-line Trips	163	39	51	17	25	30	125	2
	Trips to/from Union	323	103	65	33	24	49	288	45
	Total Trips	**596**	**217**	**257**	**90**	**127**	**129**	**503**	**65**
MEDIUM	Trips to/from Guelph	218	154	298	87	151	92	161	34
	Mid-line Trips	289	74	99	30	52	63	214	6
	Trips to/from Union	567	180	115	58	42	86	505	79
	Total Trips	**1074**	**409**	**512**	**174**	**246**	**240**	**880**	**118**
HIGH	Trips to/from Guelph	218	154	298	87	151	92	161	34
	Mid-line Trips	335	89	120	37	58	69	242	7
	Trips to/from Union	709	226	143	72	58	118	695	82
	Total Trips	**1262**	**469**	**562**	**196**	**267**	**278**	**1098**	**123**

1.5.5 Scenario 2B

Table 19: Scenario 2B Weekday Ridership Forecast

		INBOUND				OUTBOUND			
		AM PEAK	MID-DAY	PM PEAK	EVENING	AM PEAK	MID-DAY	PM PEAK	EVENING
LOW	Trips to/from Guelph	113	77	145	42	81	51	93	18
	Mid-line Trips	164	39	52	17	25	31	126	2
	Trips to/from Union	325	104	66	33	24	49	290	45
	Total Trips	**603**	**220**	**262**	**92**	**131**	**131**	**509**	**66**
MEDIUM	Trips to/from Guelph	228	162	313	91	157	95	167	35
	Mid-line Trips	292	75	100	30	53	64	215	6
	Trips to/from Union	571	182	115	58	43	86	508	79
	Total Trips	**1090**	**418**	**528**	**179**	**253**	**245**	**891**	**120**
HIGH	Trips to/from Guelph	228	162	313	91	157	95	167	35
	Mid-line Trips	338	90	121	37	58	69	243	7
	Trips to/from Union	716	228	145	73	59	119	702	83
	Total Trips	**1282**	**479**	**578**	**201**	**274**	**284**	**1112**	**124**

1.5.6 Annualized Ridership

The ridership estimates reflect a single day of travel on a weekday. In order to understand the annual impact, the figures were annualized assuming there are 252 weekdays. The remaining 113 days include weekends and holidays which were assumed to have ridership equal to 50% of weekday ridership in 2041. The 50% proportion was estimated based on Kitchener Line projections in the 2018 GO Expansion Full Business case by Metrolinx. The annual ridership is summarized in **Table 20.** The ridership figures from the 2019 Cambridge to Union GO Rail Feasibility Study have been provided in **Table 21** for reference. We expect further initiatives not considered in this study, like the promise of fare integration with the TTC, to further drive ridership past what this forecast estimates.

Table 20: Annualized Ridership Forecast by Scenario – Current Analysis

	BAU	Scenario 1A	Scenario 1B	Scenario 2A	Scenario 2B
Low	225,961	540,751	582,975	611,866	621,137
Medium	300,253	989,173	1,078,666	1,127,225	1,148,828
High	325,393	1,148,728	1,252,126	1,312,664	1,337,082

Table 21: Annualized Ridership Forecast by Scenario – 2019 Feasibility Study

	Scenario 1A	Scenario 1B	Scenario 2A	Scenario 2B
Low	415,681	439,467	494,706	538,056
Medium	N/A	N/A	N/A	N/A
High	965,980	1,015,128	1,152,269	1,215,959

2.0 Passenger Fare Revenue

2.1 Forecasting Methodology for Passenger Fare Revenue

This section describes the steps taken to forecast passenger fare revenue of service for the 2041 horizon year. Before calculating potential revenue, an average fare needs to be defined by:

- Defining the proportional ridership by age group and concession type on the Kitchener GO Line; and
- Determining the cost by distance and concession type.

Ridership estimations from **Section 1.5.2** and **1.5.3** will be multiplied by the average fare between each of the mid-line stations and Union to get the passenger fare revenue.

2.1.1 Passenger Cohort Distribution

To determine the number of trips by concession type (i.e. child vs. adult fare etc.), the age breakdown of patrons on the Kitchener Line was derived from the 2017 GO Rail Passenger Survey. The breakdown fare types by age is detailed in **Table 22**.

Table 22: Proportion of Ridership by Cohort on the Kitchener Line[3]

Age Group	Proportion of Trips
Adult	95.3%
Senior (65+)	3.6%
Student (elementary, secondary and post-secondary)	~ 1%
Child (under 12)	~ 0.1%

2.1.2 Fare Type Distribution

The 2017 GO Rail Passenger Survey also reported the fare type distribution on the Kitchener GO Line on weekdays. Metrolinx offers fare discounts to those using the regional fare card. The breakdown of weekday fare type usage is shown in **Table 23** below. It should be noted that since fare information was not available for "Group Pass" and "Other", the usage proportion in these categories was added to the "Day Pass" category to calculate average for each origin-destination pair.

[3]2017 GO Rail Passenger Survey - Metrolinx

Table 23: Proportion of Ridership by Fare Type (System-wide)

Fare Type	Proportion of Ridership
PRESTO (Smart Card)	98.6%
Single-Ride (Ticket)	1.4%

Group trips, weekend passes and other fare types represent less than 3% of the total trips and are expected to be similar to the discounted rates experienced by PRESTO users. As such these riders were considered at the PRESTO rate for the appropriate fare category (age).

2.1.3 Average Fare

The average fare by distance and concession type was retrieved through the GO Transit website using the trip planning tool for each of the origin-destination pairs. The fare between Cambridge to Guelph Central Station was assumed to be equivalent to the current fare. The fare between stations not currently online were calculated by linearly interpolating the fare between neighbouring stations based on the distance to the planned station.

2.2 Revenue Forecast

The revenue forecast was generated by multiplying the number of trips between Cambridge and each station on the Kitchener Line between and including Guelph Central Station to Union Station with the average fare (based on distance to/from Cambridge). The annualized result of this analysis is shown in **Table 24**. The annual passenger revenue calculated in the 2019 Cambridge to Union Go Rail Feasibility Study has been provided in **Table 25** for reference. The BAU case reflects no train service, while the other scenarios represent various rail implementations, indicating how revenue may change with the addition of rail service.

Table 24: Annual Passenger Revenue Forecast by Scenario – Current Analysis

	BAU	Scenario 1A	Scenario 1B	Scenario 2A	Scenario 2B
Low	$2,874,383	$7,005,219	$7,533,738	$8,047,930	$8,144,567
Medium	$4,000,725	$12,579,930	$13,658,396	$14,570,944	$14,778,208
High	$4,357,981	$15,103,834	$16,406,288	$17,511,083	$17,764,046

Table 25: Annual Passenger Revenue Forecast by Scenario – 2019 Feasibility Study

	Scenario 1A	Scenario 1B	Scenario 2A	Scenario 2B
Low	$5,227,034	$5,546,079	$6,270,266	$6,810,386
Medium	N/A	N/A	N/A	N/A
High	$12,776,499	$13,436,136	$15,318,324	$16,049,250

3.0 Sources

Content presented in this technical appendix was derived from various reputable sources. **Table 26** presents these sources in greater detail.

Table 26: Sources

Item	Source
Total Person Trips	Transportation Tomorrow Survey (2016) – University of Toronto
Population and Employment Forecast – Greater Golden Horseshoe	GGHv4 - Government of Ontario (Provided by Metrolinx)
Weekday Cordon Counts – GO Transit (2016)	Metrolinx
Passenger Fare Information	2017 GO Rail Passenger Survey – Metrolinx

Major Transit Station Areas

Table 27: MTSAs in Auto and Transit Catchments

Municipality	MTSA	In Auto Catchment(s)	In Transit Catchment(s)	Medium Density Target	High Density Target
Brampton	Airport	Bramalea	None	160	200
Brampton	Airport Rd	Bramalea and Malton	Bramalea and Malton	160	200
Brampton	Bramalea	Bramalea	Bramalea	160	200
Brampton	Bramalea GO	Bramalea	Bramalea	150	241
Brampton	Brampton GO	Brampton	Brampton	160	580
Brampton	Central Park	Bramalea	Bramalea	160	200
Brampton	Centre St	Brampton	Brampton	160	236
Brampton	Chrysler Gateway	Bramalea	Bramalea	160	200
Brampton	Dixie (Queen)	Bramalea	Brampton and Bramalea	160	298
Brampton	Dixie 407	Bramalea	Bramalea	160	200
Brampton	Gateway Terminal	Brampton and Bramalea	Brampton and Bramalea	160	561
Brampton	Glenvale-Finchgate	Bramalea	Bramalea	160	200
Brampton	Goreway (Queen)	Bramalea	None	160	200
Brampton	Goreway 407	Bramalea and Malton	Bramalea and Malton	160	200
Brampton	Highway 50	Bramalea	None	160	200
Brampton	Kennedy	Brampton	Brampton	160	259
Brampton	Laurelcrest	Brampton and Bramalea	Brampton and Bramalea	160	264
Brampton	McVean	Bramalea	None	160	200
Brampton	Mississauga Rd	Bramalea and Mount Pleasant	None	160	200
Brampton	Mount Pleasant GO	Mount Pleasant	Mount Pleasant	150	268
Brampton	Nanwood	Brampton	Brampton	160	200
Brampton	Ray Lawson	Brampton and Bramalea	Brampton	160	338
Brampton	Rutherford	Brampton and Bramalea	Brampton	160	377
Brampton	Steeles at Mississauga	Mount Pleasant	None	160	200
Brampton	The Gore	Bramalea	None	160	228
Brampton	Torbram	Bramalea	Bramalea	160	200
Brampton	Trinity Common Terminal	Brampton and Bramalea	None	160	200
Cambridge	Cambridge Centre Mall Station	Pinebush	Pinebush	160	200

Cambridge	Cambridge Terminus Station	Pinebush	Pinebush	160	200
Cambridge	Can-Amera Station	Pinebush	Pinebush	160	200
Cambridge	Delta Station	Pinebush	Pinebush	120	145
Cambridge	Main Station	Pinebush	Pinebush	160	200
Cambridge	Pinebush Station	Pinebush	Pinebush	160	200
Cambridge	Preston Station	Pinebush	Pinebush	160	200
Guelph	Guelph Central	Guelph	Guelph	200	240
Halton Hills	Acton GO	Acton	Acton	100	125
Halton Hills	Georgetown GO	Georgetown	Georgetown	100	125
Kitchener	Sportsworld Station	Pinebush	Pinebush	160	200
Mississauga	Bristol	Bramalea	None	160	214
Mississauga	Britannia	Bramalea	None	160	200
Mississauga	Burnhamthorpe	Bramalea	None	400	733
Mississauga	Cawthra 403	Bramalea	None	50	75
Mississauga	Central Parkway	Bramalea	None	80	105
Mississauga	City Centre	Bramalea	None	400	871
Mississauga	Courtney Park	Bramalea	None	160	200
Mississauga	Derry	Bramalea	None	160	200
Mississauga	Dixie 403	Bramalea and Woodbine	None	100	127
Mississauga	Dixie GO	Woodbine	None	160	200
Mississauga	Duke of York	Bramalea	None	400	440
Mississauga	Eglinton	Bramalea	None	300	456
Mississauga	Etobicoke Creek	Woodbine	None	160	217
Mississauga	Highway 407 (Hurontario)	Bramalea	None	160	200
Mississauga	Malton GO	Malton	Malton	100	125
Mississauga	Matheson	Bramalea	None	160	200
Mississauga	Orbitor	Woodbine	None	160	200
Mississauga	Renforth	Woodbine	None	160	200
Mississauga	Robert Speck	Bramalea	None	400	727
Mississauga	Spectrum	Woodbine	None	160	200
Mississauga	Tahoe	Woodbine	None	160	200
Mississauga	Tomken 403	Bramalea	None	80	105
Mississauga	Wharton	Woodbine	None	160	200
Toronto	Aga Khan Park & Museum	Union	None	200	476
Toronto	Albion	Inner Service and Woodbine	Woodbine	160	200

