The Corporation of the Town of Milton

Report To:	Council
From:	Tony D'Alessandro, Director, Transit Services
Date:	June 24, 2024
Report No:	CORS-021-24
Subject:	Milton Transit Five-Year Service Plan and Master Plan Update
Recommendation:	**THAT the Milton Transit Five-Year Service Plan and Master Plan Update (referred to herein as "Five-Year Service Plan") be received;** **AND THAT Appendix 1 Milton Transit Five-Year Service Plan and Master Plan Update be endorsed to help guide the improvement and expansion of the Milton Transit network and services through the next five years (2025-2029);** **AND THAT Council approve the Transit Investment Strategy target of one (1) service hour per capita as the goal to be achieved by 2041 as outlined in the Five-Year Service Plan;** **AND THAT Council endorse the Zero-Emission Bus (ZEB) Feasibility Strategy and Fleet Transition Plan (referred to herein as "ZEB Feasibility Strategy") noting that the proposed transition timeline is subject to approval through the annual Budget process.**

EXECUTIVE SUMMARY

- The Five-Year Service Plan provides a road map for the development of Milton Transit services to accommodate forecasted growth and to maintain service efficiency, effectiveness and resiliency.

- Service improvements highlighted in the Five-Year Service Plan are subject to adjustment through implementation phases and require subsequent approval through the annual Budget process.

- Public and stakeholder engagement throughout the planning and development stages helped shape final recommendations.

- The Five-Year Service Plan establishes an Investment Strategy that targets **one (1) service hour per capita**[1] as the goal to be achieved by 2041. This approach prioritizes a number of program improvements over the short, medium and long-term to facilitate forecasted growth through the delivery of:

    - More direct transit routes
    - More frequent service
    - Extended evening and late-night services
    - Introduction of service on Sundays
    - Longer routes with new transfer points
    - Improved service coverage
    - Redistribution of OnDemand services
    - State-of-readiness for fleet electrification
    - Adoption of PRESTO fare system
    - Supportive marketing and communications

- High-level capital and operating costs have been estimated for the phased transit programs that have been recommended in the Five-Year Service Plan (excluding costs associated with a new transit facility). The annual net operating cost for transit is expected to increase by $4.3 million (57%) during the 5-year period, and the required capital investment is projected to increase by $41.7 million (96%) over a 9-year period.

- As a prerequisite to support future grant opportunities, this report is also seeking endorsement for the ZEB Feasibility Strategy (Appendix 2) as presented to Council at the April 15, 2024 meeting (COMS-003-24).

REPORT

Background

The Milton 2051 Vision includes the delivery of a safe, reliable and integrated transit system, providing a viable option for residents and visitors, as they navigate the community defined by smart density, placemaking, mobility and economic development. Service reviews and Master Plan updates provide guidance toward program improvements and service growth in alignment with the corporate vision.

[1] "Service Hour per Capita" is a performance indicator that measures the amount of transit service available to the serviceable population. The Five-Year Service Plan targets an investment strategy of one (1) service hour per capita as the goal to be achieved by 2041.

Background

The Town retained Arcadis IBI Group to undertake the Milton Transit Five-Year Service Plan and Master Plan Update (CORS-024-23). The Five-Year Service Plan provides a roadmap for the Milton Transit system to define service requirements and a framework for service planning and prioritization. The overarching objective is to achieve a balanced and sustainable transit network that manages Milton's current and forecasted growth in the 2025-2029 planning horizon, and beyond, while effectively contributing to the Town's Vision and strategic direction. The study builds on previous service plans to further develop short, medium and long term transit requirements. Council approved the scope of work via COMS-002-23.

Discussion

The Five-Year Service Plan provides a road map for the development of Milton Transit services that are effective, efficient and resilient. The plan is comprised of several components including:

- Vision for transit in Milton
- Investment strategy
- Transit network redesign and phasing plan
- Conceptual service plan in growth areas
- Supporting initiatives including: fleet electrification, fare policy and structure, marketing and communications
- Financial plan including asset requirements; capital and operating impacts

Essential to the success of the Five-Year Service Plan, public and stakeholder engagement throughout the planning and development stages helped shape final recommendations. The approached incorporated a number of consultation techniques to solicit feedback from residents and stakeholders, including:

- Project information page on Let's Talk Milton (throughout the project)
- Initial in-person engagement (June 22, 2023)
- Council workshop (June 26, 2023)
- Online surveys (June/July 2023; May 2024)
- Phase 1 and Phase 2 key stakeholder meetings including: business community and associates, educational and post-secondary institutions, Milton Accessibility Advisory Committee, government agencies, neighbouring transit service providers (August 2023; April/May 2024)

Discussion

The Project Steering committee, comprised of Town staff, met throughout the process, providing guidance, input and recommendations on key study deliverables.

Outcomes and Supporting Recommendations Summary

The Five-Year Service Plan provides a prioritized program of improvements to Milton Transit service and operations over the short, medium and long-term. The plan also establishes an Investment Strategy that targets **one (1) service hour per capita** as the goal to be achieved by 2041; the amount of transit service available to the serviceable population. This approach prioritizes a number of program improvements over the short, medium and long-term to facilitate forecasted growth through the delivery of:

- More direct transit routes
- More frequent service
- Extended evening and late-night services
- Introduction of service on Sundays
- Longer routes with new transfer points
- Improved service coverage
- Redistribution of OnDemand services
- State-of-readiness for fleet electrification
- Adoption of PRESTO fare system
- Supportive marketing and communications

The Five-Year Service Plan also includes recommendations that support the commitment towards Zero-Emissions Bus (ZEB) technology as outlined in COMS-003-24 (Appendix 2), maintaining a pragmatic, measured and adaptable approach that balances the transition with service reliability and sustainable funding programs. Future grant opportunities are likely subject to the completion of a ZEB Feasibility Strategy and subsequent endorsement from Council.

A key enabler for recommendations outlined in the Five-Year Service Plan is the development of the Transit Operations Facility, currently in progress. The plan highlights program requirements for consideration during facility planning, design and construction phasing. Furthermore, additional staffing for corporate support have been identified in the Five-Year Service Plan. Additional dedicated Transit Division staff will also be required and phased accordingly to support service implementations, contract and change management functions.

Discussion

Summary

Endorsement of the Five-Year Service Plan will help guide the improvement and expansion of the Milton Transit network and associated services through 2029. Phasing of the Plan will be updated annually based on performance monitoring and the annual budget approval process.

Financial Impact

The financial impacts are outlined in Appendix 1 and summarized in the tables below. It should be noted that the study excludes costs associated with the Transit facility, which will be further refined through the design stage of the facility.

Over the next nine years (2025-2033) the study suggests that an incremental capital investment of $41.7 million will be required above and beyond the funding that had previously been included in the 2024 budget and forecast. This is largely the result of a shift in future bus purchases to a combination of diesel and battery electric, as outlined in the Zero-Emission Bus Feasibility Strategy and Fleet Transition Plan (COMS-003-24), along with adjustments made for route optimization and growth.

	Capital Plan Impact - 2025-2033		
	Per 2024 Budget & Forecast	Transit Master Plan	Variance
Replacement Buses	$ 15,853,665	$ 25,953,000	**$ 10,099,335**
Growth Buses	24,129,487	46,146,000	**22,016,513**
Infrastructure & Other	3,288,883	12,837,000	**9,548,117**
Total	**$ 43,272,035**	**$ 84,936,000**	**$ 41,663,965**

Capital funding requirements will be further assessed through the development of the annual budget but can be expected to include a combination of development charges, Town source and grant funding. An initial review of the current available funding within applicable reserve and reserve funds suggests that a substantial portion of this investment may require debenture financing. However, staff will continue to actively seek grant funding opportunities, as they arise, to offset the increased capital costs of electric buses.

The study identifies an incremental expected net increase in operating costs of $4.3 million over the next five (5) years. For 2025 specifically, the expected new incremental costs of $310,000 will result in additional pressure on the property tax rate of approximately 0.31%.

The forecasted total pressure for 2025, as presented through the 2024 budget process, currently equals 12.36%.

	Operating Plan Impact					
	2024 Budget Adjusted*	2025	2026	2027	2028	2029
Ridership Forecast	1,095,000	1,295,000	1,787,000	1,880,000	2,090,000	2,271,000
Total Expenditure	$ 12,044,000	$ 13,980,000	$ 15,890,000	$ 17,903,000	$ 20,183,000	$ 21,679,000
Total Revenue	$ (4,529,000)	$ (6,155,000)	$ (7,399,000)	$ (7,963,000)	$ (8,484,000)	$ (9,870,000)
Net Impact	**$ 7,515,000**	**$ 7,825,000**	**$ 8,491,000**	**$ 9,940,000**	**$ 11,699,000**	**$ 11,809,000**
YOY Change		**$ 310,000**	**$ 666,000**	**$ 1,449,000**	**$ 1,759,000**	**$ 110,000**

*Note: 2024 Budget has been adjusted to reflect the $333.9K transfer to reserve for new buses that was deferred to 2025 through the 2024 budget as well as increased revenues due to higher than projected ridership. As the $333.9K transfer to reserve was not included in the 2024 operating budget it represents an additional budget pressure in 2025 beyond the $310,000 identified in the study.

Respectfully submitted,

Kristene Scott
Commissioner, Corporate Services

For questions, please contact: Tony D'Alessandro, MCIP, RPP Phone: Ext. 2548
Director, Transit Services

Attachments

Appendix 1. Milton Transit Five-Year Service Plan and Master Plan Update
Appendix 2. Zero-Emission Bus (ZEB) Feasibility Strategy and Fleet Transition Plan

Approved by CAO
Andrew M. Siltala
Chief Administrative Officer

Recognition of Traditional Lands

The Town of Milton resides on the Treaty Lands and Territory of the Mississaugas of the Credit First Nation. We also recognize the traditional territory of the Huron-Wendat and Haudenosaunee people. The Town of Milton shares this land and the responsibility for the water, food and resources. We stand as allies with the First Nations as stewards of these lands.

MILTON TRANSIT

Five-Year Service Plan and Transit Master Plan Update

Final Report

June 10th, 2024

Milton Transit Five-Year Service Plan and Master Plan Update

Final Report

June 10, 2024

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Appendix A – Zero Emission Bus Energy Modelling Methodology

Executive Summary

The Town of Milton is **one of Canada's fastest growing municipalities**, with a projected population increase of over 20% in the next five years. As a result, there will be more people and more travel to, from, and within Milton. Change is apparent in the Town, with more housing and jobs planned in many existing residential and rural areas. Post-secondary institutions, like Wilfrid Laurier University and Conestoga College, are expanding in Milton and attracting a significant number of students. A responsive transit service is critical for meeting the needs of an increasing population in a manner that facilitates connections to critical services and fosters a strong quality of life for residents, visitors and people of all abilities.

This Milton Transit Five-Year Service Plan and Master Plan Update ("the Plan") sets out a **strategic vision** and **re-designed transit network** to guide transit planning and operations from now to 2029 and beyond. It demonstrates how **increased transit investment is critical** to support the future needs of the community, and how this investment will enable Miltonians to use transit to get to where they need to go, when they need to go. The Plan serves as a roadmap to identify key requirements and enablers to help the Town realize its desired transit future over the next five years, while establishing a foundation to support the strategic vision for Milton 2051.

Milton Transit Today

Milton Transit currently operates a hub-and-spoke designed transit service, centered around the Milton GO Station (780 Main Street East) as the primary transfer location. Service is comprised of local routes, one inter-municipal route, school-oriented routes, flexible OnDemand transit service and a specialized accessible transit service (known as "Milton access+").

There are numerous factors that drive the need to re-think how transit is planned and delivered in Milton:

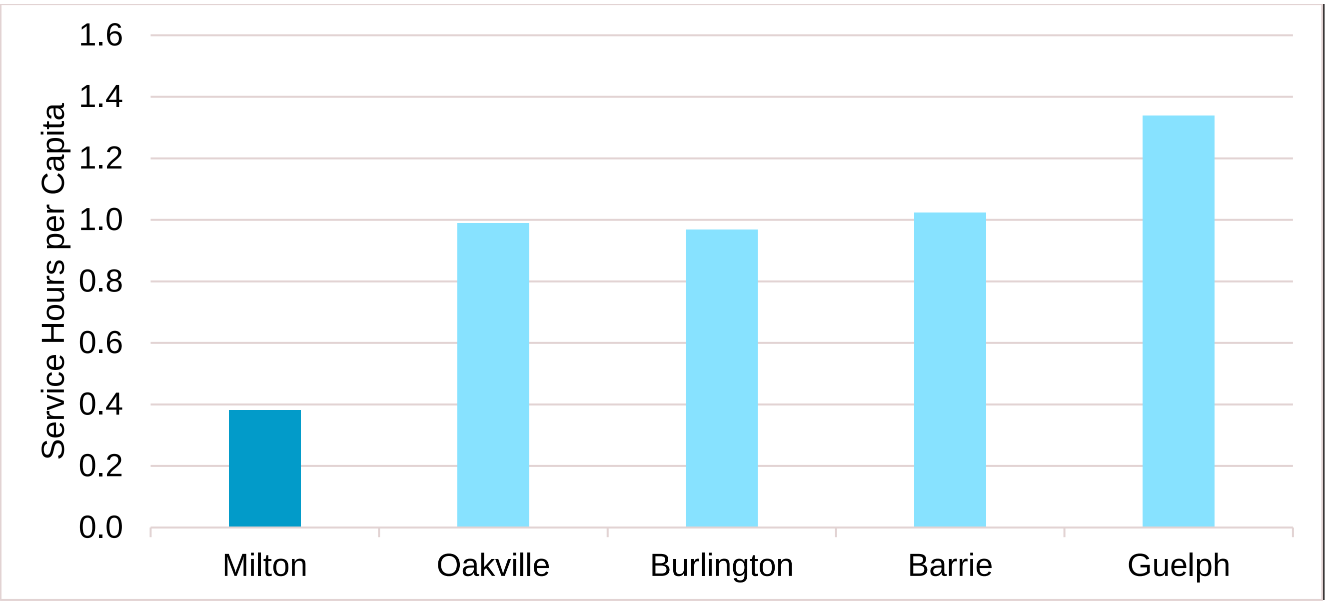
- **Ridership is growing at a record rate:** Pre-pandemic data shows that Milton Transit ridership growth outpaced population growth in the service area from 2014-2019. This demonstrates that ridership growth was primarily driven by additional investment in transit service as opposed to strictly population growth. Further, ridership levels have fully recovered from the COVID-19 pandemic and have set all-time records in recent months. Ridership in the first quarter of 2024 is more than double the ridership in the first quarter of 2023, and 2024 annual ridership is forecasted to be almost 70% higher than 2023 annual ridership. New post-secondary satellite campuses like Wilfrid Laurier University and

Conestoga College will attract more students to Milton in the near-term, who are a key driver of ridership growth.

- **Transit investment lags far behind ridership growth:** Investment in transit service growth was largely paused during the COVID-19 pandemic, while population continued to grow. As ridership has boomed in the last year and especially recent months, transit service investment remains far below the levels needed to effectively serve transit riders.
- **Milton Transit's coverage and travel times do not effectively meet customer needs:** While many Miltonians use transit to connect to regional GO services, the existing network is not convenient for many customers using transit for trips within Milton. Many Miltonians reported that transit does not serve their desired destinations in a timely manner, or that the buses do not come frequently enough to provide freedom of mobility. There is a need to address coverage, frequency, and travel times to increase the attractiveness of transit.
- **Development patterns are changing:** Milton Transit's current route network focuses on serving established, lower-density communities. Socioeconomic changes have led to higher-density communities being built on Milton's urban periphery, along with significant condominium developments along major corridors, which can contain the population of an entire neighbourhood within several towers. This demonstrates a disconnect between where Miltonians increasingly live and where transit service has historically been provided.
- **Transit service is not as reliable as it once was:** Limited investment in transit today means that there are not enough buses to effectively serve all the routes. Given the impacts of growth with increased traffic congestion, buses do not have adequate time to travel the length of their routes and frequently arrive late at stops. There is a need to increase investment and transit fleet capacities to provide a reliable and timely transit service.
- **Service availability on Sunday is increasingly critical:** Milton is the largest municipality in Canada, and the only municipality over 50,000 people, that operates fixed-route transit service that does not run on Sundays. Many residents have expressed a strong desire for transit service on Sundays (conventional and specialized) to access social services, places of work, places of worship, and recreational opportunities.
- **Milton Transit needs to catch up with evolving industry trends:** Current and emerging trends include co-mingled "Family of Services" operational models, fleet electrification, regional PRESTO fare integration, municipally owned transit assets and more. Innovation is apparent in the industry, and Milton Transit needs to capitalize on these opportunities to provide a resilient, reliable, seamless and modern transit service.
- **Milton Transit's per capita investment is the lowest among peer municipalities:** Milton Transit provides less than half the number of service hours per capita compared to municipalities of similar population size, geography, and travel patterns (Exhibit E.1 below).

There is a need to increase service levels to attract and retain residents as part of Milton's vision to offer outstanding opportunities to live, learn, work and play.

Exhibit E.1.1: 2019 Service Hours Per Capita for Milton and Similar Regions



Milton's Vision for Transit

Transit has an integral role to play in meeting the needs of the evolving community, as defined in existing plans, master plans and strategic documents. Transit will help to manage sustainable growth and enable higher densities along corridors, nodes, and in key growth areas. It will provide reliable connections that can serve the needs of residents and visitors, regardless of age, ability or circumstance. Milton Transit will be forward-looking and reflect emerging trends like alternative service delivery strategies and battery electric technologies. Transit is part of a sustainable transportation network that can help to mitigate the need for capital-intensive investments in road projects.

Milton clearly outlines the importance of transit in the *2023-2027 Strategic Plan* – **connected transit and mobility is one of the key strategic themes**. This means that transit is aligned with population growth and supported by a "family of services" operational model that increases ridership and supports the post-secondary student population. This strategic theme also calls for accelerated investments in Milton-owned transit assets to drive ridership growth.

> *"By 2027, Milton will have laid the foundation for its future as a diverse and welcoming community defined by **higher densities enabled by transit**. This foundation will include **transit system advancements**, prioritized infrastructure…"*
>
> \- Milton's Practical Vision for 2023-2027

The Town is already acting on plans to **develop a community that is supported by high-quality transit**. Milton's urban design guidelines for key growth areas like Boyne, Derry Green and Sherwood all call for transit-supportive design with density built around high-quality transit connections and amenities. Another example is the Elsie MacGill Secondary School that opened in 2022 and was designed to emphasize student travel by active modes and transit.

The Town of Milton has clear aspirations and direction to be a growing community with a strong and balanced economy and vibrant quality of life, and **transit is an essential component of this desired future**.

An Investment Strategy to Close the Gap

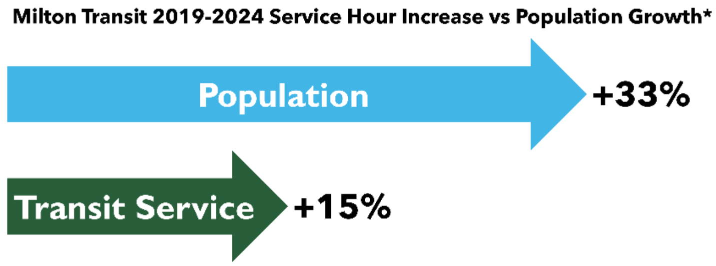
There is a clear gap between the service and experience provided by Milton Transit today and the role that transit needs to play to help Milton achieve its strategic objectives in the future. This Plan identifies an investment strategy that aims to guide transit planning and close this gap:

- By 2029, the Town of Milton will **double its investment** in conventional transit service compared to today.
- By 2041, Milton Transit will provide **one service hour per capita**, commensurate with the current investment made by its Halton Region peers. This is **more than a 150% increase** in service hours per capita compared to what Milton provides today (Exhibit E.2).

The Plan is built on a long-term goal of:

1 service hour per resident,

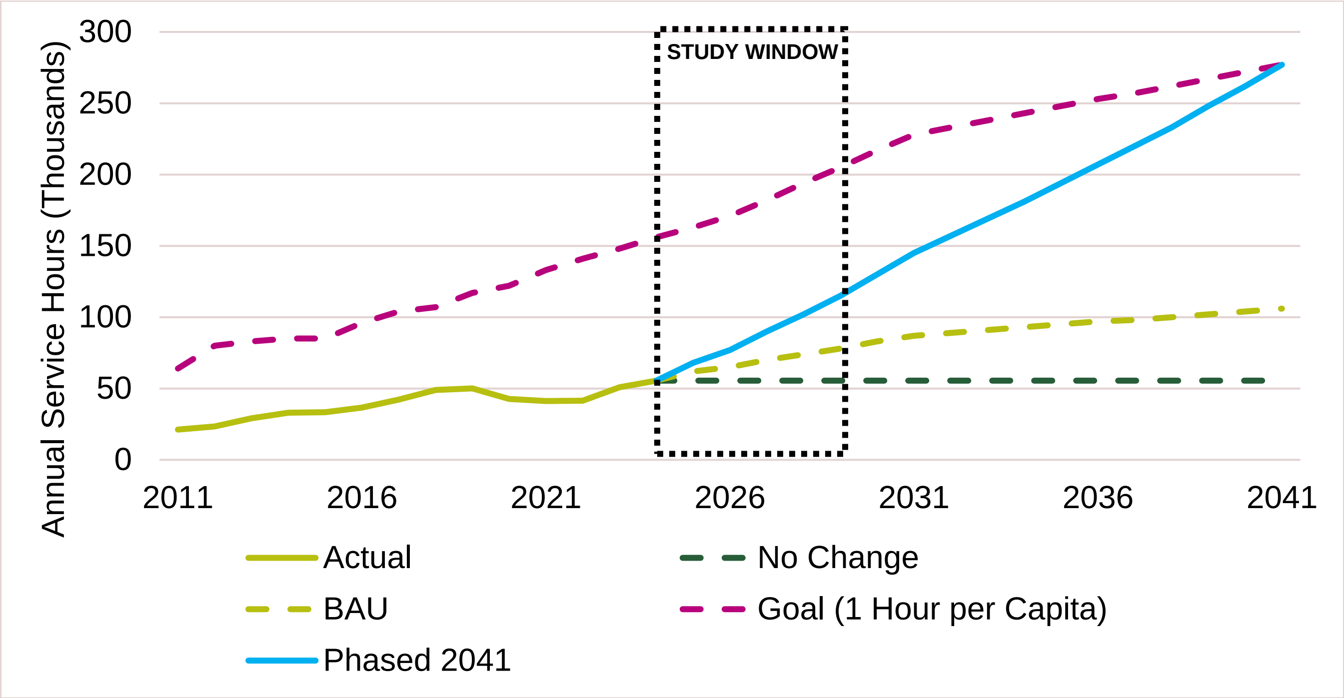
roughly double the number provided today



**2024 data based on Town population projections and budgeted transit service*

This investment strategy will enable the Town to provide a re-designed transit network that better meets residents' needs with supporting programs and initiatives that reflect industry-best practices.