Toronto	Avenue	Inner Service	None	200	240
Toronto	Bathurst	Inner Service and Union	Inner Service and Union	200	247
Toronto	Bay	Union	Union	900	940
Toronto	Bloor GO	Inner Service	Inner Service	300	471
Toronto	Bloor-Lansdowne GO	Inner Service	Inner Service	300	459
Toronto	Bloor-Yonge	Union	Union	900	1032
Toronto	Broadview	Union	Union	200	242
Toronto	Caledonia	Inner Service	Inner Service	160	228
Toronto	Castle Frank	Union	Union	200	240
Toronto	Chaplin	Inner Service	None	200	240
Toronto	Chester	Union	Union	200	240
Toronto	Christie	Inner Service	Inner Service	200	240
Toronto	College	Union	Union	1200	1396
Toronto	Corktown	Union	Union	400	688
Toronto	Cosburn	Union	None	200	240
Toronto	Downsview Park	Inner Service	None	200	240
Toronto	Driftwood	Inner Service	None	160	200
Toronto	Dufferin	Inner Service	Inner Service	250	290
Toronto	Duncanwoods	Inner Service	None	160	200
Toronto	Dundas	Union	Union	1900	2041
Toronto	Dundas West	Inner Service	Inner Service	300	496
Toronto	Dupont	Inner Service and Union	Inner Service and Union	200	254
Toronto	East Harbour	Union	Union	300	340
Toronto	Eglinton West	Inner Service	Inner Service	200	240
Toronto	Emery	Inner Service	None	160	310
Toronto	Etobicoke North	Inner Service and Woodbine	Inner Service and Woodbine	150	294
Toronto	Exhibition	Inner Service and Union	Inner Service and Union	250	472
Toronto	Fairbank	Inner Service	Inner Service	160	262
Toronto	Flemingdon Park	Union	None	200	250
Toronto	Forest Hill	Inner Service	Inner Service	160	200
Toronto	Front-Spadina	Union	Union	400	722
Toronto	Gerrard-Carlaw	Union	Union	300	340
Toronto	High Park	Inner Service	Inner Service	200	240
Toronto	Humber College	Woodbine	Woodbine	115	140
Toronto	Islington	Inner Service	None	300	367
Toronto	Jane	Inner Service	Inner Service	200	240

Toronto	Jane and Finch	Inner Service	None	200	257
Toronto	Keele (TTC)	Inner Service	Inner Service	250	347
Toronto	Keelesdale	Inner Service	Inner Service	160	220
Toronto	King	Union	Union	2000	2152
Toronto	King-Bathurst	Union	Union	400	441
Toronto	King-Liberty	Inner Service and Union	Inner Service and Union	250	539
Toronto	Kipling	Woodbine and Inner Service	None	300	385
Toronto	Lansdowne	Inner Service	Inner Service	250	322
Toronto	Lawrence West	Inner Service	Inner Service	200	240
Toronto	Leslieville	Union	Union	300	402
Toronto	Long Branch	Woodbine	None	150	189
Toronto	Martin Grove	Woodbine	Woodbine	100	125
Toronto	Milvan Rumike	Inner Service	None	160	248
Toronto	Mimico	Inner Service	None	200	259
Toronto	Moss Park	Union	Union	400	502
Toronto	Mount Dennis	Inner Service	Inner Service	160	200
Toronto	Mount Olive	Inner Service and Woodbine	None	160	205
Toronto	Museum	Union	Union	700	763
Toronto	Norfinch Oakdale	Inner Service	None	160	222
Toronto	Oakwood	Inner Service	Inner Service	160	237
Toronto	Old Mill	Inner Service	Inner Service	50	75
Toronto	Osgoode	Union	Union	1700	2243
Toronto	Ossington	Inner Service	Inner Service	200	240
Toronto	Pape	Union	None	200	240
Toronto	Park Lawn	Inner Service	None	400	490
Toronto	Pearldale	Inner Service	None	160	200
Toronto	Pioneer Village (Toronto)	Bramalea	None	55	80
Toronto	Queen	Union	Union	2000	2262
Toronto	Queens Park	Union	Union	900	1085
Toronto	Queen-Spadina	Union	Union	400	462
Toronto	Rosedale	Union	Union	200	244
Toronto	Rowntree Mills	Inner Service	None	80	105
Toronto	Runnymede	Inner Service	Inner Service	200	240
Toronto	Science Centre	Union	None	200	408
Toronto	Sheppard West	Inner Service	None	200	240
Toronto	Sheppard-Yonge	Inner Service	None	350	390
Toronto	Sherbourne	Union	Union	500	540

Toronto	Signet Arrow	Inner Service	None	160	214
Toronto	Spadina	Union and Inner Service	Union and Inner Service	300	390
Toronto	St Andrew	Union	Union	1700	2163
Toronto	St Clair	Union	Union	300	516
Toronto	St Clair West	Inner Service	Inner Service	200	313
Toronto	St George	Union	Union	400	461
Toronto	St Patrick	Union	Union	1500	1563
Toronto	St. Clair-Old Weston	Inner Service	Inner Service	150	282
Toronto	Stevenson	Inner Service and Woodbine	None	160	200
Toronto	Summerhill	Union	Union	200	259
Toronto	Thorncliffe Park	Union	None	200	300
Toronto	Tobermory	Inner Service	None	85	110
Toronto	Union	Union	Union	1700	2028
Toronto	Wellesley	Union	Union	1000	1149
Toronto	Westmore	Woodbine	Woodbine	160	200
Toronto	Weston GO	Inner Service	Inner Service	200	356
Toronto	Wilson	Inner Service	None	200	240
Toronto	Woodbine	Woodbine	Woodbine	150	200
Toronto	Wynford	Union	None	200	546
Toronto	York Mills	Inner Service	None	85	110
Toronto	Yorkdale	Inner Service	Inner Service	200	240
York	Ansley Grove	Bramalea	None	200	240
York	Commerce	Bramalea and Inner Service	None	350	390
York	Concord	Bramalea	None	160	200
York	Creditstone	Bramalea	None	300	340
York	Highway 407 (TTC)	Bramalea	None	0	25
York	Keele (Hwy 7)	Bramalea	None	160	200
York	Pine Valley	Bramalea	None	160	200
York	Pioneer Village (York)	Bramalea	None	200	240
York	Vaughan Metropolitan Centre	Bramalea	None	400	440
York	Weston (Hwy 7)	Bramalea and Inner Service	None	250	290
York	Wigwoss-Helen	Bramalea	None	160	200

Appendix B
Grade Crossing Analysis

H372245

February 14, 2024

The Region of Waterloo
Cambridge Passenger Rail IBC and Concept Design

Analysis of Existing At-Grade Crossings

1. Introduction and Executive Summary

This Project Memo is intended to build on the previous work completed in the *2021 Cambridge to Union GO Rail Feasibility Study Phase 2 Report*) to review the existing crossings in the corridor and determine the level of investment needed to upgrade or modify the crossings to grade separations as required. This Memo outlines the existing at-grade crossings, the necessary upgrades or modifications needed to implement the passenger rail service and provides a more detailed estimate of capital costs. This Memo provides an overview of the primary foreseeable technical constraints to implementing the Cambridge-Guelph Passenger service, and related mitigation measures, as they related to grade crossings.

Identification of the impacted at-grade and grade separated crossings along the two different service alignments are summarized herein. When considering potential infrastructure improvements, an environmental assessment of the crossings along the proposed corridor will be required, as well as consideration for utility relocation, property impacts, construction staging, groundwater table effects, visual impacts, and future road capacity requirements.

Some crossings are subject to cost-prohibitive or non-practical construction constraints such as adjacent hydro corridors, nearby private driveways, underground utilities, or neighbouring property impacts. Each of the crossings would need to be assessed if the train speed or frequency is to be raised above its current level to ensure compliance with rail safety standards. The approach here is based on a predominantly single-track railway assumption. Double tracking may at certain locations introduce new considerations.

The conclusion is to upgrade the grade crossings with improved warnings and signage and in some cases, active restraint devices and in one case build a road-over-rail grade separation.

2. Crossings Overview

2.1 Silvercreek to Pinebush Alignment

A high-level review was conducted to assess the existing conditions of the crossings along the Silvercreek to Pinebush alignment (i.e. from Silvercreek Parkway South to the Pinebush Transit Station). This alignment involves tracks for the Fergus Spur and the Galt Industrial Spur. The crossings along this alignment are primarily surrounded by residential or industrial land uses. The following high-level review considers use of the existing line for increased frequency and speed of rail service. A detailed summary of the crossings can be found in below Table 1. The goal of the review was to feed into the capital costs calculated for the Initial Business Case Report, and further develop an understanding of technical constraints.

Table 1. Summary of Grade Crossing Analysis and Estimated Costs

#	Roadway Name	Existing Type of Warning System	Anticipated Minimum Warning System Upgrades	Estimated Cost
1	Silvercreek Parkway South	FLB + Cantilevers	· Add gates	$ 500,000.00
			· Upgrade antiquated cantilevers and other signal components to meet standards	$ 200,000.00
2	Fife Road	FLB + Cantilevers	· Add gates	$ 500,000.00
			· Upgrade antiquated cantilevers and other signal components to meet standards	$ 200,000.00
3	Whitelaw Road	FLB	· Add gates	$ 500,000.00
			· Upgrade antiquated signals components to meet standards	-
4	Wellington Road 32	FLB	· Add gates	$ 500,000.00
			· Upgrade antiquated signals components to meet standards	-
5	Wellington Road 124/Country Road 124	FLB	· Grade separation	$ 30,000,000.00
6	Blackbridge Road	SRCS + Stop Sign	· Add FLB and gates	$ 500,000.00
			· Ensure visibility of warning system upon both approaches	$ 50,000.00
7	Guelph Avenue	FLB + West Cantilever	· Add gates	$ 500,000.00
			· Upgrade antiquated signals components to meet standards	$ 200,000.00
			· Address nearby driveway in northwest quadrant to mitigate queuing over the tracks	$ 50,000.00
8	Highway 32/ Beaverdale Road	FLB	· Add gates	$ 500,000.00
			· Upgrade antiquated signals components to meet standards	$ 200,000.00
9	Eagle Street North	SRCS	· Add FLB and gates	$ 500,000.00
			· Ensure visibility of warning system upon both approaches	$ 50,000.00
10	Industrial Road	SRCS	· Add FLB and gates	$ 500,000.00
			· Ensure visibility of warning system upon both approaches	$ 50,000.00
Subtotal Grade Crossing Improvements				**$ 5,500,000.00**
Subtotal Grade Separations				$ 30,000,000.00

#	Roadway Name	Existing Type of Warning System	Anticipated Minimum Warning System Upgrades	Estimated Cost
GRAND Total Crossings & Grade Separations				**$ 35,500,000.00**

2.1.1 Existing Crossings

The Silvercreek to Pinebush alignment has 21 crossings in total, as described in Table 2. The public crossings along the corridor which are subject to significant roadway traffic volumes have been highlighted in Figure 1.

Ten crossings are public and at-grade; five are grade separated; and six are private and at-grade for residential dwellings or businesses. Of the ten public and at-grade crossings, seven are equipped with Flashing Lights and Bell (FLB); while three crossings are passive with Standard Railway Crossing Signs (SRCS). There are five private and at-grade crossings along the Fergus Spur. Three of which are located between Whitelaw Road and Wellington Road 32; a fourth is located between Wellington Road 32 and Wellington Road 124/ County Road 124; and the fifth is at the north end of Winston Boulevard. Along the Galt Industrial Spur, two public and at-grade crossings are found with SRCS.

For the purpose of this Study, the majority of existing grade separated crossings were assumed structurally sound, capable of carrying the proposed train traffic, and requiring minor rehabilitation work within the next 5 years. Only the Mill Pond bridge is anticipated to require rehabilitation as described below.

2.1.2 Mill Pond Bridge

The existing Mill Pond Bridge over the Speed River, near Hespeler Road and approximately 12 km from the Guelph Junction, is deemed structurally sound. However, the bridge will require rehabilitation to support the Silvercreek to Pinebush alignment and service. More detail on the rehabilitation required was highlighted in the Speed River Bridge Inspection Report (May 2016) by the Goderich Exeter Railway (GEXR). The report indicates the need for the replacement of the bridge's wooden ties. As a result, future phases of work will require an estimate cost to complete the railway tie replacement work was included in this Study.

Further studies will be required to assess and confirm the structural integrity of the bridge to support the proposed passenger service.

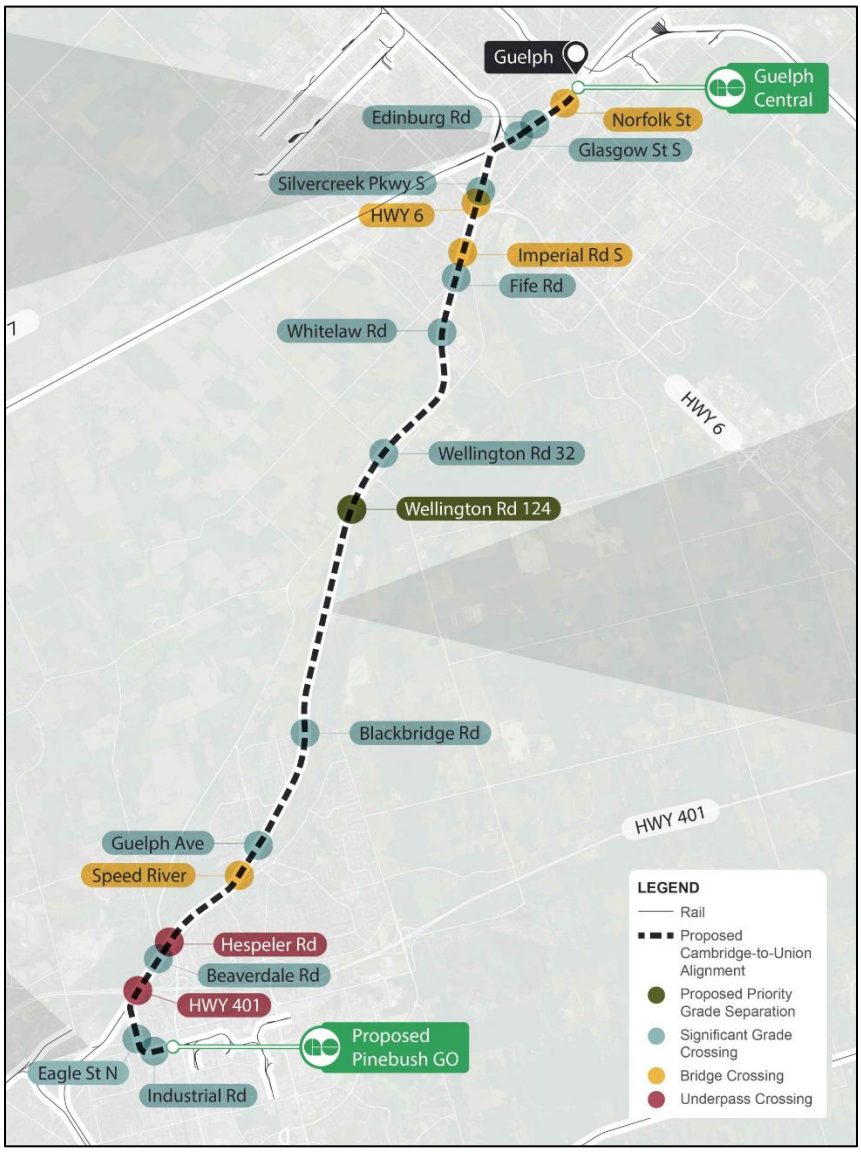

Figure 1. Significant crossings along the proposed Silvercreek to Pinebush alignment

(not all included– see Table 2)

Table 2. Crossings along the Fergus Spur and Galt Industrial Spur (from north to south).

#	Roadway Name	Railway Mileage	Crossing Type	Type of Warning System
1	Silvercreek Parkway South	29.51 Fergus Spur	At-Grade: Public	FLB + Cantilevers
2	Hanlon Parkway & Highway 6 Exit Ramp	approx. 29.32 Fergus Spur	Grade Separation (bridge/rail-over-road)	n/a
3	Imperial Road South	approx. 28.86 Fergus Spur	Grade Separation (bridge/rail-over-road)	n/a
4	Fife Road	28.60 Fergus Spur	At-Grade: Public	FLB + Cantilevers
5	Whitelaw Road	28.03 Fergus Spur	At-Grade: Public	FLB

#	Roadway Name	Railway Mileage	Crossing Type	Type of Warning System
6	Private (dwelling)*	approx. 27.71 Fergus Spur	At-Grade: Private	SRCS assumed
7	Private (dwelling)*	approx. 27.60 Fergus Spur	At-Grade: Private	SRCS assumed
8	Private (industry)*	approx. 27.47 Fergus Spur	At-Grade: Private	SRCS assumed
9	Wellington Road 32	26.59 Fergus Spur	At-Grade: Public	FLB
10	Private (dwelling, double track)*	approx. 26.06 Fegus Spur	At-Grade: Private	SRCS assumed
11	Wellington Road 124/Country Road 124	25.93 Fergus Spur	At-Grade: Public	FLB
12	Private (industry, James Aggregate)*	approx. 24.87 Fergus Spur	At-Grade: Private	SRCS assumed
13	Blackbridge Road	23.63 Fergus Spur	At-Grade: Public	SRCS + Stop Sign
14	Guelph Avenue	22.37 Fergus Spur	At-Grade: Public	FLB + West Cantilever
15	Mill Pond Bridge	approx. 22.00 Fergus Spur	Grade Separation (rail-over-water)	n/a
16	Winston Boulevard*	approx. 21.66 Fergus Spur	At-Grade: Private	SRCS
17	Hespeler Rd / Regional Road 24*	approx. 20.98 Fergus Spur	Grade Separation (tunnel/road-over-rail)	n/a
18	Highway 32/ Beaverdale Road	20.80 Fergus Spur	At-Grade: Public	FLB
19	Highway 401	approx. 20.43 Fergus Spur	Grade Separation (tunnel/road-over-rail)	n/a
20	Eagle Street North	0.44 Galt Ind. Spur	At-Grade: Public	SRCS
21	Industrial Road*	0.74 Galt Ind. Spur	At-Grade: Public	SRCS

*These crossings not illustrated on the map of Figure 1.

2.1.3 Anticipated Improvements

To facilitate the proposed rail service, improvements or installations of automatic warning systems for all at-grade crossings should be considered. At a high-level, without formal completion of grade crossing assessments, it is anticipated that at minimum, automatic warning systems with Flashing Lights, Bell and Gates (FLBG) would be required at all of the public at-grade crossings along the proposed alignment. The provision of railway gates could also include quad-gates, or similar additional gates, for crossings with multiple lanes and sidewalks. However, for the purpose of this study, the minimum single gate configuration for each roadway approach is assumed. More specifically, Table 3 outlines the minimum anticipated improvements required for each at-grade crossing.

Table 3. Anticipated Minimum Warning System Upgrades for Public At-Grade Crossings – Silvercreek to Pinebush alignment

#	Roadway Name	Existing Type of Warning System	Anticipated Minimum Warning System Upgrades
1	Silvercreek Parkway South	FLB + Cantilevers	• Add gates • Upgrade antiquated cantilevers and other signal components to meet standards • New bungalow
2	Fife Road	FLB + Cantilevers	• Add gates • Upgrade antiquated cantilevers and other signal components to meet standards • New bungalow

#	Roadway Name	Existing Type of Warning System	Anticipated Minimum Warning System Upgrades
3	Whitelaw Road	FLB	• Add gates • Upgrade antiquated signals components to meet standards • New bungalow
4	Wellington Road 32	FLB	• Add gates • Upgrade antiquated signals components to meet standards • New bungalow
5	Wellington Road 124/Country Road 124	FLB	• Grade separation
6	Blackbridge Road	SRCS + Stop Sign	• Add FLB and gates • Ensure visibility of warning system upon both approaches • New bungalow
7	Guelph Avenue	FLB + West Cantilever	• Add gates • Upgrade antiquated signals components to meet standards • Address nearby driveway in northwest quadrant to mitigate queuing over the tracks • New bungalow
8	Highway 32/ Beaverdale Road	FLB	• Add gates • Upgrade antiquated signals components to meet standards • New bungalow
9	Eagle Street North	SRCS	• Add FLB and gates • Ensure visibility of warning system upon both approaches • New bungalow
10	Industrial Road	SRCS	• Add FLB and gates • Ensure visibility of warning system upon both approaches • New bungalow

In addition to the minimum warning system upgrades for the at-grade crossings, the following additional improvements can also be considered:

- Improve crossing surface and roadway approaches.
- Remove vegetation in immediate quadrants of the crossing.
- Add second bell for pedestrian/ cyclist approaches.
- The 5 private crossings should be individually assessed to identify their applicable design vehicle and the appropriate crossing warning system for the rail service proposed.
- A rough order of magnitude total estimate of the minimum crossing improvements required is detailed in Table 1. The costs shown include total estimated railway and municipal costs for the following improvements.
- Add FLB and gates: adding a completely new automatic warning system and connecting power to the crossing.
- Upgrade antiquated signals components to meet standards: completing the upgrading of the existing cantilever to meet the new standards.
- Ensure visibility of warning system upon both approaches: completing brush cutting on railway, municipal or private lands.

2.1.4 Eagle Street North and Industrial Road At-Grade Crossings

The Eagle Street North and Industrial Road crossings are anticipated to contribute the highest cost and level of effort to bring the crossings up to compliance for the new rail service.

The crossings are located within the Hespeler Road mixed-use corridor in Cambridge as shown in Figure 2. The Eagle Street North crossing is adjacent to an employment corridor and a low/medium density residential area (City of Cambridge Official Plan, 2018). A vegetated buffer separates the railway and the

surrounding residential properties. The Industrial Road crossing is located in an industrial area. There are no identified natural heritage features in the immediate surrounding area (City of Cambridge Heritage Master Plan, 2008).

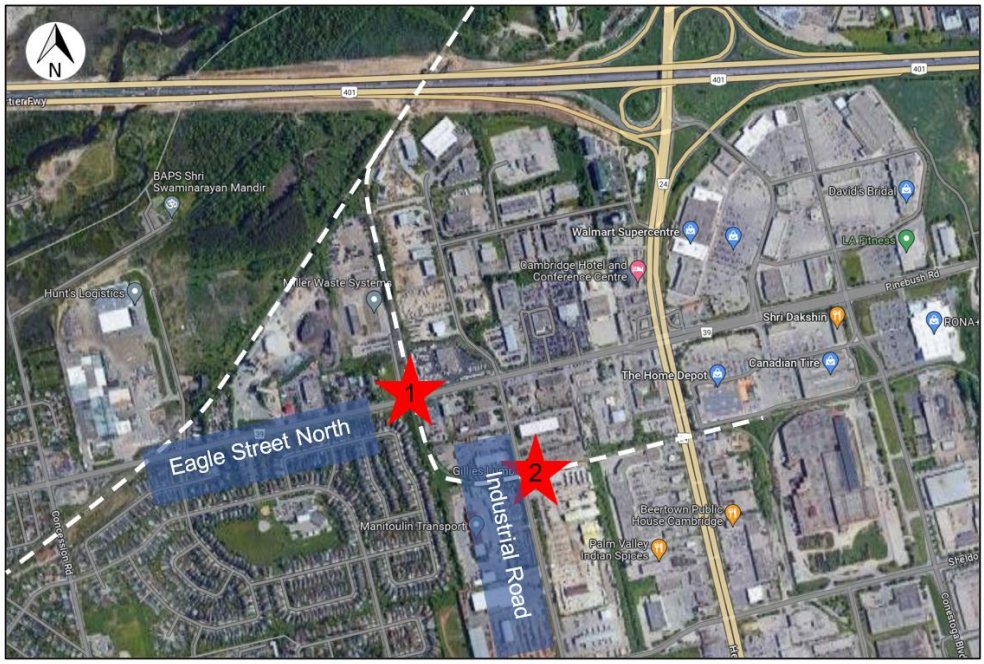

Figure 2 Map showing the location of the Eagle Street North (star 1) and Industrial Road crossings (star 2) with SRCS. Railway tracks shown in dashed white lines. (Google Maps, 2023)

Eagle Street North (indicated with a “1” star on Figure 2, above) is an arterial road. As seen in Figure 3, there are aerial hydro pole lines located on the south side and west side of the Eagle Street North crossing. Eastbound traffic approaching the Eagle Street North crossing consists of a one-lane roadway with a paved shoulder and multi-use pathway. Westbound traffic approaching the Eagle Street Noth crossing consists of a one-lane roadway with paved shoulder. The perpendicular crossing does not have an automatic warning system and has Standard Railway Crossing Signs (SRCS). To the west one private driveway is located within 30 metres of the crossing which is not ideal for railway safety as westbound vehicles entering the driveway may cause queuing over the tracks.

Industrial Road (indicated with a “2” star on Figure 2, above), is a minor arterial road. As seen in Figure 4, there are aerial hydro pole lines located on the east side and south side of the crossing. Northbound traffic approaching the Industrial Road crossing consists of a one-lane roadway with shared centre lane and a paved shoulder. Southbound traffic approaching the Industrial Road crossing consists of a one-lane roadway with shared centre laned and a paved shoulder. The perpendicular crossing does not have an automatic warning system and has Standard Railway Crossing Signs (SRCS). To the north two private driveways are located within 30-metres of the crossing which is not ideal for railway safety as northbound vehicles entering the driveways may cause queuing over the tracks.

Taking the high-level noted considerations into account, a rough order of magnitude estimated cost has been provided for installing FLBG warning systems at both crossings, as found in Table 1 (cost spreadsheet).

Figure 3 Facing east showing the location of the Eagle Street North crossing with SRCS. (Google Maps, 2023)

Figure 4 Facing north showing the location of the Industrial Road crossing with SRCS. (Google Maps, 2023)

2.1.5 Grade Separated Crossings

The closure of existing crossings, or conversion of existing at-grade crossings into grade separations, would by some perspectives be ideal to mitigate risks related to railway operations for any increase in rail service. However, due to constraints with planning priorities, finite sources of capital to pay for such

improvements, neighbouring properties, and other crossing specific aspects, grade separations can be prioritized according to risk level.
Specific to the Silvercreek to Pinebush alignment, volume and crossing angle can contribute to an at-grade crossing's increase in risk level. A skewed angle can contribute to rail safety concerns regarding obstructed sightlines for approaching trains, and increased clearance time and distance required for crossing users to traverse the crossing. Therefore, due to the skewed conditions and anticipated traffic volumes, Wellington Road 124 should be prioritized as a grade separation .