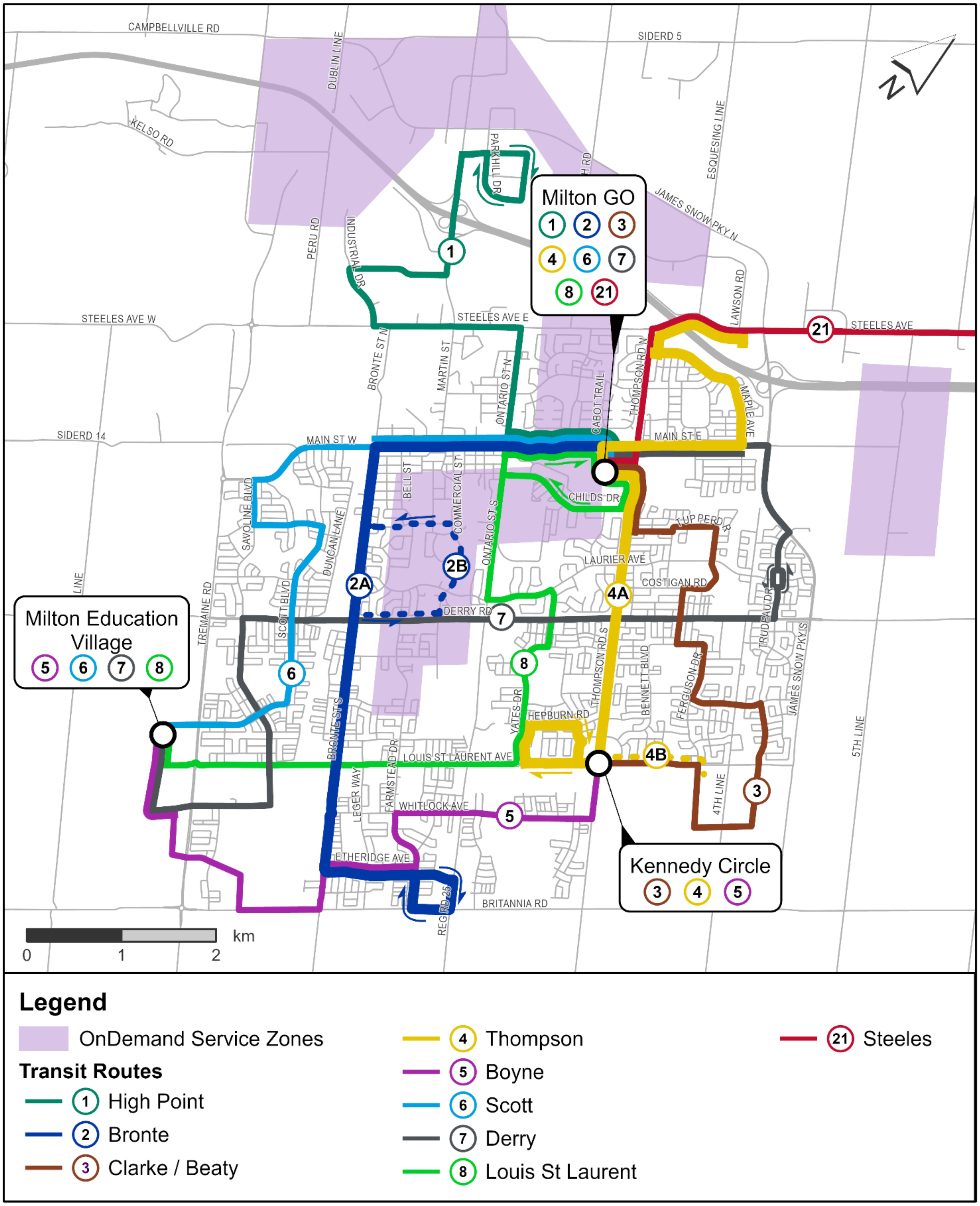
Exhibit E.1.2: Historical/Projected Service Hours by Transit Investment Scenario (2011-2041)



2029 Transit Network

The proposed 2029 transit network, shown below in Exhibit E.3, is designed to reflect changing travel patterns and support trips that connect to regional GO Transit as well as trips within Milton.

Exhibit E.1.3: Proposed 2029 Milton Transit Network



Key Outcomes

The proposed 2029 transit network features the following improvements and benefits:

- **More direct transit routes** that increase the convenience and speed of transit service;
- **More frequent service** with buses every 15-20 minutes on weekdays along major corridors (Routes 2 & 4) and buses at least every 30 minutes all week on local routes;
- **Extended evening and late-night service** with weekday and Saturday service until 11:30PM;
- **Introduction of Sunday service** from 7:00AM to 7:00PM;
- **Longer routes** to enable customers to reach more destinations without requiring transfers;
- **New transfer points** at the future Milton Education Village (MEV) and Kennedy Circle area;
- **An increased number of residents** within walking distance of a bus stop and greater access on transit – the average Milton resident can access 2.3 times more people/places within a 45-minute transit trip compared to today; and,
- **Re-distribution of OnDemand service areas** to optimize operational efficiency and prioritize areas where OnDemand can perform best.

Supporting Recommendations

In addition to the conventional transit network improvements described above, the Plan identifies supporting programs and initiatives to help Milton increase ridership and provide a high-quality transit experience for customers:

- **More access+ Vehicles and Service:** There is growing specialized trip demand for access+ services. The proposed 2029 transit network includes an increase in access+ vehicles and service investment. This increase will help meet growing trip demand, reduce wait times, improve overall service reliability and improve integration with conventional bus service.
- **Fleet Electrification:** The Town of Milton conducted a Zero Emission Bus Feasibility Strategy & Fleet Transition Plan in early 2024 to develop a roadmap for Milton Transit to phase out diesel buses and transition to battery-electric buses (BEBs). The Five-Year Service Plan carries forward the recommendations for a measured and phased implementation of BEBs between now and 2040. Transit systems across the country are transitioning their fleets to BEBs, and doing so in Milton will ensure alignment with industry best practices and buses that include modern transit technology innovations. It is also important for Milton Transit to maintain service reliability so that ridership can continue to grow during the phased transition.

- **PRESTO Fare System:** Many residents use Milton Transit to connect to and from regional transit. In addition, residents from other municipalities travel to Milton using regional transit. The Plan recommends the adoption of the PRESTO fare payment system by early 2028. This will increase convenience and help to facilitate seamless transfers and fare payment when using Milton Transit and other municipal/regional transit agencies like GO Transit, Brampton Transit and MiWay. This will improve inter-municipal travel for Milton residents and help Milton employers attract talent from outside of Milton.
- **Marketing and Communications:** There is an opportunity for Milton to improve communications channels and conduct marketing initiatives. These are intended to increase awareness of Milton Transit's services, attract new riders, communicate transit information and improve customer experience. This plan recommends a range of initiatives that target different key market segments, among both transit riders and non-transit riders, through various channels.

Key Enablers

In addition to the investment strategy described above, the following key enablers are required to implement the 2029 transit network and recommendations:

- **Town-Owned Transit Facility/Bus Garage:** Milton Transit's current service provider leases a small facility that does not adequately fulfill its required maintenance and storage functions and does not have enough vehicle capacity for growth. Without a new, expanded bus garage, Milton Transit will not be able to add more transit service and transition to a BEB fleet in the future. Milton Transit has developed plans to construct a Town-Owned Garage that is purpose-built by the Town of Milton as a stage-of-the-art transit facility to be available within the five-year Plan horizon. This study excludes the costs associated with the Town-owned Transit Facility.
- **Additional Milton Transit Staff:** Milton Transit's staff currently consist of three full-time equivalents (FTEs) and one co-op student. Additional Corporate Support Services are provided by the Town that are shared among multiple departments. It is recommended that the Corporate Support Services department dedicate two FTEs to Milton Transit operations to reflect an increasing workload due to the recent and planned growth of the transit service. Firstly, a **Transit Technology/IT Specialist** who would manage all Milton Transit technologies and supporting back-end systems. Secondly, a **Marketing, Program and Partnerships Specialist** who would implement campaigns, develop service programs, and coordinate system changes to riders while overseeing partnerships. These roles were identified as critical to the implementation of the Service Plan and supporting recommendations, and do not preclude additional FTEs from being added in future years as new staffing needs arise. Additional dedicated Transit Division staff will also be required

and phased accordingly to support service implementations, contract and change management functions.

Budget and Phasing of Recommendations

The recommended 2029 transit network includes the following budget implications:

- **$49,800,000** capital cost over the five-year Plan horizon.
- **$89,635,000** gross operating cost over the five-year Plan horizon.
- **$39,871,000** operating revenues over the five-year Plan horizon.
- **$49,764,000** net municipal operating spend over the five-year Plan horizon.