2.1.5.1 Wellington Road 124

The existing Wellington Road 124 crossing is the crossing with the highest skew to the railway tracks at an estimated angle of 5 degrees (175 degrees) with the roadway. The roadway is an arterial east-west travel-way. To mitigate such risks, upgrading this at-grade crossing to a grade separation may be considered. However, constructing a grade separation at this location will require consideration of various constructability aspects, some of which are highlighted below.

Existing overhead and underground utilities will require relocation prior to the construction of a grade separation for the Wellington Road 124 crossing. As seen in Figure 5, an existing aerial hydro transmission corridor abuts the north side of the road, and an additional local aerial hydro distribution corridor abuts the south side of the road. Markers for buried utilities are also observed in the northwest quadrant of the crossing, as well as along the railway corridor. Work to relocate, protect, or avoid these existing utility corridors should be considered when planning for a grade separation.

The construction of a rail-over-road bridge (i.e., road-under-rail) is generally more costly to construct when compared to a road-over-rail bridge. As an example, a recent Class EA completed by Hatch Ltd. for the City of Barrie, determined that an underpass was 2.5 times more expensive than an overpass to construct, although this cost could vary in other locations based on the specific physical context for construction of the overpass. Depending on the surrounding groundwater and soil conditions, a bridge (i.e. rail-over-road) would also require a pumping station. As the elevation of the roadway and railway approaches to the existing crossing are relatively flat, a road-over-rail grade separation could be considered to reduce costs. A road-over-rail grade separation would also avoid vertical realignment of the railway tracks which would be difficult due to the nearby track curvature to the north, as well as railway design standards.

Figure 5 Facing east at the approach to the Wellington Road 124 crossing. View of the existing aerial hydro corridor to the north, and aerial powerline to the south. (Google Maps, 2023)

During construction, a diversion road with temporary level crossing could be constructed, to maintain traffic and allow activities to occur within the existing roadway alignment. With this diversion approach, service roads for accessing the private properties with driveways onto Wellington Road 124 will be required. Alternatively, acquisition of the closest properties impacted could be considered.

Grade separating the Wellington Road 124 crossing could be further optimized by realigning the roadway approaches to reduce the length of the bridge structure. Reducing the bridge length will reduce construction and maintenance costs. This concept has been applied to precedent similar projects as shown in Figure 6. Roadway realignment will also affect the driveways upon the approach to the crossing. For Wellington Road 124, a minimum of twelve driveways to the east/north and another four driveways to the west/south all within 500 meters of the crossing, could be affected by the construction of a grade separation. As a result, work and agreements related to realigning the roadway approaches and addressing the existing driveways should be considered when planning for a grade separation.

Surrounding the intersection of the railway track and Wellington Road 124 there is a small hamlet, a rural employment zone, a prime agricultural area, and a Built Heritage Resource to the northeast of the crossing at 6974 Wellington Road 124 (Wellington County Official Plan, 2019). As well, the roadway and the Greater Western Railway are considered as historical elements by the City of Cambridge. According to the Wellington Road 124 Class Environmental Assessment (Class EA) Study (MTE Consultants Inc., December 2019), there is archaeological potential located to the south and north of Wellington Road 124, requiring both test pit and pedestrian surveys. Therefore, costs for further study and mitigations to protect neighbouring lands should be considered when planning for a grade separation.

Taking the high-level noted considerations into account, a rough order of magnitude estimated cost has been provided for grade separating Wellington Road 124 as found in Table 1 (cost spreadsheet).

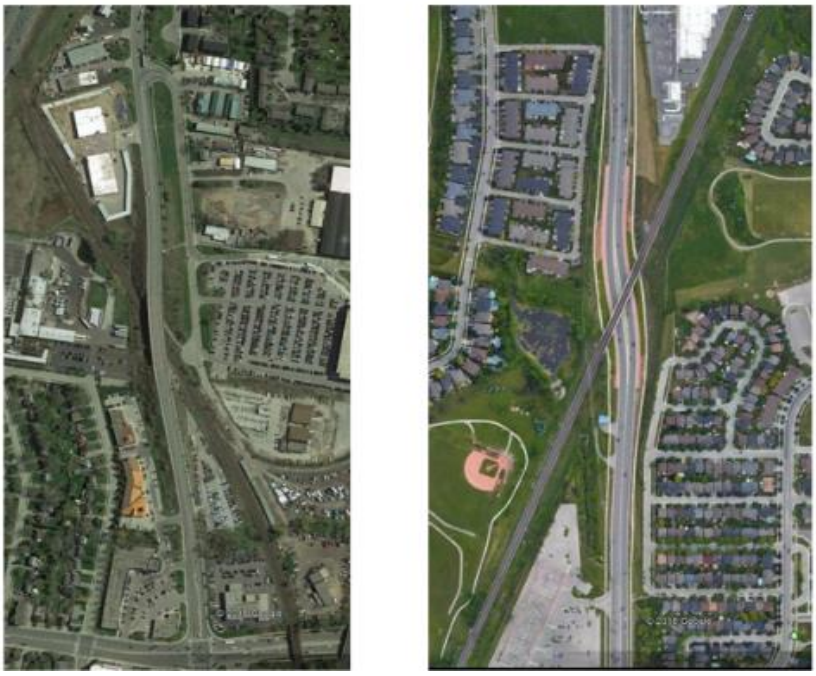

Figure 6 Example of (1-left) road over rail (Plains Road, Burlington, ON) and (2 - right) road under rail (Appleby Line, Burlington, ON) constructed to mitigate the safety challenges of a skewed railway crossing (Google Maps, 2019)

2.2 Guelph Line Alignment

A high-level review was conducted to assess the existing conditions of the crossings along the Guelph Line alignment (i.e from Guelph Central Station to Guelph Junction). This alignment involves the Metrolinx Kitchener line on the Guelph subdivision. Any improvements along this alignment would be undertaken as part of the Kitchener corridor's expansion plans.

The crossings along this alignment are primarily surrounded by residential land uses. The following high-level review considers use of the existing line for increased frequency and speed of rail service. The goal of this review was to feed into the capital costs calculated for this Study.

2.2.1 Existing Crossings

The railway corridor in the proposed Guelph Line alignment has 7 crossings, as illustrated in Figure 7.

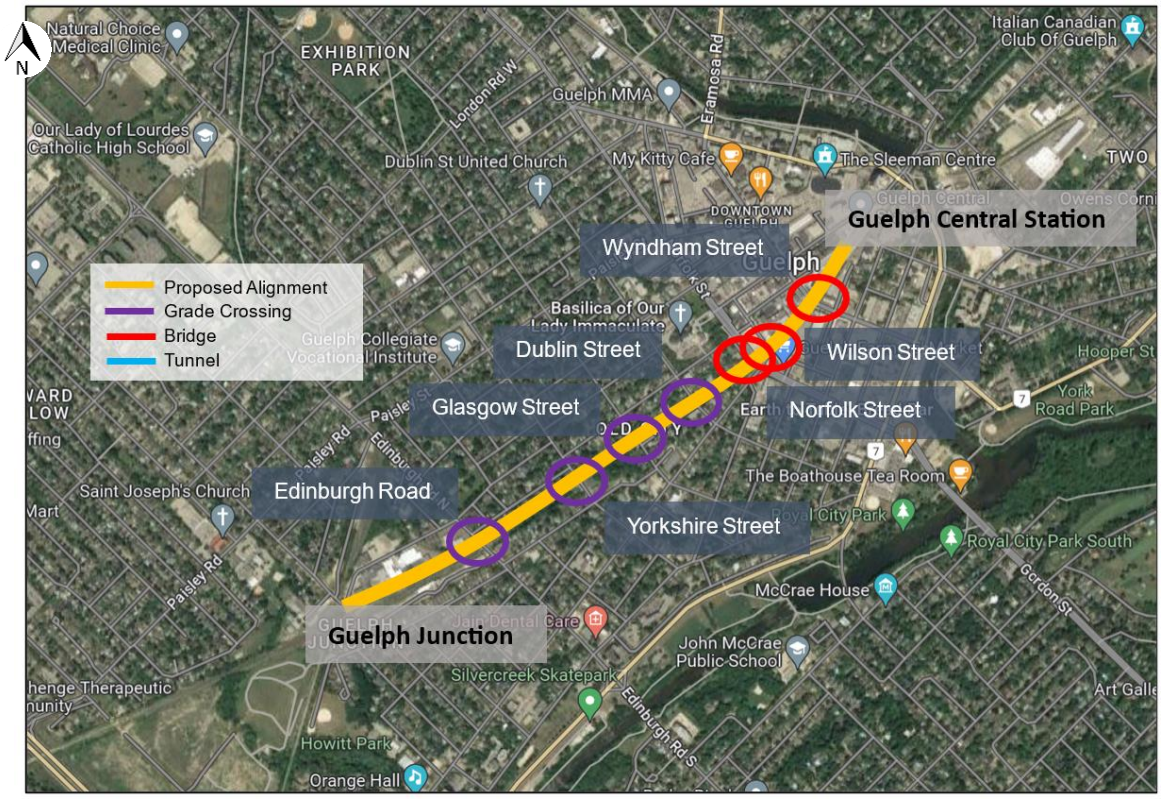

Figure 7 Crossings along the proposed Guelph Line alignment. (Google Maps, 2023)

Four of the crossings are public and at grade; and three are grade separated. Three of the four at-grade crossings are equipped with Flashing Lights, Bells and Gates (FLBG).

Table 4. Crossings along the Guelph Line.

#	Roadway Name	Railway Mileage	Crossing Type	Type of Warning System
1	Edinburgh Road South	49.54 Guelph Sub	At-Grade: Public (2 tracks)	FLBG
2	Yorkshire Street	49.33 Guelph Sub	At-Grade: Public (2 tracks)	FLBG
3	Glasgow Street	49.20 Guelph Sub	At-Grade: Public	FLBG
4	Dublin Street	49.09 Guelph Sub	At-Grade: Private Access Gated	CLOSED

#	Roadway Name	Railway Mileage	Crossing Type	Type of Warning System
5	Norfolk Street / Gordon Street	approx. 48.96 Guelph Sub	Grade Separation (bridge/rail-over-road)	n/a
6	Wilson Street	approx. 48.84 Guelph Sub	Grade Separation (bridge/rail-over-road)	n/a
7	Wyndham Street	approx. 48.82 Guelph Sub	Grade Separation (bridge/rail-over-road)	n/a

The Dublin Street at-grade crossing is barricaded with concrete barriers and fencing as shown in Figure 8. It can be suspected that existing railway traffic may have contributed to the closure of the Dublin Street at-grade crossing. Due to the approximately 60 metre distance between the Dublin Street Crossing and the intersection of Dublin Street and Waterloo Avenue to the south, northbound roadway vehicles stopped for passing trains could have caused queuing into the intersection of Dubin Street and Waterloo Avenue. The roadway traffic signal along Waterloo Avenue could have also been installed to control the volume of northbound roadway traffic entering Dublin Street to mitigate queuing in the intersection. This concept of railway traffic volume affecting nearby intersections should also be considered if selecting this alignment for the Cambridge-Guelph service.

Figure 8 Facing north at the Dublin Street crossing. (Google Maps, 2023)

2.2.2 Anticipated Improvements

With the anticipated minimum requirement of automatic warning systems with FLBG for all public at-grade crossings, this Guelph alignment is conformant.

The City of Guelph initiated a Rail Crossing Study in June 2022[1] to promote the preservation of connectivity and their transportation goals. The study includes consideration of the Alma Street, Edinburgh Road, Yorkshire Street, and Glasgow Street crossings. Recommendation was anticipated to be presented to Council in 2024. As a result, publicly available results of the study are yet to be published.

[1] City of Guelph, www.haveyoursay.guelph

2.2.3 Future Grade Separated Crossings

2.2.3.1 Edinburgh Road

Although conversion of all at-grade crossings to grade separations is the conservative approach, prioritization of grade separation candidates can be done.

Specific to the Guelph alignment, at the onset of this initial study in 2019, the City of Guelph anticipated that due to the volumes of roadway traffic and anticipated increase in railway traffic from the proposed rail service, a grade separation could be warranted for Edinburgh Road.

As shown in Figure 9, surrounding the intersection of the railway track and Edinburgh Road are densely developed with commercial and residential areas. Costs for further study and mitigations to protect neighbouring lands should be considered when planning for a grade separation.

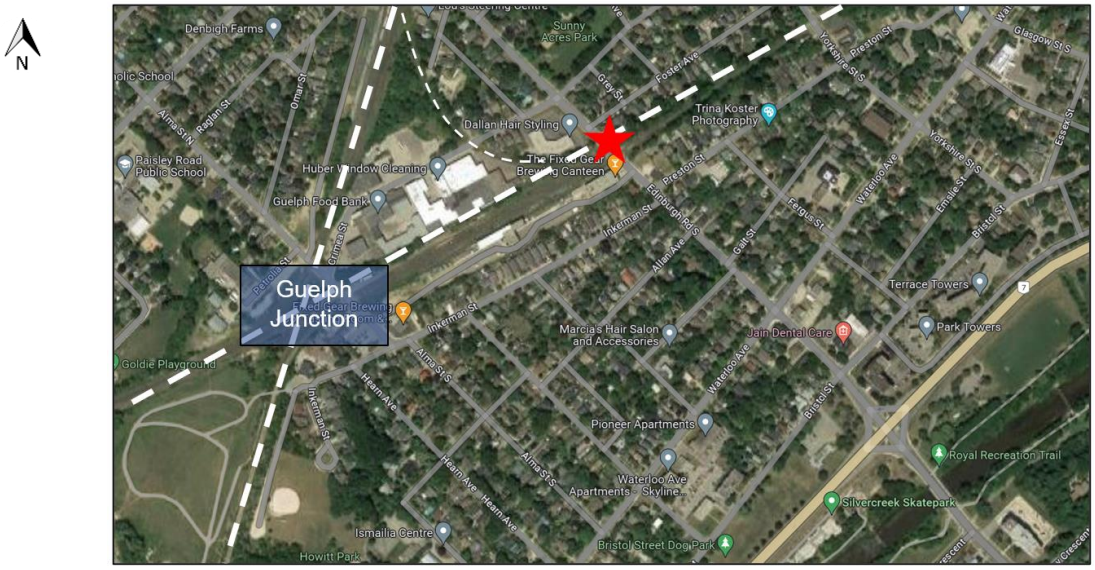

Figure 9 Plan view showing the Edinburgh Road crossing (red star) and surrounding area. Railway tracks shown in white dashed lines. (Google Maps, 2023)

Grade separating Edinburgh Road will have the following primary challenges to consider, at minimum.
Railway challenges:

- Existing capacity for multiple mainline tracks.
- Proximity to the existing railway Junction.
- Proximity to industrial spur lines.
- Roadway challenges:
- Existing densely built environment with commercial and residential driveways upon the crossing's approach.
- Existing roadway approach gradient to the south.
- Proximity of nearby local and Stop Sign controlled intersections and private driveways within the crossings approach (closest driveway at approximately 25 metres from the crossing).
- Proximity to the nearby Waterloo Avenue traffic-controlled intersection (approximately 280 meters from the crossing).

As shown in Figure 10, in relation to the gradient of the south approach, the crossing is at a crest to the roadway. Whereas, in relation to the gradient of the north approach, the crossing is relatively level with the roadway. Due to the crest from the south approach, constructing a road-over-rail grade separation would be challenging as the approach gradient would need to be increased to meet the minimum roadway overhead clearance of 7.01 metres (23 feet) above the railway tracks. Therefore, one solution

would be to consider the existing south gradient as lending itself more practically to a rail-over-road (tunnel) grade separation. For a tunnel, the following primary challenges should be considered, at minimum.

Railway challenges for a rail-over-road grade separation:

- Multiple bridge spans for each track and assessing how the spans may affect the nearby switches for the industrial spur.
- Maintenance of railway operations during construction (i.e. track diversion(s)) and the constrained railway approaches to the crossing.
- Extensive and specialized railway design and staging which would require prior review and acceptance from the railway authority and private industries served by the industrial spur.
- Roadway challenges for a rail-over-road grade separation:
- Extensive cut in the south approach and the need to close or create alternative routes to existing intersections and private driveways upon both approaches.
- Temporary or permanent modification(s) or closure(s) of the existing intersections along both approaches to the crossing (i.e. both traffic-controlled and Stop Sign-controlled).
- Maintenance of roadway traffic during construction and the constrained roadway approaches to the crossing.
- Maintenance of pedestrian / cyclist traffic during construction (i.e. existing sidewalks on both the east and west sides of the crossing).
- Respect of the impacted residential and commercial properties adjacent to the crossing, and upon the crossing's approach.
- Requirement for a pumphouse to address drainage in the tunnel.
- Extensive roadway design and staging plans which would require assessment, public review, allocation of public funds, municipal review and approvals.

Figure 10 Facing north at the traffic-controlled intersection of Waterloo Avenue and Edinburgh Road (South). The upslope gradient towards the tracks is evident. (Google Maps, 2023)

Figure 11 Facing south at the approach to the Edinburgh Road crossing. View of the existing aerial hydro corridor to the east, and aerial powerline to the north of the tracks and which crosses perpendicular to the road. (Google Maps, 2023)

Conversely however, the opposite case could be made for the north approach lending itself more practically to a road-over-rail (bridge) grade separation. With a bridge, coordination with the railway is typically much less than what is required for a tunnel as there are no direct impacts to the existing tracks. During construction, railway horizontal and vertical clearances to existing tracks are to be respected, and operational protection of railway traffic is applied (i.e. railway flagging). Therefore, for a bridge, it is primarily roadway challenges that should be considered. Such minimum challenges can include the following.

- Extensive fill in both approaches and the need to close or create alternative routes to existing intersections and private driveways upon both approaches.
- Temporary or permanent modification(s) or closure(s) of the existing intersections along both approaches to the crossing (i.e. both traffic-controlled and Stop Sign-controlled).
- Maintenance of roadway traffic during construction and the constrained roadway approaches to the crossing.
- Maintenance of pedestrian / cyclist traffic during construction (i.e. existing sidewalks on both the east and west sides of the crossing).
- Respect of the impacted residential and commercial properties adjacent to the crossing, and upon the crossing's approach.
- Extensive roadway design and staging plans which would require assessment, public review, allocation of public funds, municipal review and approvals.

Grade separating the Edinburgh Road crossing would require creation of local roadways to access the businesses and residences which will be located within the elevated roadway approaches to the bridge. A minimum of twelve driveways to the east/north and another four driveways to the west/south all within 500 meters of the crossing, could be affected by the construction of a grade separation. As a result, work and agreements related to realigning the roadway approaches and address the existing driveways should be considered when planning for a grade separation.

In addition to the above-described challenges, existing overhead and underground utilities will require relocation prior to the construction of a grade separation for the Edinburgh Road crossing. As seen in Figure 11, an existing aerial hydro pole line abuts the east side of the road, and an additional aerial line is located north and parallel to the railway. Markers for buried utilities are also observed as along the railway corridor. Work to relocate, protect, or avoid these existing utility corridors should be considered when planning for a grade separation.

2.2.3.2 Silvercreek Parkway

With all the primary challenges described above for the Edinburg Road crossing, another alternative would be to close the Edinburgh Road crossing and create cul-de-sac's at the north and south approaches. Although this would significantly save on design and construction costs, increase railway and roadway safety, and reduce the level of effort for such a project; political and transportation demands may not easily permit this closure alternative. An alternative north-south roadway would need to be established if considering closure of the Edinburgh Road crossing.

Constructing a new grade separation for the Guelph GO Subdivision at Silvercreek Parkway could offer such an alternative. At the time of this report, there was no crossing at Silvercreek Parkway. The potential Silvercreek Parkway crossing is an approximately 1.80 km roadway detour from Edinburgh Road. The portion of Silvercreek Parkway to the north of the tracks is observed to be higher than the portion of roadway to the south of the tracks. However, to optimize the design and reduce costs, a road-over-rail grade separation could be feasible due to the lesser densely developed area. As shown in Figure 12, surrounding the intersection of the railway track and Silvercreek Parkway are not yet densely developed. To the south there are undeveloped lands, and the north is observed to be low-density residential neighbourhoods. A grade separation would likely not be required for the Fergus, but the cost for grade separating both on Silvercreek Parkway is still anticipated to be less than one at Edinburg Road.

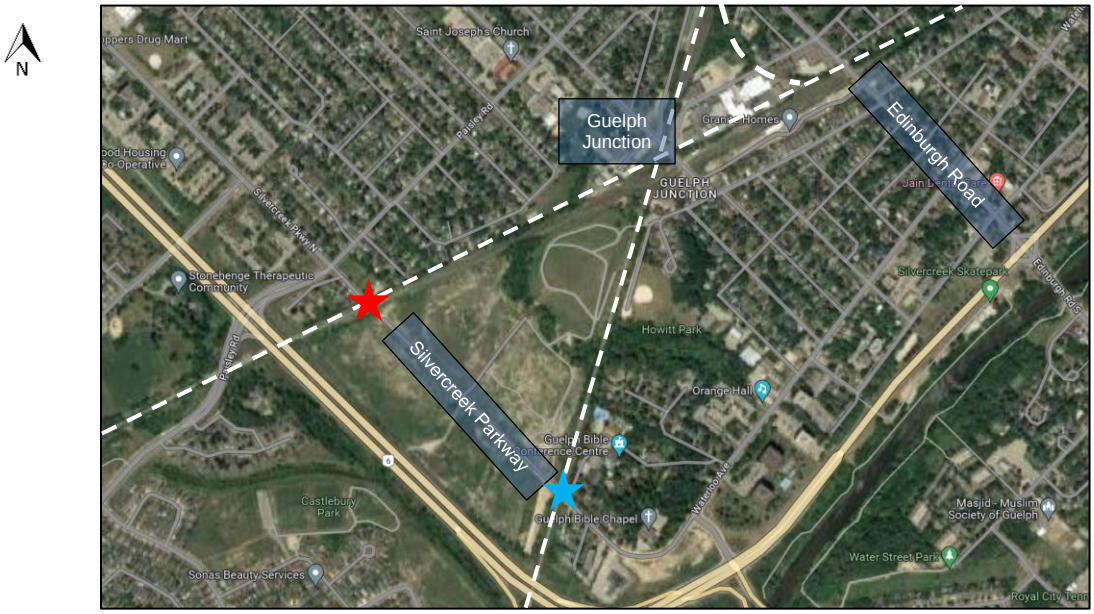

Figure 12. Plan view showing the potential Silvercreek Parkway Guelph GO Subdivsion bridge (red star), Fergus Spur bridge (blue star) and surrounding area. Railway tracks shown in white dashed lines. (Google Maps, 2023)

Some of the primary benefits of road-over-rail grade separations for Silvercreek Parkway, when compared to Edinburgh Road, could be as follows.

- Lesser impacts to the railway as the grade separation location is farther from the Junction and existing industrial spurs.
- Reduced number of impacted properties as the area to the south is not fully developed, and directly north of the crossing is a low-density residential area.
- Reduced number of impacted intersections upon the approach to the crossing. It could be anticipated that only the Paisley Road intersection would be affected.
- Low impacts to existing roadway and pedestrian traffic during construction (i.e. as there is currently no connection between Silvercreek Parkway over the tracks).

- Redirection of traffic outside of the densely residential areas.
- Reduced costs and level of efforts due to the less densely developed areas around the Silvercreek Parkway crossing.
- Increased potential use should the Metrolinx Kitchener corridor expansions require closure of the crossings being studied by the City of Guelph.

For the purpose of this study, the minimum rough order of magnitude estimated cost has not considered the future grade separating of Edinburgh or Silvercreek Parkway found in Table 1. Due to the complexity of an Edinburgh Road grade separation and uncertainties around alternatives, without knowledge of the railway and roadway design requirements, it is not possible to adequately consider the costs associated with the anticipated final configuration.