The capital and operating budgets are summarized in the tables below. The budget for conventional and specialized transit is provided in Exhibit E.4, All major Plan recommendations have been aligned into three implementation phases, as outlined in Exhibit E.5

Exhibit E.1.4: Conventional and Specialized Transit Budget (Dollars in Thousands)

	2024 (Baseline)	2025	2026	2027	2028	2029
Population	143,897	147,529	159,597	166,845	173,223	180,886
Post-Secondary Enrollment	700	3,000	3,100	3,200	3,200	5,700
Conventional Service Hours	67,900	83,400	91,200	108,500	131,000	143,700
Specialized Service Hours	10,000	10,000	10,500	11,000	11,500	12,000
Total Ridership Forecast (000s)	1,095	1,295	1,787	1,880	2,090	2,271
Transit Division Staff (FTEs)	4	5	6	6	6	6
Total Conventional Fleet / BEBs	20 / 1	24 / 3	27 / 6	34 / 7	38 / 8	41 / 12
Total Specialized Fleet / BEBs	14 / 0	15 / 0	16 / 0	16 / 2	16 / 2	18 / 4
Operating Revenues						
Fare Revenue	$2,468	$3,353	$3,798	$4,037	$4,468	$5,006
U-Pass/Post-Secondary Contribution	$250	$250	$868	$896	$896	$1,596
Reserve Contributions (including Provincial Gas Tax)	$1,083	$1,670	$1,851	$2,107	$2,197	$2,345
Other Municipality Subsidies	$555	$709	$709	$750	$750	$750
Other	$173	$173	$173	$173	$173	$173
Total	**$4,529**	**$6,155**	**$7,399**	**$7,963**	**$8,484**	**$9,870**

	2024 (Baseline)	2025	2026	2027	2028	2029
Operating Expenditures						
General/Administration	$749	$940	$1,092	$1,092	$1,092	$1,092
Transportation Operations	$6,579	$7,228	$7,676	$8,639	$9,882	$10,594
Fuel for Vehicles	$1,467	$1,511	$1,497	$1,761	$2,088	$2,080
Electricity for Vehicles (BEBs)	$7	$63	$123	$143	$176	$264
Vehicle Maintenance	$1,080	$1,269	$1,383	$1,627	$1,944	$2,125
BEB Charging Equipment Maintenance	$6	$18	$36	$54	$60	$96
Transfer to Reserve	$2,156	$2,951	$4,083	$4,587	$4,941	$5,428
Total	**$12,044**	**$13,980**	**$15,890**	**$17,903**	**$20,183**	**$21,679**
Net Operating Spending						
Net Municipal Spend	$7,515	$7,825	$8,491	$9,930	$11,699	$11,809
Per Capita	$52.22	$53.04	$53.20	$59.58	$67.54	$65.28
Cost Recovery Ratio	38%	44%	47%	44%	42%	46%
Capital Expenditures						
Conventional Diesel Buses	N/A	$2,985	$6,525	$915	$1,830	$0
Conventional BEBs & Charging Equipment	N/A	$5,980	$5,980	$2,096	$1,942	$7,921
Specialized Diesel Buses	N/A	$218	$874	$955	$0	$1,036
Specialized BEBs & Charging Equipment	N/A	$0	$0	$1,005	$0	$1,005
Support Vehicles	N/A	$0	$220	$0	$0	$0
Bus Stops and Amenities	N/A	$176	$289	$917	$76	$443
Transit Terminals	N/A	$0	$0	$2,451	$500	$0
PRESTO Fare Card	N/A	$0	$0	$1,085	$60	$200
Farebox Replacement	N/A	$0	$0	$2,116	$0	$0
Total	**N/A**	**$9,359**	**$13,888**	**$11,540**	**$4,408**	**$10,605**

Note: The budgets are an estimate based on the best understanding of population forecasts, ridership projections, post-secondary enrollment figures, and unit costs. All financial values are provided in current dollars without inflation assumptions applied. See “Capital and Operating Budgets” section for full list of assumptions.

Exhibit E.1.5: Implementation Plan

Phase 1	2025	• Sunday service 7AM-7PM (September) • Realignment of Routes 2, 4, 6, 7, 8 (September) • Suspension of Routes 5, 9 – Replaced by realigned Route 8 • Frequency improvements for all routes (September) • New Central OnDemand Zone (September) • Adjustments to 401 Industrial & Boyne OnDemand Zones (September) • Procurement of diesel and electric buses • New stop amenities to enable new routes, and improve accessibility & comfort • Hiring of new FTE: Transit Technology/IT Specialist
	2026	• U-Pass agreement comes into effect with Conestoga College and Laurier University (September) • access+ growth in service hours • Procurement of diesel and electric buses, and support fleet • New stop amenities to enable new routes, and improve accessibility & comfort • Hiring of new FTE: Marketing, Programs and Partnerships Specialist
Phase 2	2027	• Realignment of Routes 2, 3, 4, 7 (September) • Frequency improvements for Routes 4, 7 (September) • Remove Boyne OnDemand Zone (September) • Begin operating service to Growth Areas • Extend service to 11:30PM Mon-Sat (September) • PRESTO system is procured for 2028 launch • Farebox Replacement Program to modernize bus fleet revenue collection • MEV Terminal construction begins for 2028 launch • access+ growth in service hours • Procurement of diesel and electric buses • New stop amenities to enable new routes, and improve accessibility & comfort

	2028	• Electronic fare system transitions to PRESTO (January) • MEV Terminal opens • Kennedy Circle Terminal construction begins for 2029 launch • access+ growth in service hours • Procurement of diesel and electric buses • New stop amenities to enable new routes, and improve accessibility & comfort
Phase 3	2029	• Realignment of Routes 3, 4, 5, 6, 7, 21 (September) • Frequency improvements for Routes 2, 4, 8 (September) • access+ growth in service hours • Kennedy Circle Terminal opens • Procurement of electric buses • Added stop amenities to accommodate new routes, and improve accessibility & comfort

Public and Stakeholder Engagement

As the Five-Year Service Plan is a guiding document for transit, **open consultation** with residents and stakeholders was a critical contributor to the Plan. A range of activities and forums provided opportunities for both stakeholders and members of the public to give feedback and help shape this document. Consideration was given to all concerns and comments provided by stakeholders and the public.

This Plan included two rounds of engagement. The first round occurred in June-August 2023 and included an in-person public information centre (PIC) as well as an online survey. Stakeholder meetings were hosted both in-person and virtually with businesses, community groups, Town staff, Milton Accessibility Advisory Committee (MAAC), Halton Region, neighbouring transit systems, Metrolinx, Ontario Ministry of Transportation (MTO) and the transit service operator (PWTransit). The second round occurred in April-May 2024 and included a second online survey. Stakeholder meetings were hosted virtually with similar groups as the first round of engagement.

Key themes heard during public and stakeholder engagement include the following:

- Many residents are **not familiar** with Milton Transit services, particularly older adults;
- There is a need for **more frequent service** and **better coverage**;
- **Direct routes** make transit more appealing;
- Connections to **schools** and **places of work** are key;

- Residents and visitors rely on transit during **off-peak hours** like evenings and weekends;
- Residents want to use transit to travel to **neighbouring municipalities**;
- Transit **affordability** is critical, particularly for residents and visitors without access to a car;
- OnDemand and access+ should be **seamlessly integrated**; and,
- There is a strong desire for **PRESTO** fare integration.

1 Introduction

The Town of Milton is **one of Canada's fastest growing municipalities**, with a projected population increase of over 20% in the next five years. As a result, there will be more people and more travel to, from, and within Milton. Change is apparent in the Town, with more housing and jobs planned in many existing residential and rural areas. Post-secondary institutions, like Wilfrid Laurier University and Conestoga College, are expanding in Milton and attracting a significant number of students. A responsive and adaptive transit service is critical for meeting the needs of an increasing population in a manner that facilitates connections to critical services and fosters a strong quality of life for residents, visitors and people of all abilities. Numerous Provincial, Regional, and municipal plans and policies identify transit as essential for effective, sustainable, and livable communities. Milton is identified in these plans for various transit improvement initiatives, such as regional priority transit corridors and GO rail expansion. The Town of Milton and Milton Transit have also previously identified transit initiatives to support population growth and improved transit service, including intensification around major transit corridors and Major Transit Station Areas (MTSA), fleet electrification, and alternative service delivery models.

1.1 Report Objectives

This Milton Five-Year Service Plan and Master Plan Update ("the Plan") sets out a **strategic vision** and **re-designed transit network** to guide transit planning and operations from now to 2029 and beyond. It demonstrates how **increased transit investment is critical** to support the future needs of the community, and how this investment will enable Miltonians to use transit to get to where they need to go, when they need to go. The plan serves as a roadmap to identify key requirements and enablers to help the Town realize its desired transit future over the next five years, while establishing a foundation to support the strategic vision for Milton 2051. This report:

- **Evaluates the current transit services** provided within Milton, including conventional, OnDemand, and access+ specialized transit, to identify and recommend service changes and service delivery model changes that enhance the transit network
- **Recommends short, medium and long-term** transit requirements in community growth areas to achieve a "transit first" service delivery model
- **Evaluates the administrative and business processes** within Milton Transit, including staffing and organizational structure, service policies and standards, fleet and asset management, and customer service, to make recommendations that optimize transit operations

- **Evaluates the current fare policy, structure and products** used by Milton Transit to recommend adjustments and updates that support business goals
- **Recommends a Marketing and Communications Plan (MCP)** that outlines overall communications and marketing goals, communication objectives, and implementation of the MCP
- **Outlines the 5-year operating costs and 10-year capital costs required to implement all recommendations,** incorporating forecasted changes in ridership and revenue streams

1.2 Report Overview

The plan includes the following sections:

- **Section 2 Vision, Mission, and Objectives –** An overview of relevant plans and policies and an updated vision, **mission**, and objectives for the Five-Year Service Plan and Master Plan Update
- **Section 3 Conventional Transit Review –** An analysis of existing conventional and on-demand transit service in Milton, resulting in a recommended service plan
- **Section 4 Specialized Transit Review –** An analysis of existing specialized transit services in Milton alongside a peer review of comparable services, resulting in a recommended specialized transit service plan
- **Section 5 Administrative Support and Service Delivery –** An analysis of existing Milton Transit organizational and business processes, service delivery models, and current key performance indicators, resulting in a recommended administrative and service delivery model
- **Section 6 Policies Service Standards –** An analysis of existing Milton Transit service standards and policies, resulting in recommended updates to service standards and policies
- **Section 7 Fleet and Infrastructure –** An analysis of existing transit maintenance and storage facilities, fleet composition, and passenger amenities, resulting in recommended increases in capacity, fleet, and passenger amenities, and changes to fleet composition
- **Section 8 Fare Policy and Payment –** An analysis of the existing fare structure and fare payment technology, resulting in recommended updates to the fare structure and identified needs for fare payment technology
- **Section 9 Marketing and Communications –** An assessment of existing marketing and communications platforms, resulting in identification of improvements to these platforms and future initiatives
- **Section 10 Capital and Operating Budgets –** An overview of the short, medium, and long-term capital and operating requirements for the previously identified recommendations

- **Section 11 Public and Stakeholder Engagement –** An overview of previously completed, ongoing, and future public and stakeholder engagement initiatives, including any insights obtained from this engagement.

2 Vision, Mission, and Objectives

This section includes a review of relevant plans and policies related to local transit, and the previously completed 2019-2023 Milton Transit Services Review and Master Plan, which in turn provide the context needed to update Milton Transit's vision, mission, and strategic objectives for the updated Five-Year Service Plan.