Appendix C
Capital and Operations Expenditure Summary

Capital Cost Summary Table

Item	Option 1A		Option 1B		Option 2A		Option 2B	
	Count	Estimate ($M, $2023)	Count	Estimate ($M, $2023)	Count	Estimate ($M, $2023)	Count	Estimate ($M, $2023)
Class 3 Track Upgrades	19.3 km	$12.5	9.8 km	$12.5	19.3 km	$12.5	9.8 km	$12.5
Class 3 Track Siding	-	$0.0	-	$0.0	0.5 km	$0.3	0.5 km	$0.3
Class 4 Track Upgrades	-	$0.0	9.5 km	$7.6	-	$0.0	9.5 km	$7.6
Signalization	1	$3.8	1	$3.8	2	$6.2	2	$6.2
EBMU Rolling Stock (4-car trainsets)	2	$44.1	2	$44.1	3	$66.2	3	$66.2
EBMU Spare Parts	1	$4.4	1	$4.4	1	$6.6	1	$6.6
EBMU Charging Stations	2	$8.2	2	$8.2	2	$8.2	2	$8.2
Power Block (required for EBMU Charging Stations)	2	$0.7	2	$0.7	2	$0.7	2	$0.7
Pinebush GO Station Infrastructure & Rail Access Improvements	-	$17.8	-	$17.8	-	$17.8	-	$17.8
Guelph Central GO Station Infrastructure	-	$17.3	-	$17.3	-	$17.3	-	$17.3
Storage and Light Maintenance Facility	1	$11.5	1	$11.5	1	$11.5	1	$11.5
Grade Crossing Improvements/Upgrades	10	$6.2	10	$6.2	10	$6.2	10	$6.2
Guelph Junction Infrastructure Improvements	-	$5.8	-	$5.8	-	$5.8	-	$5.8
Wellington Road 124 Grade Separation	-	$30.0	-	$30.0	-	$30.0	-	$30.0
Property Acquisition Allowance*	-	$8.5	-	$8.5	-	$8.5	-	$8.5
Hespeler-Speed River Bridge Repair & Mill Pond Bridge Repair	-	$5.0	-	$5.0	-	$5.0	-	$5.0
Soft Costs	15% of capital costs, excluding rolling stock and property costs							
Contingency	30% of capital costs, excluding rolling stock and property costs							

** Assumes lands proposed for light maintenance and storage facility, as well as lands required to build Pinebush GO Station and PUDO*
** Property allowance only for purposes of Financial Case, excluded from Economic Case*

Annual Operations and Maintenance Cost Summary Table

Item	Option 1A		Option 1B		Option 2A		Option 2B	
	Count	Estimate ($M, $2023)	Count	Estimate ($M, $2023)	Count	Estimate ($M, $2023)	Count	Estimate ($M, $2023)
Staff *	5	$0.6	5	$0.6	5	$0.6	5	$0.6
Electricity for Charging **	-	$0.3	-	$0.3	-	$0.3	-	$0.3
Station Maintenance ***	-	$0.2	-	$0.2	-	$0.2	-	$0.2
Track and Rail Infrastructure Maintenance	-	$0.3	-	$0.3		$0.4	--	$0.4
Rolling Stock Maintenance		$0.4		$0.6		$1.5		
Rolling Stock Mid-Design Life Overhaul	Two events (2041 and 2071) during 60-year lifecycle analysis occurring at mid-life of rolling stock. Assumed at 50% of initial rolling stock purchase price							
Contingency	30% of operating and maintenance costs, excluding rolling stock mid-design life overhaul							

** Includes Metrolinx's 25% labour benefits assumption*
*** Considered conservative consumer rates*
**** Assumed majority associated with new Pinebush GO Station. Maintenance budget exists for current Guelph Central Station*

Appendix D
Conceptual Design Drawing Package

PROPOSED FOR

METROLINX

CAMBRIDGE TO UNION
PROPOSED GO RAIL, STATION AND TRACK

CONTRACT NO. RFP #C2023-22

ISSUED FOR CONCEPT DESIGN

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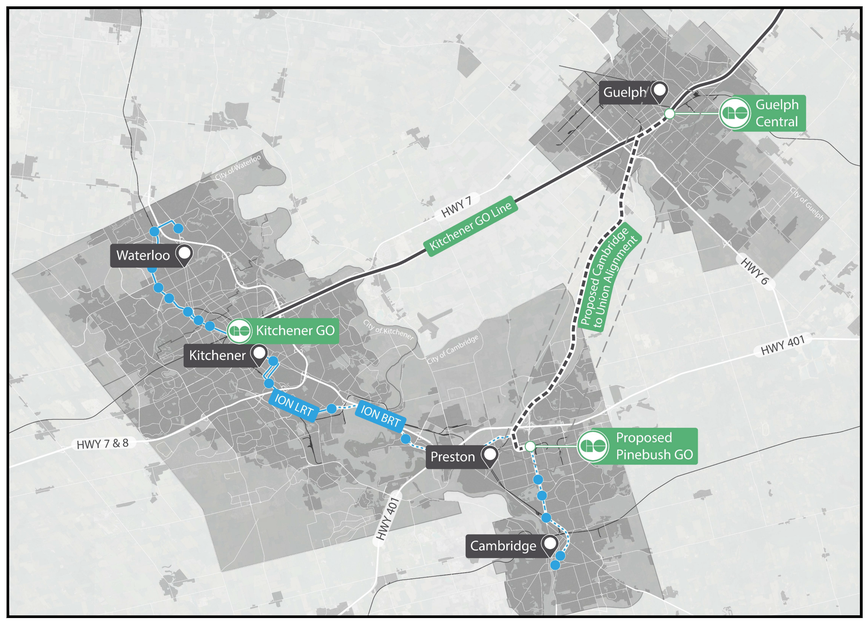

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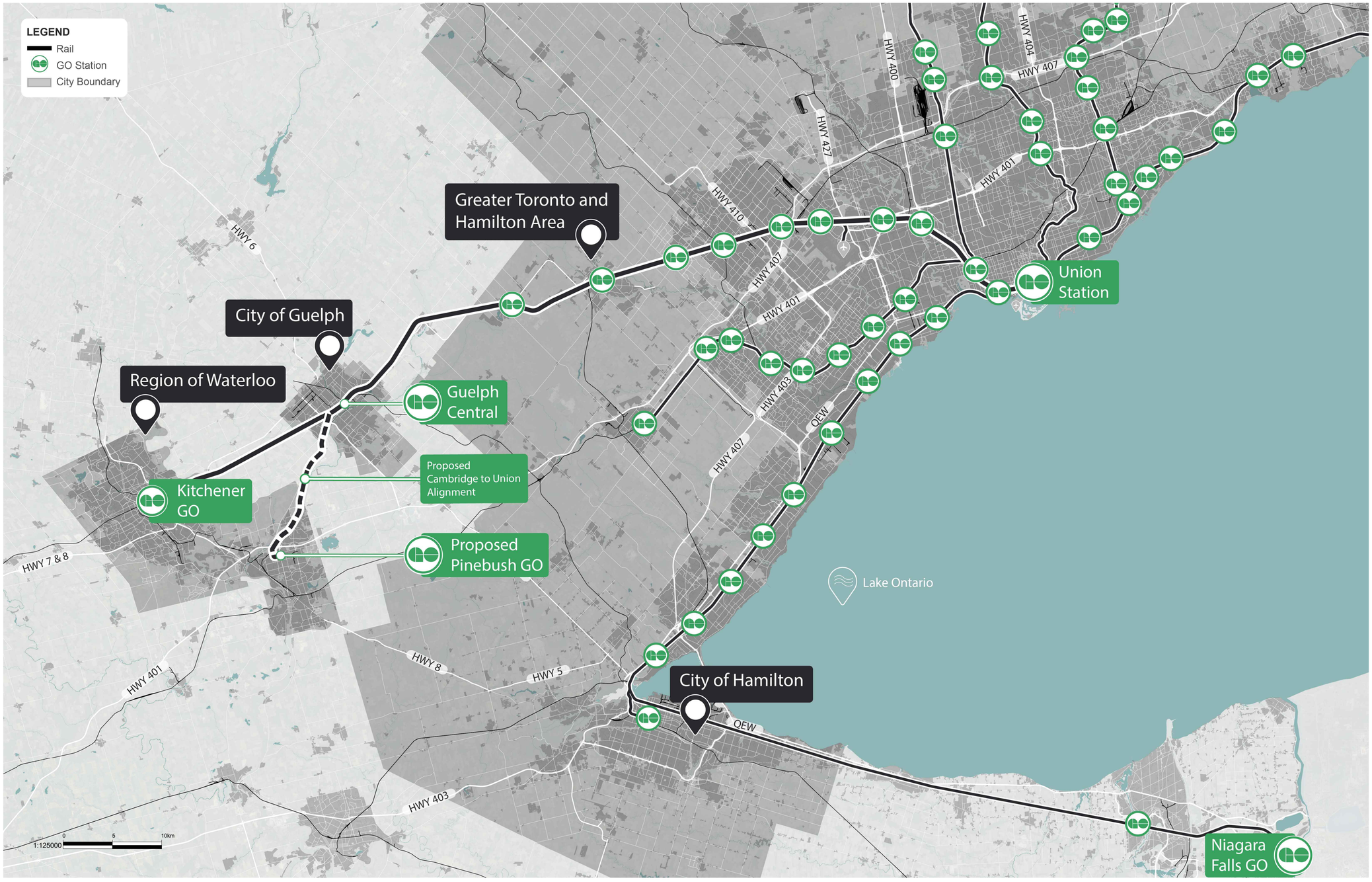
TYPE OF WORK PLATFORM, STATION AND TRACK CONCEPT DESIGN

MUNICIPALITY REGION OF WATERLOO, CITY OF GUELPH



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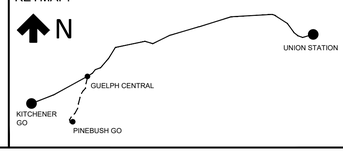

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CAMBRIDGE TO UNION - GO RAIL REGIONAL TRANSIT CONTEXT PLAN

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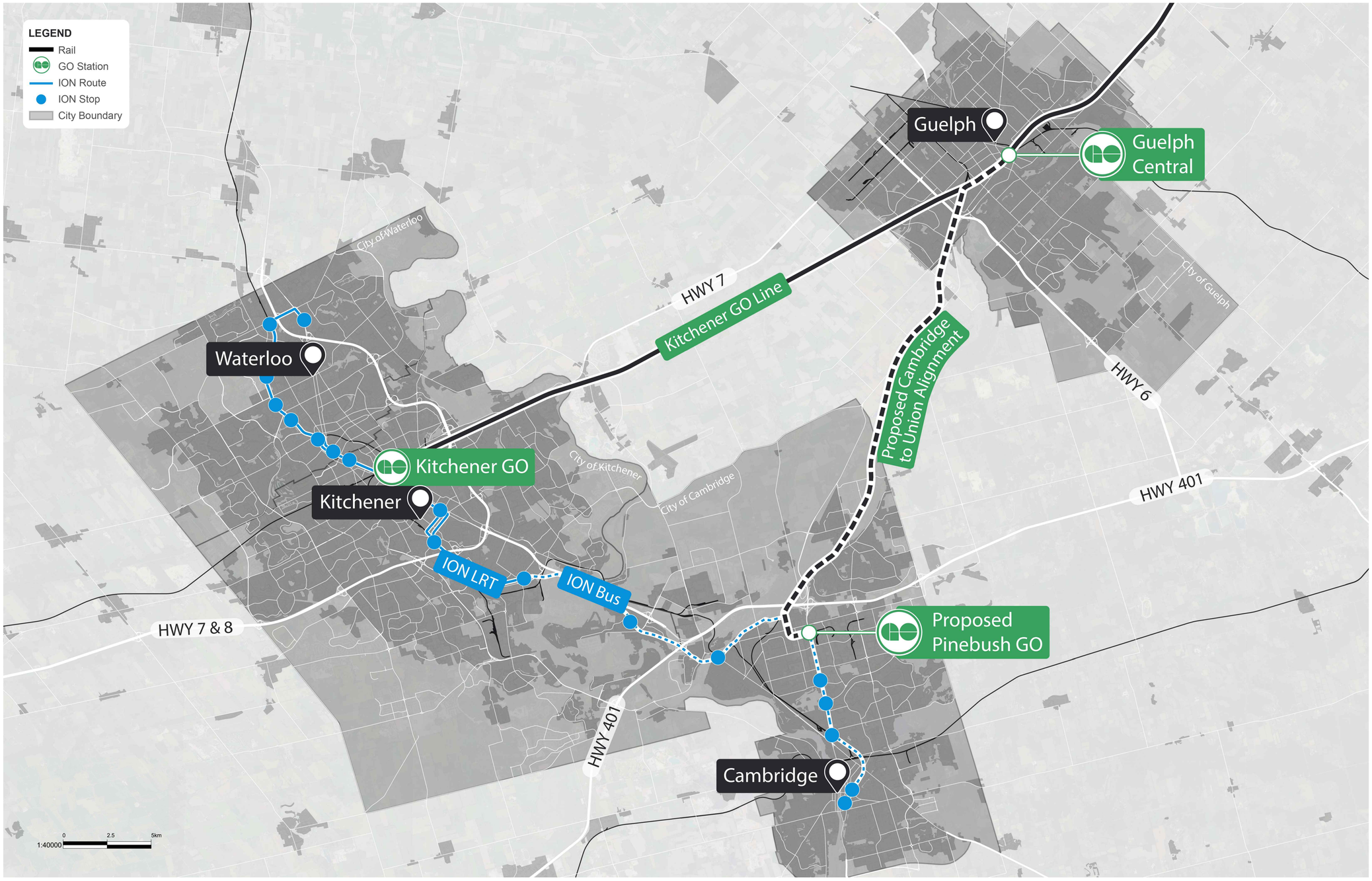