2.1 Policy Review

A review of relevant policies and studies was undertaken to develop an understanding of the local context in which transit service is provided. This review included local Town of Milton plans and policies, along with those at the Halton Region, and provincial levels.

2.1.1 Town of Milton

2019-2023 Milton Transit Services Review and Master Plan (2018)

In 2018, the Town of Milton developed a *Transit Master Plan* to guide the next five years of transit service and investment in the town. This plan included a service review which investigated service levels, budget, accessibility, fare structure/policy, transit technology, infrastructure requirements, and marketing/communications. The review encompassed both conventional fixed route, and access+ specialized transit services.

The outcome of the recommendations contained in the Transit Master Plan include conventional and specialized transit service improvements, the establishment of Milton OnDemand service, new transfer hubs, regional routes to Mississauga, Next-Gen PRESTO fare technology, and other staffing and marketing improvements. Recommendations which were implemented in the past five years include: Cross-boundary service to Mississauga (Route 21), new OnDemand transit service, suspension of Route 10, and co-mingled "Family of Service" approach to access+ and OnDemand. Recommendations which were not implemented include: Suspension of Routes 5 & 9, 15-minute peak frequency on local routes, creation of transfer points at the MEV and Kennedy Circle, elimination of cash fares, and adoption of the PRESTO fare system.

Milton Transit Alternative Service Delivery Strategy (2021)

The *Milton Transit Alternative Service Delivery Strategy* was developed to guide the implementation of permanent OnDemand services. The Strategy includes service standards to guide potential conversion of fixed routes to OnDemand (and vice versa), financial considerations, and integration with access+ via the Family of Services approach, allowing for complementary transit services.

Battery Electric Bus Feasibility Study and Transition Plan (2023)

Milton Transit undertook a fleet electrification feasibility study via a Metrolinx joint procurement. The initial findings of the study have indicated that it would be feasible to electrify all existing routes via several possible alternatives which may require fleet expansion, diesel heating, or en-route chargers. The highest-scoring alternative would require 1-5 additional buses, depending on battery capacity, and would not increase non-revenue kilometres above the baseline.

It was also recommended that Milton Transit consider options such as en-route charging at Milton GO station or in-depot overhead pantograph chargers to determine the feasibility of implementing any of the alternative strategies in future. A Transit Operations Facility is a prerequisite for the large-scale adoption of battery-electric technology. The study concluded in 2024 and included costing and implementation strategies. Most municipalities are considering fleet electrification as their main fleet moving forward, and this plan is in alignment with current industry practices.

Milton Official Plan (2018)

The *Town of Milton Official Plan*, first adopted in 2010, was fully approved by the Region and Province in 2018. The Official Plan guides Milton's development, particularly with respect to residential, employment, and agricultural lands. The Plan also provides supportive policies with respect to transportation and public transit, highlighting the importance of transit in community planning.

The Plan also outlines how Major Transit Station Areas (MTSAs) will be developed (Milton GO station) and directs that mixed-use nodes should be serviced by convenient public transit. 200 persons and jobs per gross hectare is the minimum development density within MTSAs to be achieved by 2031, which supports the viability of existing and planned transit infrastructure and service. MTSAs are also planned to be multi-modal - accessible by walking, cycling, transit, and driving. It should be noted that the Town is currently updating its Official Plan – We Make Milton project, which will incorporate strategic themes of how we live, move, work and grow in Milton.

2018-2022 Milton Transportation Master Plan (2018)

The *Milton Transportation Master Plan* (TMP) outlines a plan for a multi-modal transportation network to serve the residents of Milton, creating a vibrant, sustainable, and connected community. Primary considerations for the TMP were the urbanization of outlying areas of the town, planned intensification around Milton GO station, rural connectivity, and goods movement to and from industrial areas. The TMP recognized that Milton can mitigate capital-intensive investments into road projects by focusing on a transportation network which integrates active transportation, public transit, and transportation demand management (TDM) strategies.

Recommendations for transit service from the TMP included increasing service levels (to 0.5 service hours per capita), improving competitiveness of transit versus automobiles, expanding the service area, and ensuring state-of-good-repair for fleet and facilities. The TMP also included transit-oriented development guidelines which support the construction of neighbourhoods which are designed to encourage transit use and active transportation.

The Milton TMP is currently being updated to align transportation policy with Milton's growth plan and priorities, and to reflect recent Provincial policy directions on intensification within the built boundary and development of complete communities.

2023-2027 Milton Strategic Plan and Strategic Vision for 2051

The Town of Milton's ***Strategic Plan*** **identifies a shared vision that guides the Town's work to meet evolving community needs. Milton's** Strategic Vision for 2051 **is "In 2051, Milton will be a safe, diverse and welcoming community that respects its natural beauty and heritage, supports a range of neighbourhoods, sustains a strong and balanced economy, and offers outstanding opportunities to live, learn, work and play."**

The Plan also includes a Practical Vision for 2023-2027, which is entirely based upon enhanced transit service, stating: **"**By 2027, Milton will have laid the foundation for its future as a diverse and welcoming community defined by higher densities enabled by transit.

This foundation will include transit system advancements, prioritized infrastructure, quality facilities and a diverse housing stock in varied neighbourhoods where people can live and work close to nature.

One of the Plan's strategic themes is Connected Transit and Mobility. This means investing in Milton-owned transit assets, like a municipal transit garage facility, to promote sustainable transportation use in harmony with smart density, placemaking, mobility, and economic development. There is strategic direction to grow Milton's local transit service and ridership and advocate for improved inter-municipal transit connectivity. This desire includes a focus on equity and building upon Milton Transit's 'family of services' to support growing populations like post-secondary students.

Milton Secondary Plans

There are several approved and draft Secondary Plan areas within Milton which highlight the role of transit in these communities and provide specific density and/or service designs. A non-exhaustive list of these areas and their policies is provided below.

The **Trafalgar Secondary Plan** recommends *Frequent Transit* services along Trafalgar Road, which is categorized as service that runs at least every 15 minutes in both directions throughout the day, every day of the week. The **Agerton Secondary Plan** recommends the designation of Trafalgar Road and Derry Road as Transit Priority Corridors. It also targets an overall minimum density of 70 residents and jobs combined per hectare and targets the Major Transit Station Area (MTSA) within the secondary plan area to achieve an overall density of 150 residents and jobs combined per hectare. The **Milton GO Station area** is targeted to achieve a minimum density of 200 residents and jobs combined per hectare by 2031. **The Boyne Survey Secondary Plan** targets an overall density of 70 residents and jobs per hectare, exclusive of lands within the Natural Heritage System. The **Milton Education Village Secondary Plan** targets densities between 85 and 115 residents and jobs combined per hectare, and a minimum transit modal share of 20%.

2.1.2 Halton Region

Halton Regional Official Plan (2022)

The Region of Halton sets the broad policy objectives which the local municipalities must adhere to when developing their own Official Plans. With respect to public transit, the *Halton Regional Official Plan* (ROP), supports seamless regional transit across Halton, including enhancements to the GO Transit network. The ROP also sets a goal of 20% transit mode share by Halton residents by 2031. The 2016 TTS mode share reported only 5% transit mode share by Halton residents (inclusive of local and GO Transit). The ROP also supports planning for all residences to be located within 400 metres of a transit stop. Finally, the ROP envisions investigating the feasibility of a single regional transit provider.

Halton Transportation Master Plan (2011)

The regional *Halton Transportation Master Plan* (TMP) identifies 2031 conceptual higher-order transit corridors (see Exhibit 2.1), including the following:

- Regional Road 25: Main Street to Lower Base Line West
- Regional Road 6: Tremaine Road to Highway 407
- Regional Road 3: Highway 401 to Highway 407
- GO Rail Cambridge Extension

Exhibit 2.1: Halton Transportation Master Plan - Milton

Source: Transportation Master Plan, Region of Halton (2011)

These transit corridors would include exclusive, or semi-exclusive rights-of-way reserved for transit vehicles. The ROP also recommends that transit priority measures be protected for to improve access to transit hubs, such as Milton GO.

Mobility Management Strategy for Halton (2016)

The Mobility Management Strategy for Halton (2016) has a broad scope and aims to develop the vision, goals, and associated strategies to help guide the region's near-term and long-term transportation system to 2041. One element the plan focuses on is increasing modal share of public transit. It aims to prioritize transit-supportive infrastructure, increase service frequencies, increase first-mile/last-mile solutions, and improve connections to GO Transit and local transit hubs.

The plan recommends a region-wide Transit Priority Mobility Network, including key transit priority corridors that will form a grid on which to provide infrastructure, technology, and operational improvements to improve travel speed, reliability, and convenience of transit. These corridors are based on the Higher Order Transit Corridors identified in the ROP and TMP, with some additions to connect corridors to existing and future regional transit hubs, GO stations, civic centres, urban growth centres, intensification areas, and employment areas.

The Transit Priority Mobility Network to 2041 includes the following priority corridors and mobility links within Milton (Exhibit 2.2):

- Regional Road 25: Main Street to Lower Base Line West (priority corridor)
- Regional Road 8 from Regional Road 25 to James Snow Parkway (priority corridor)
- Regional Road 7 from Tremaine Road to Highway 407 (priority corridor)
- Regional Road 6: Tremaine Road to Highway 407 (priority corridor)
- Regional Road 4: Highway 401 to Main Street (priority corridor)
- Regional Road 3: Highway 401 to Highway 407 (priority corridor)
- Main Street: Regional Road 25 to James Snow Parkway (priority corridor)
- Regional Road 25: Campbellville Road to Main Street (mobility link)
- Regional Road 4: Main Street to Lower Base Line West (mobility link)

Exhibit 2.2 Transit Priority Mobility Network to 2041 Map – Milton

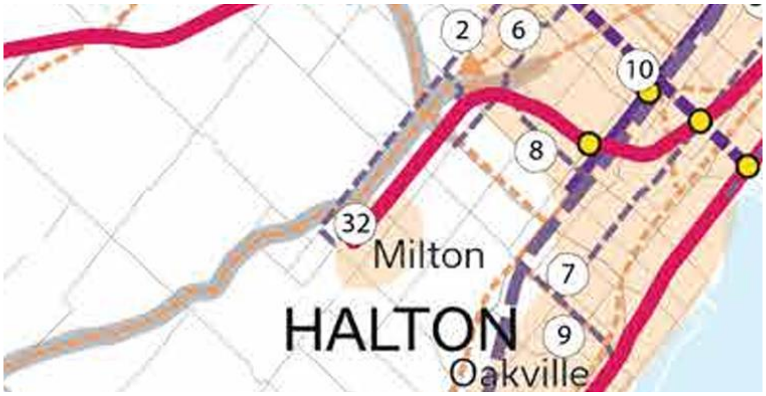
Source: Mobility Management Strategy for Halton (2016)

2.1.3 Provincial

Connecting the GGH: A Transportation Plan for Greater Golden Horseshoe (2022)

Connecting the GGH is the Province's multi-modal transportation plan, which will guide investments in transportation over the next 30 years. By 2051, the Town of Milton is envisioned to operate bus frequencies of at most 10 minutes within its urban boundary. New or enhanced higher-order transit connections are planned along Steeles from Mississauga to Regional Road 25. In addition, Milton Line GO Expansion is expected to increase the frequency of trips along the corridor. The Plan also includes policy direction with respect to fare and service integration, transit priority measures, and adoption of modern transit technologies (including PRESTO). Regional fare integration is identified as an initiative that will improve transit user experience, provide seamless connections, and make transit more convenient and accessible. The map below shows the higher-order transit network serving Milton (Exhibit 2.3).