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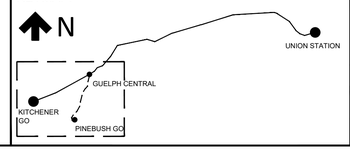

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CAMBRIDGE TO UNION - GO RAIL LOCAL TRANSIT CONTEXT PLAN
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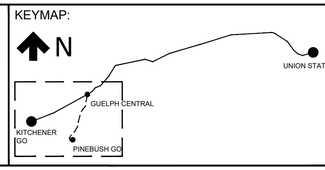

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CAMBRIDGE TO UNION - GO RAIL
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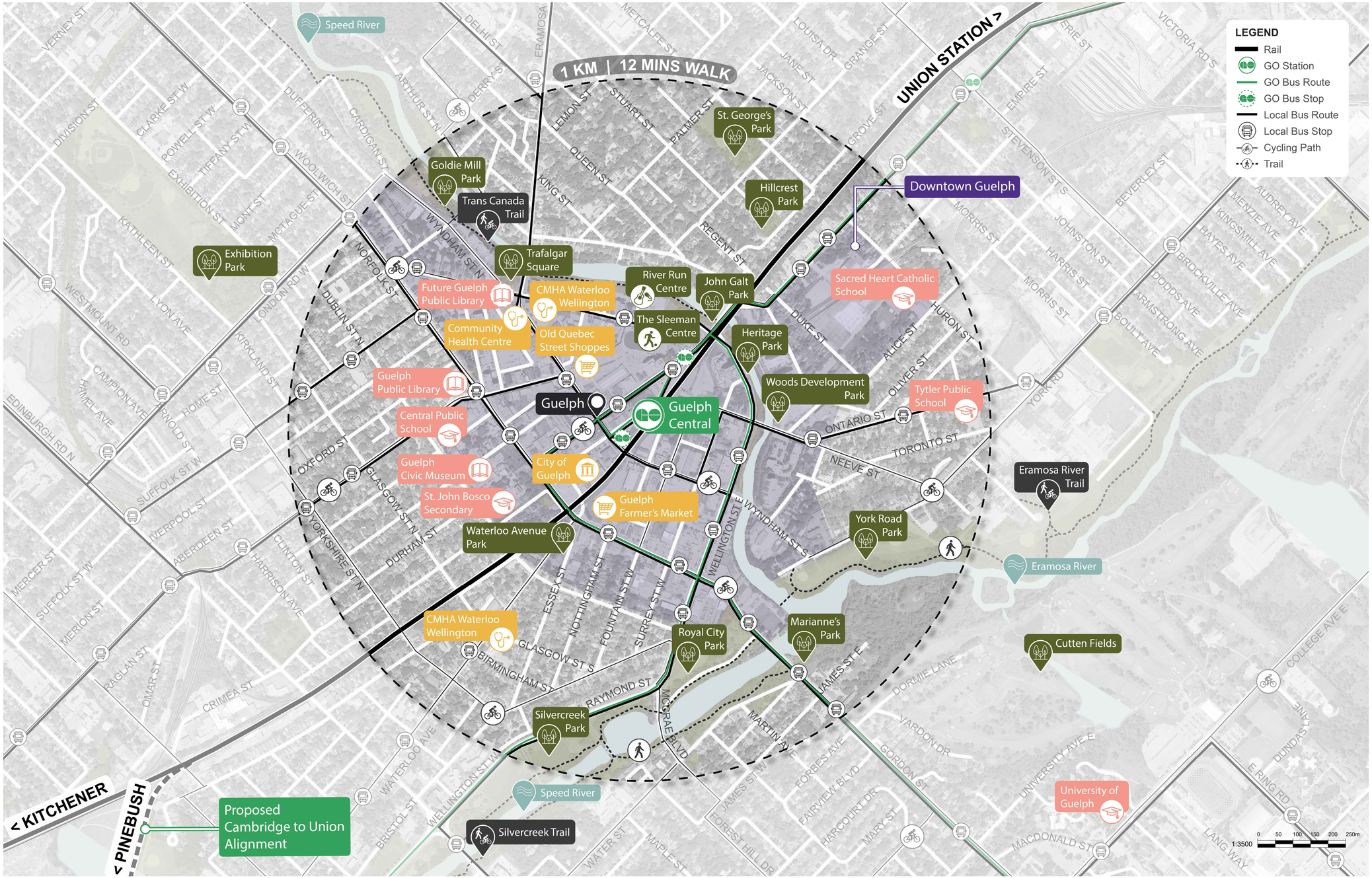

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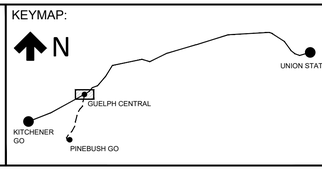

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CAMBRIDGE TO UNION - GO RAIL
GUELPH STATION CONTEXT PLAN
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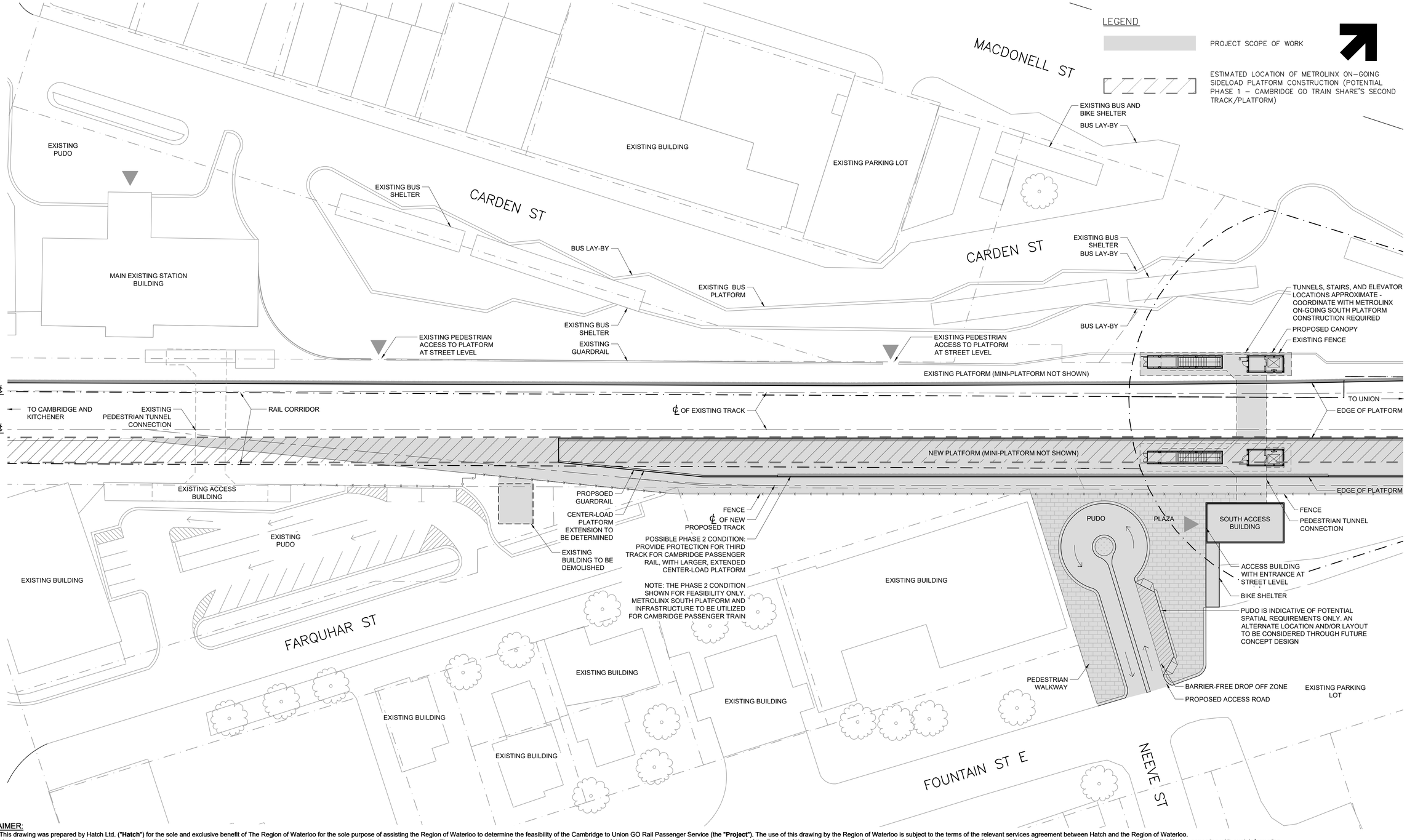

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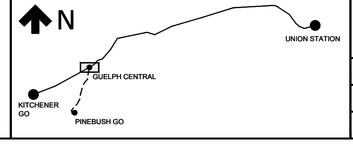

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CAMBRIDGE TO UNION - GO RAIL
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PRELIMINARY PLATFORM CONCEPT PLAN
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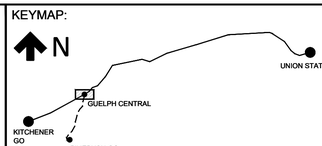

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CAMBRIDGE TO UNION - GO RAIL
GUELPH STATION
PHASE 1 - 2-TRACKS
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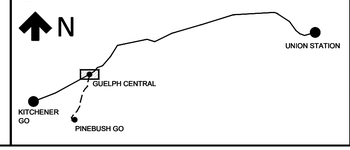

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CAMBRIDGE TO UNION - GO RAIL
GUELPH STATION
PHASE 2
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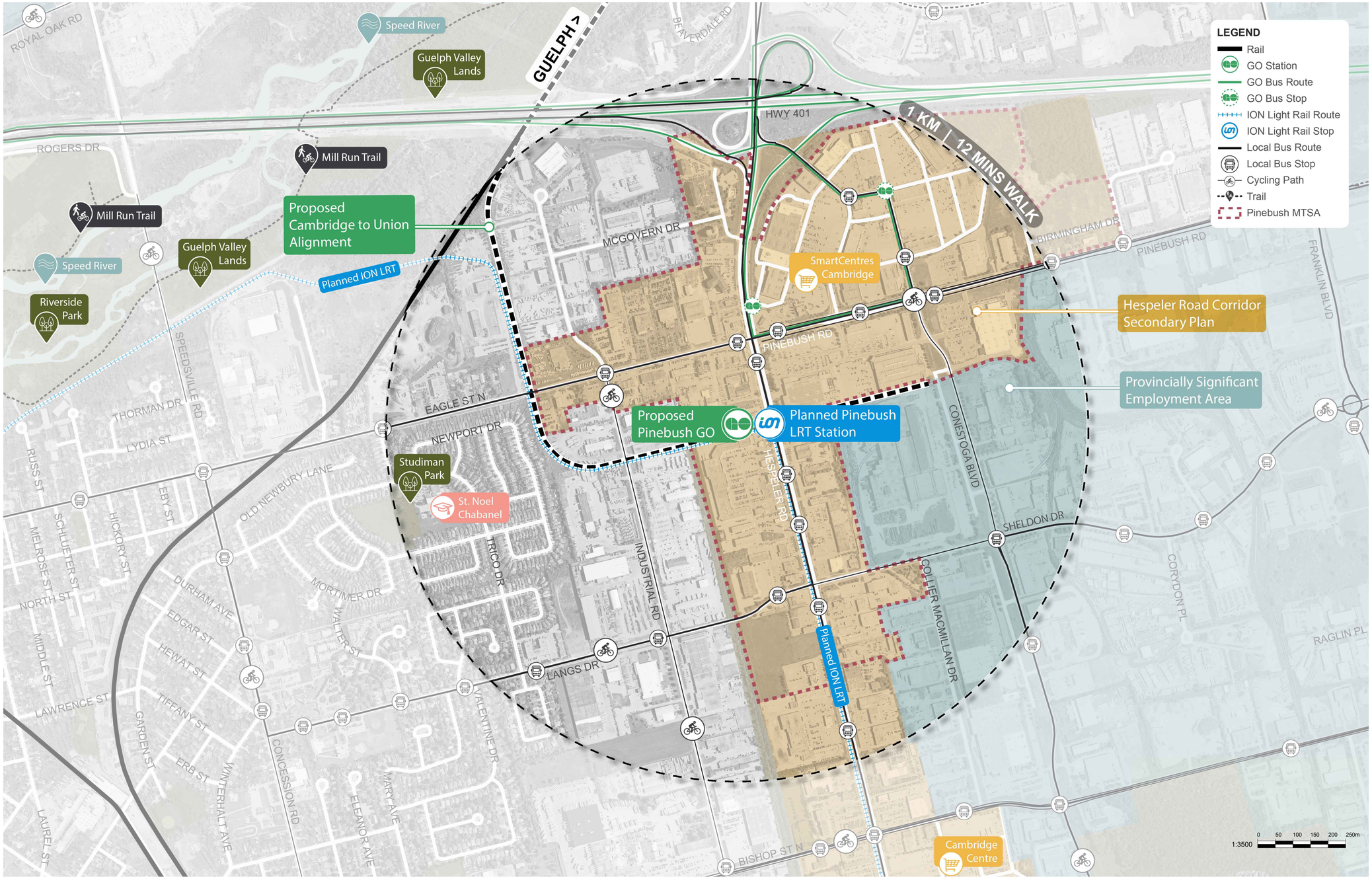