Exhibit 2.32.3: Connecting the GGH Transportation Map - Milton



Source: Connecting the GGH: A Transportation Plan for Greater Golden Horseshoe, MTO (2022)

Metrolinx 2041 Regional Transportation Plan (2018)

The *2041 Regional Transportation Plan* (RTP) is Metrolinx's long-term planning document. Unlike *Connecting the GGH,* the RTP is focused solely on public transportation. The RTP includes several new frequent transit connections within Milton, including Priority Bus/Streetcar along Derry Road, Regional Road 25, and Regional Road 3. In addition, the RTP envisions Frequent Regional Express Bus service along Highway 407 and 401 (Exhibit 2.4).

Exhibit 2.42.4: 2041 RTP - Milton

Source: 2041 Regional Transportation Plan, Metrolinx (2018)

Metrolinx GO Bus Network Concept Vision to Regional Express Bus (2023)

Metrolinx has begun planning for a re-imagined GO Bus network, which would be founded on the vision of a “Regional Express Bus” system. Exhibit 2.5 below indicates that long-term plans include direct routes between Milton and Toronto, Mississauga, Guelph, and Kitchener.

Exhibit 2.52.5: Planned Regional Express Bus System

Source: Regional Express Bus Concept, Metrolinx (2023)

A Place to Grow: Growth Plan for the Greater Golden Horseshoe (2019) and Provincial Policy Statement (2020)

A Place to Grow and the *Provincial Policy Statement* (PPS) are two Provincial policy instruments to guide land-use planning and development. The PPS is a broader policy tool which applies province-wide and is issued under the *Planning Act*, while *A Place to Grow* is specific to the Greater Golden Horseshoe, provides more specific guidance about land use, and is issued under the *Places to Grow Act, 2005.* The PPS supports the building of transit-oriented development and planning of appropriate population densities around transit corridors. *A Place to Grow* designates Downtown Milton as an Urban Growth Centre which should support increased residential and employment density, along with serving as the focal point for transit service in the area.

The Province is currently consulting on its plans to combine both documents into a single land-use policy document in future. The draft proposed *Provincial Policy Statement* was initially published for comment in 2023, and an updated draft was released in April 2024. If adopted by the Province, the proposed *Provincial Policy Statement* would replace both the PPS (2020) and *A Place to Grow.*

Through consultation in 2023, additional policies are being proposed as part of the updated PPS, grouped into 5 pillars: Generate increased housing supply, Make land available for development, provide infrastructure to support development, Balance housing with resources, and Implementation. Initiatives under these pillars include expanding the definition of multi-unit types and typologies, minimum intensification targets for built-up areas and MTSAs, planning for intensification adjacent to existing and planned frequent transit corridors, and protecting corridors for major transit infrastructure. These updated policies further emphasize the foundational nature of transit in building livable communities.

2.1.4 Key Takeaways

The above Regional and Provincial plans and policies outline goals for seamless and expanded transit service in the Region of Halton, GTHA, and GGH. The Town of Milton and Milton Transit have made recommendations in multiple plans for conventional and specialized transit service improvements and expansions, new infrastructure and technology, and other staffing and marketing improvements to grow Milton's transit service concurrently with rapid population growth. All plans and policies highlight the importance of transit in community-building. The implementation of these goals is dependent upon investment in transit, as outlined later in the plan. Given the planned growth forecasted in Milton, there is a gap between transit service provided in Milton and the ambitious goals within these policy documents. This highlights an urgent need to work towards increased transit investment to achieve Regional, Provincial and municipal policy goals.

2.2 Vision, Mission and Objectives

This section provides the vision, mission, and strategic objectives from the previous 2019-2023 Milton Transit Services Review and Master Plan Update as well as an updated vision, mission, and strategic objectives for the updated Five-year Service Plan. The vision outlines what Milton Transit desires to achieve, the mission outlines how that will be achieved, and objectives provide key milestones to implement the vision and mission. The updated vision, mission, and objectives are informed by the previously reviewed policies.

2.2.1 Existing Vision, Mission, and Objectives

Milton Transit's vision statement is as follows:

> Milton Transit provides a safe, reliable, accessible and cost-effective public transportation
>
> Going to school, work, shopping malls, doctor's appointments, the gym, the library, or just to explore your community, Milton Transit is the preferred travel option for you and your family. We embrace a safe, reliable, innovative and cost-effective system, putting transit in the centre of communities, while promoting connectivity, personal mobility and independence. Whether you are a student, older adult, regular commuter or someone who has additional needs, Milton Transit can take you there with ease, because we do not want to be an added stress in your life. We want you to concentrate on what's most important – family, friends, work, school and having fun without worrying about getting there!
>
> We retain the right service provider who shares in our collective values. Operators and customer service staff remain the face and voice of our business; representative of the vision we have to give you the best possible experience using any of the services we offer. We also embrace new, sustainable technologies and approaches to grow our business, offering a menu of services catered to the varying needs you may have.
>
> This is Milton Transit on the Move!

This vision statement is expanded upon in its mission as follows:

Milton Transit Work Plan was created to create a roadmap of initiatives to achieve the vision and mission. The following goals were outlined as part of the Milton Transit Work Plan development process:

- Service Recovery
- Integrated Transit Strategy
- Service Innovation and Growth
- Climate Change and Sustainability
- Fiscal Responsibility
- Organizational Resiliency
- Accessibility
- Customer Service and Relations
- GTHA Integration

The Town of Milton produced its own Work Plan in 2020 which included the following high-level goals: Planning for Growth, Increasing Revenue Potential, Community Attractiveness and Competitiveness, and Service Innovation. Milton Transit's Work Plan goals fall under 1 or more of these Town-wide goals.

2.2.2 Updates to Vision, Mission and Objectives

The following principles were identified for the future vision, mission, and objectives:

- Must tie into and build on Council's *Milton 2051 Strategic Plan*, including the 2023-2027 Practical Vision;
- Be concise and easy to understand; and
- Reflect major changes which have occurred or are underway in Milton (Changing travel patterns, growing population, fleet electrification, OnDemand, Town-owned Garage).

The recommended Transit Vision is provided below:

> Milton Transit will provide a safe, frequent, reliable, and accessible service which meets the changing travel needs of residents and visitors, regardless of age, ability, or circumstance.

This updated vision highlights the change in travel patterns within Milton, as well as the visions within the *Milton 2051 Strategic Plan* that focus on equity and diversity, and the desire for greater investment in transit services.

The recommended mission statement is provided below:

Milton Transit service will be enhanced to accommodate population growth and enable sustainable development of high density, mixed-use neighbourhoods. An integrated suite of transit services, which includes investing in a modern fleet, fixed and dynamic programs will complement existing service designs and grow ridership amongst emerging markets such as youth, local workers, post-secondary students, and persons with varying abilities.

This updated mission further expands upon the vision, indicating how a more equitable transit system may be achieved, and how population and ridership growth, and high densities are supported by transit improvements.

The goals outlined as part of the Milton Transit Work Plan development process as listed above are largely still consistent with the updated vision and mission. It is recommended that these goals are maintained in order to achieve the updated vision and mission, however, goals have been renamed and reordered to provide greater clarity on the objectives of each goal.

- Implementing an integrated transit planning strategy
- Ensuring successful service growth and operations
- Providing and improving service and infrastructure accessibility
- Continuing service optimization and recovery
- Monitoring fiscal performance for efficient management
- Transitioning to sustainable operations
- Continuous improvement of customer-facing services and customer relations
- Planning for effective integration with the regional transit network
- Continuous improvement of organizational professional development and outreach programs

2.2.3 Key Takeaways

- Much of the 2019-2023 Milton Transit Services Review & Master Plan’s vision, mission, and strategic objectives remain relevant with this update – namely reliability, equity, and accessibility.
- There is now a greater emphasis on enhanced transit investment and accommodating a rapidly growing community in innovative ways for the updated Five-Year Service Plan, aligning with municipal, Regional, and Provincial policies.

3 Conventional Transit Review

This section provides an assessment of Milton Transit's network from the perspective of system-wide performance, individual route-level and OnDemand zone-level performance, and demographics of the service area.

3.1 System Review

3.1.1 System Overview

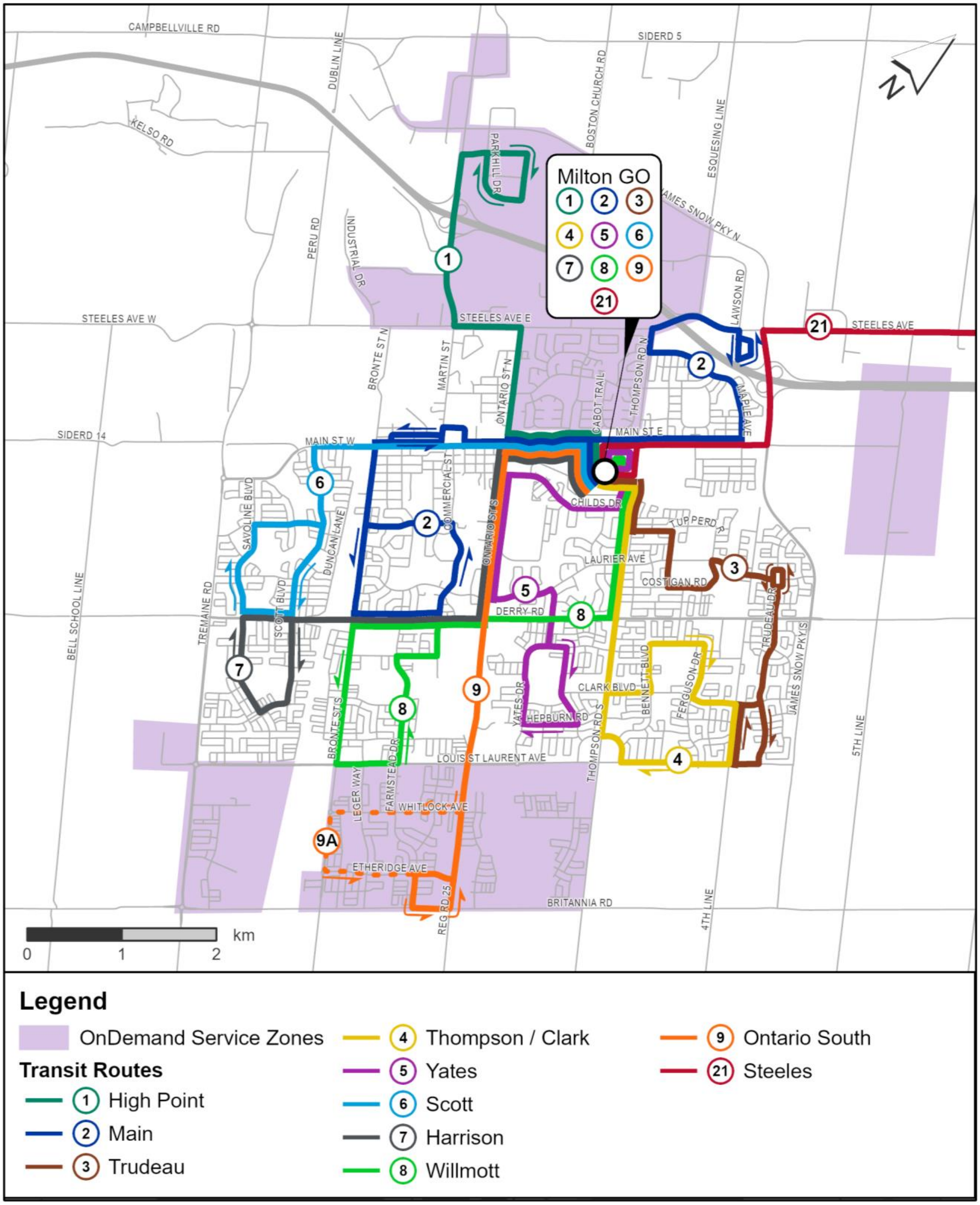
Milton Transit operates a transit service oriented around its sole transfer point at the Milton GO Station (Exhibit 3.1). The service consists of:

- Nine (9) local routes servicing the urban areas of Milton;
- One (1) inter-municipal route connecting Milton to Toronto Premium Outlets and Lisgar GO Station in Mississauga;
- Five (5) school extras which offer targeted services to local high schools around bell times; and
- Four (4) OnDemand zones which provide stop-to-stop service within the zone and to connecting hubs/transfer points.

On weekdays, local routes are scheduled to operate on a "pulse system", meeting at the same times at the Milton GO Station to facilitate transfers. On Saturdays, two groups of routes are pulsed on a half-hour offset, with some routes running at both times.

The GO station-oriented design means areas near the station and major arterials leading towards it are served by several overlapping routes, with most routes ending in one-way loops which circulate along neighbourhood streets. This service design is cost-effective, by focusing on providing service to a rider group which previously made up a significant share of travel demand in the town, which is commuters to Toronto and Mississauga. However, this focus on regional commuters no longer reflects diversifying and growing local travel patterns. Due to the lower frequencies on the system, it is impractical to transfer at points across the network other than the GO station, meaning cross-town trips require detouring through the GO station to transfer routes. This design leads to high travel times for trips which do not start or end at the GO station, making transit less competitive with other travel modes for local journeys.

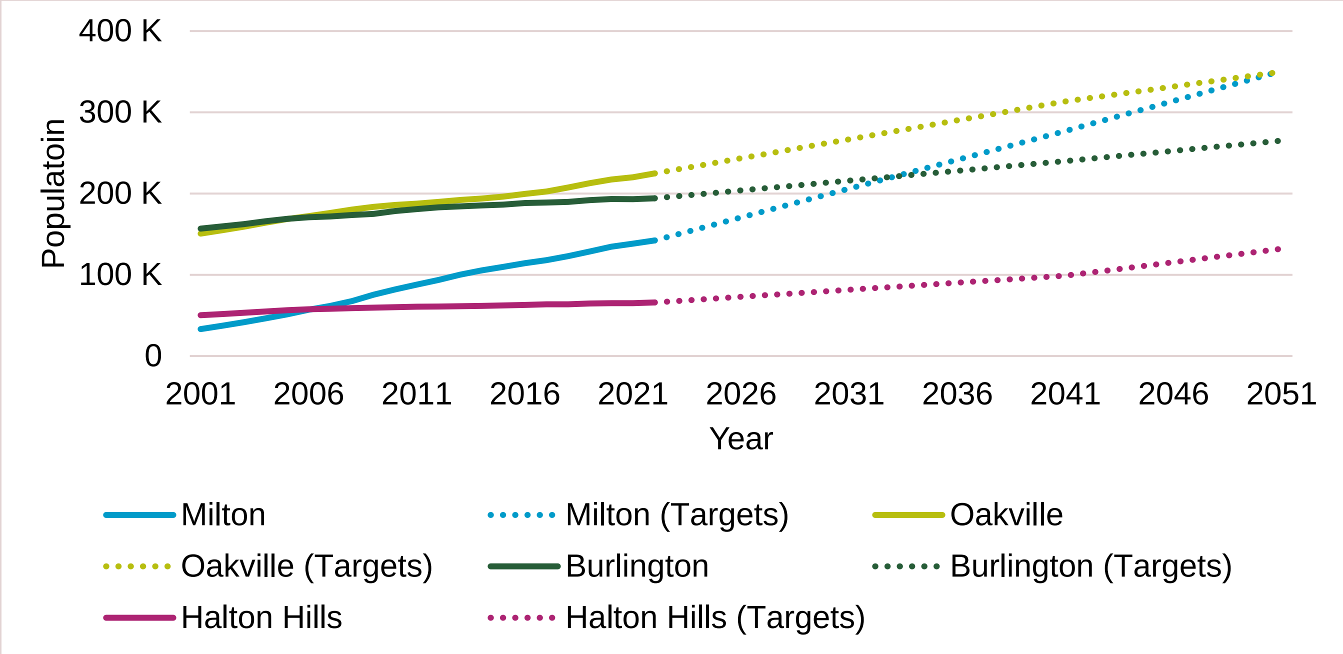
Exhibit 3.1:Milton Transit's Existing Network



3.1.2 Demographic Analysis

Milton is one of Canada's fastest-growing municipalities. Since the previous Five-Year Service Plan was completed in 2019, Milton's population was projected by Regional population forecasts to have grown by 27,000 residents, or a 21% increase. These forecasts predict Milton's growth rate will be higher than other municipalities in Halton Region through to 2051, with an average annual population growth rate of 3.1% over the next 30 years. The forecast suggests that Milton's population will eclipse Burlington in the next 10 years, and equal Oakville's population by 2051 (see Exhibit 3.2).

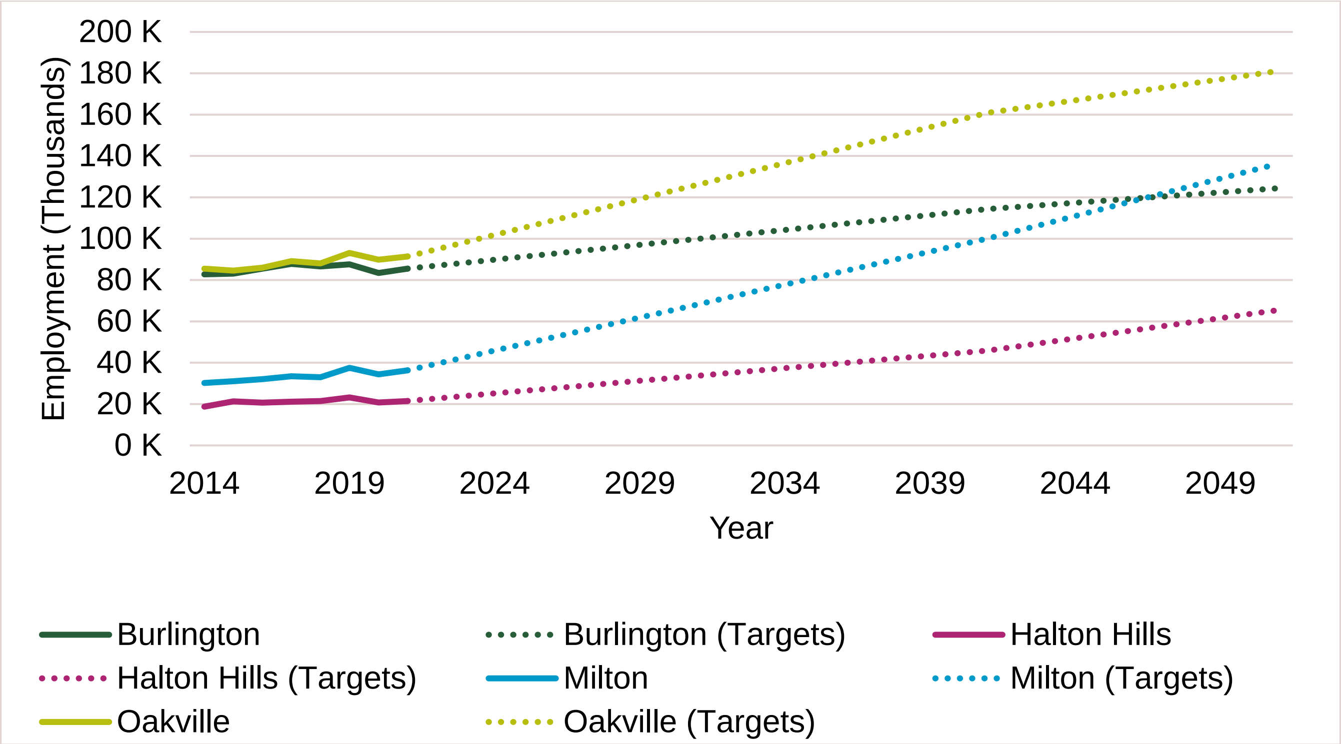
Exhibit 3.2: Halton Region Population Forecast



Source: Population Estimates (2001-2022) from Statistics Canada; Population Growth Targets (2041, 2051) from the Halton Region Official Plan

Milton also continues to support a rapidly expanding employment base, with a large industrial and logistics sector. New business parks are being developed, focused around the existing Highway 401 industrial area, as well as newer growth along James Snow Parkway and Fifth Line to the east of Milton's existing urban boundary. According to Regional forecasts, Milton will have a larger employment base than Burlington in 2046. The forecasts also estimate that employment will near-double in Milton by 2029, compared to the beginning of the previous Five-Year Service Plan in 2019 (see Exhibit 3.3).