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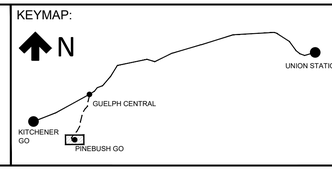

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CAMBRIDGE TO UNION - GO RAIL
PINEBUSH STATION CONTEXT PLAN
CONCEPT DRAWING

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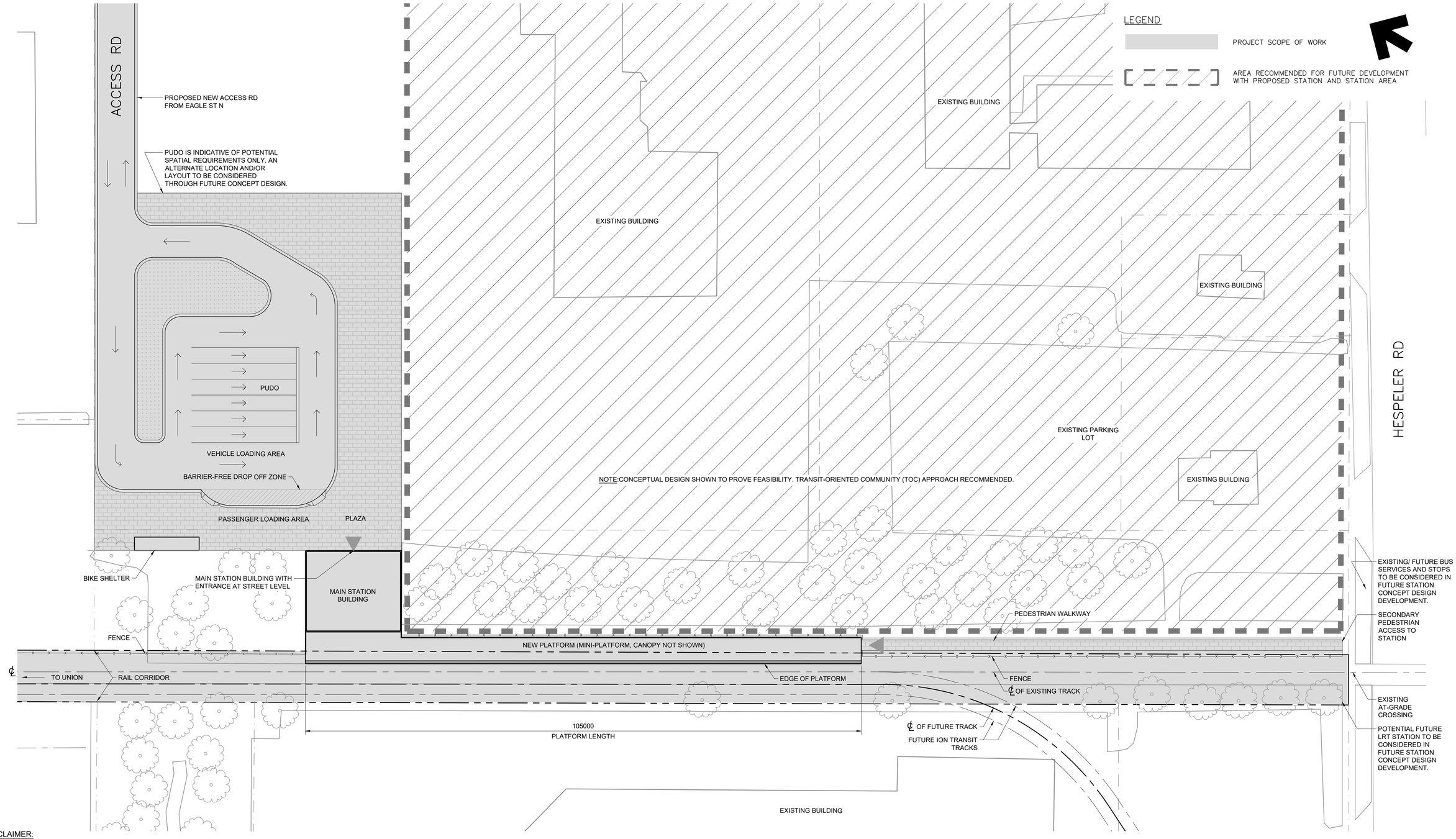

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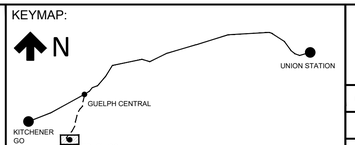

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CAMBRIDGE TO UNION - GO RAIL
PINEBUSH STATION
PRELIMINARY PLATFORM CONCEPT PLAN
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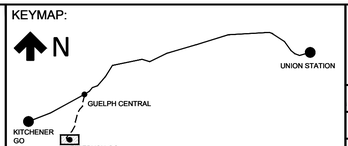

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CONTRACT NO: RFP#2023-22

HATCH

Region of Waterloo

CAMBRIDGE TO UNION - GO RAIL
PRELIMINARY PINEBUSH STATION
CONCEPT RENDER

DWG. NO.	REV.	SHEET
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Date: December 12, 2023, 9:17 AM Login name: prod14046
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Appendix E
Conceptual Design Brief

Appendix F
Additional Research Material

England Case Study

There is ample precedent for maximizing user benefits through inter-city transit connections. Many countries and city-regions are heavily reliant on the use of transit systems to connect their municipalities. To Canadian eyes, it may seem that “Europe is different”, and the centres of their cities do look different from Canadian cities, but these looks can deceive… Canadian cities, at their very centres, are denser and have worse road access!

This outcome defies the stereotype that European cities outperform Canadian ones on every urbanist metric. Greater London compares unfavourably to Toronto in some regards: London, and its peer European cities, are wealthy places and car ownership and use is quite high, while highway provision is higher than many places in Canada. Against this, these cities better manage road congestion, because of slower population growth, congestion charging, and parallel conventional rail services. Consequently, for many trips, driving is a reasonable and attractive choice. So, it is not unreasonable to compare these cities to Canada that feature good planning regulations, i.e., ones that favour the protection of urban centres and neighbourhoods.

England recently constructed the Elizabeth Line, with service opening in 2022 (Figure F1). The Line runs from Reading and Heathrow in the west to Shenfield and Abbey Wood in the east, stopping at 41 stations.

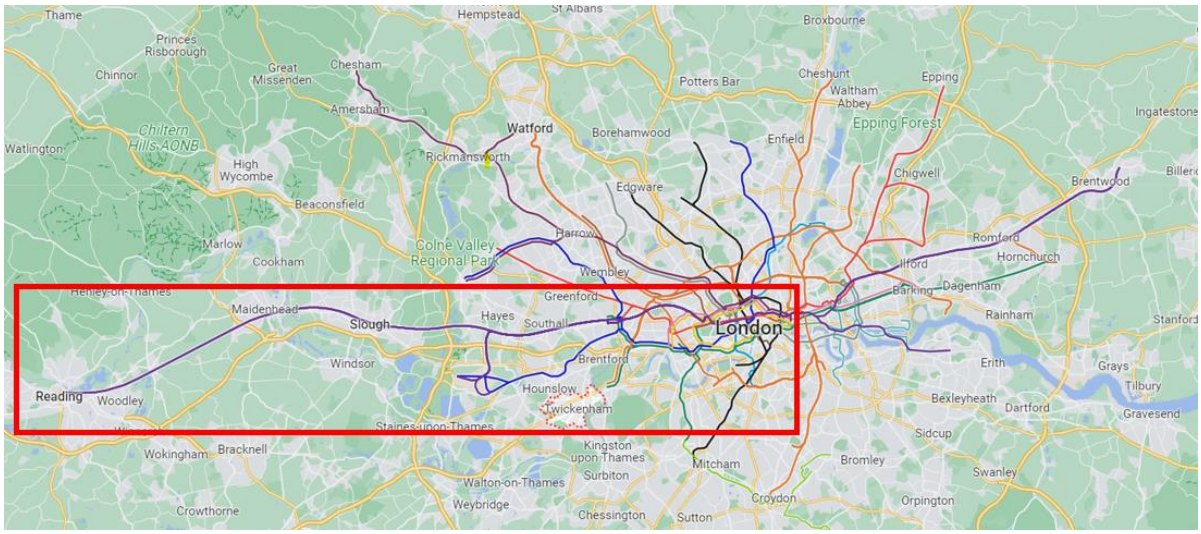

Figure F1: Elizabeth Line between Reading and London

Comparing Reading-London to Kitchener-Toronto demonstrates interesting contrasts:

- While Kitchener to Toronto covers an approximate distance of 120 kilometres and Reading to London covers approximately 60 kilometres, there are stations along both lines that have similar minimum distances between stations, with the shortest distance being 1 kilometre and shortest journey time being 3 minutes;

- Conversely, the longest distance between stations on the Kitchener GO Line is 22 kilometres whereas it is only 11 kilometres on the Elizabeth Line; and
- The longest time between stations on the Kitchener GO Line is about 22 minutes, contrasted with only 10 minutes on the Elizabeth Line (Elizabeth line trains run faster on average than Kitchener GO Line trains).

The most significant similarity to consider is the populations that the lines serve. In both Kitchener and Reading, the lines serve communities with population densities of 3,500-16,000 residents per square kilometre. In each community, as well as the communities along the line, residents can access jobs in a wide array of employment sectors including but not limited to agriculture, industry, retail, and finance.

Similarly, the line also provides an indirect connection to Heathrow Airport, which is similar in geographical relationship to Pearson Airport (west side of the metro area, with congested access roads). The main road east-west, the M4, is notorious for its round-the-clock congestion. However, Hwy 401 fares noticeably worse than the M4, with greater variability of travel times during daytime hours and greater relative difference between congested and uncongested travel times.

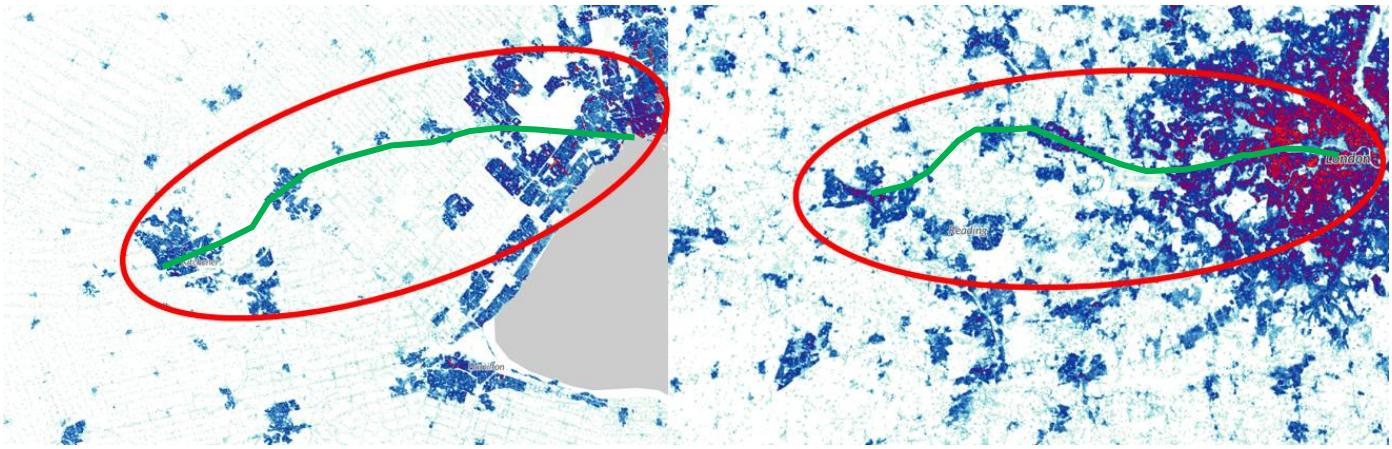

Figure F2: Population density along the Kitchener GO Line (left) and Elizabeth Line (right)
Kitchener and Elizabeth Lines represented in green (not to scale)
(Modified World Population Density Interactive Map)

Given that European transit is often regarded as an international best-practice for connecting small to large cities over short and long distances, the similarity of the Kitchener GO and Elizabeth lines reinforces the idea that enhancing transit connectivity across municipalities, including Cambridge to Guelph, can provide user benefits. In both examples, the transit service connects regions, connects users to employment opportunities, minimizes the use of personal vehicles, minimizes sprawl by directing growth around transit, as well as creates opportunities for future transit projects.