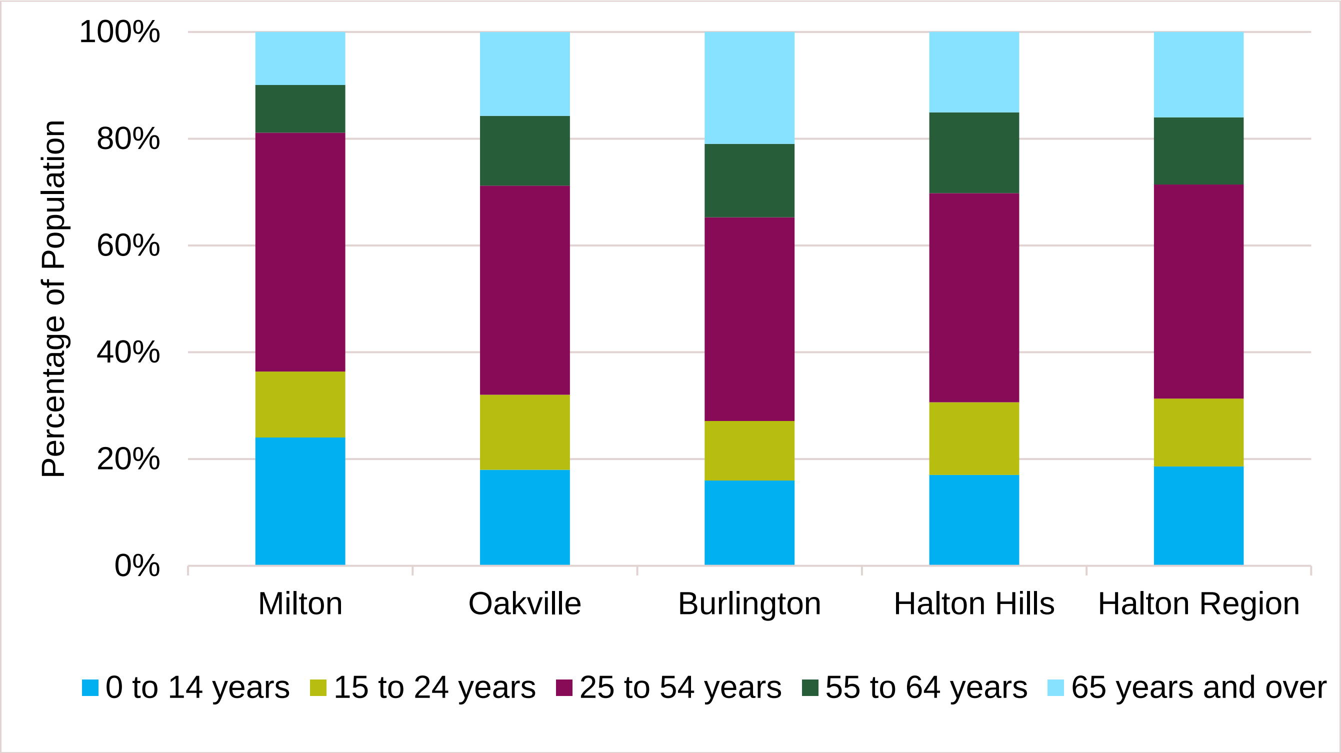
Exhibit 3.3: Halton Region Employment Estimates



Source: Employment Estimates (2014-2021) from Halton Region Annual Employment Surveys; Employment Growth Targets (2041, 2051) from the Halton Regional Official Plan

Milton is not only quickly growing, but welcoming many new families into the town, resulting in a share of the population under 25 years old which is 4% above the Region average, and a share of the population aged 55 and over which is 10% below the Region average. This composition is reflected in the high proportion of youth who ride Milton Transit compared to peers (Exhibit 3.4).

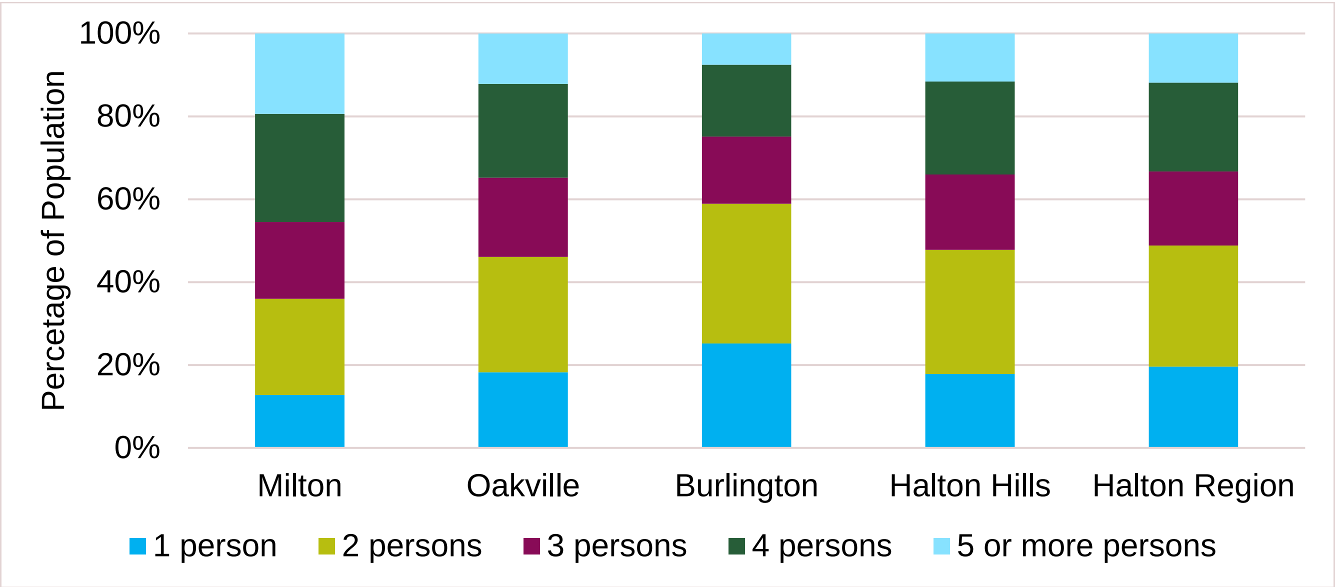
Exhibit 3.4: Halton Region Age Segmentation by Municipality



Source: 2021 Census of Population, Statistics Canada

Milton is also home to households of a larger average size than other municipalities in the Region. While Halton Region as a whole has 33% of households with four (4) or more persons, in Milton this figure is 45%, near-half of the town's households. Larger household sizes result in higher levels of population density in neighbourhoods which traditionally are lower-density areas. (Exhibit 3.5).

Exhibit 3.5: Halton Region Household Size by Municipality



Source: 2021 Census of Population, Statistics Canada

Population density within Milton by census dissemination area was explored to identify areas of potentially higher transit propensity. The results of population density mapped spatially demonstrate a “donut” pattern of residential development in Milton, where outlying areas have a higher population density than inner areas. This observation is atypical considering the expected patterns of urban growth are usually where central areas have seen historically higher-density development. As per the map (see Exhibit 3.6), the areas of highest population densities in Milton are:

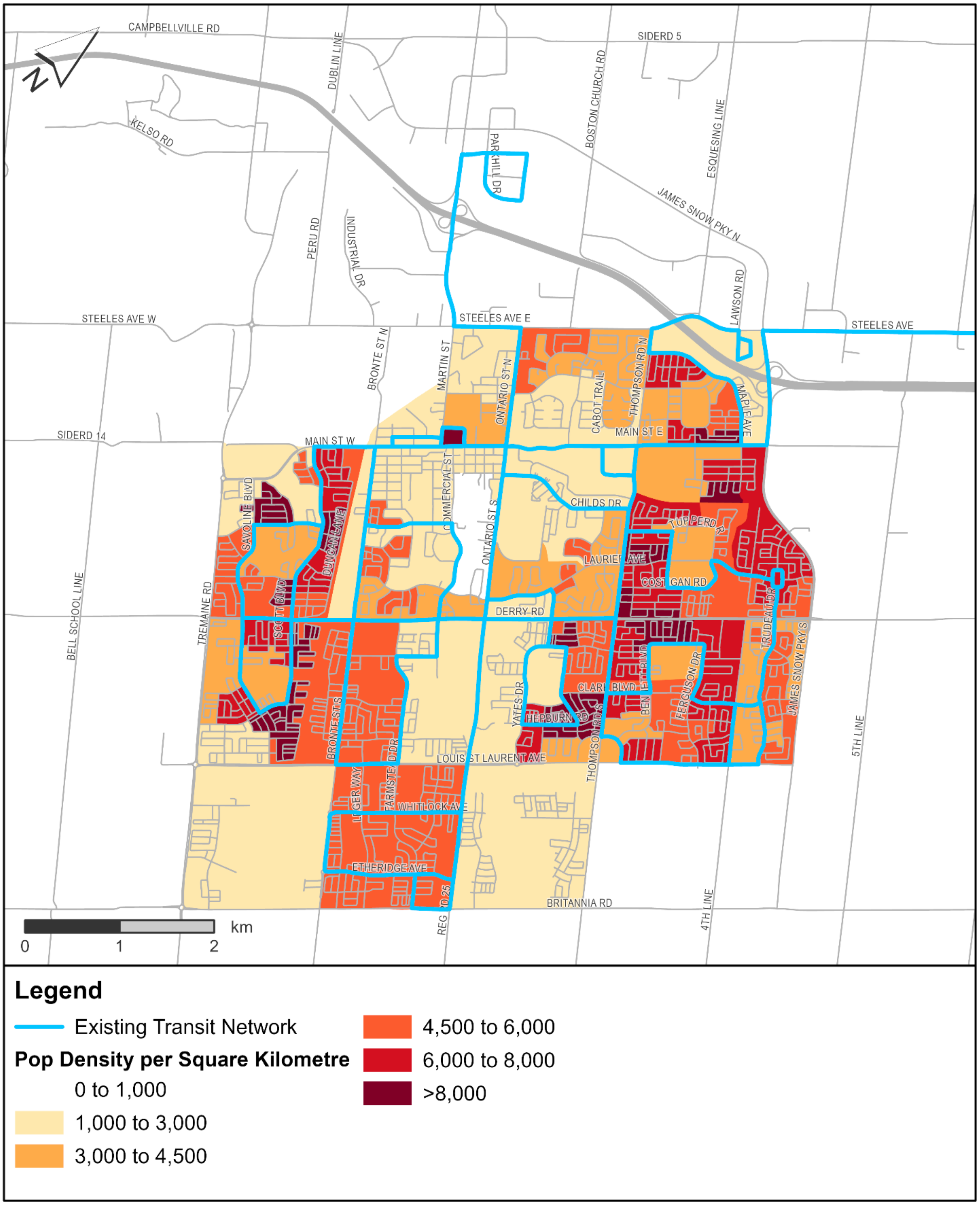
- Main Street, at Millside Drive
- Derry Road, between Thompson Road and Fourth Line
- East of Thompson Road, between the CP Rail line and Louis St Laurent Avenue
- Main Street, between Thompson Road and Maple Avenue
- Scott Street, from Main Street to Louis St Laurent Avenue
- Hepburn Avenue, from Yates Drive to Thompson Road

A disconnect is noted between the areas of highest-density, and the provision of transit service. All routes (except Routes 1 & 21) operate at 30-minute peak headways while certain routes pass through areas of much higher population densities than others.

It should be noted that the map was generated using the most-recent Census data from 2021, and considering new and under construction higher-density development in the town results in emerging nodes of population density in the following areas:

- Main Street and Thompson Road, adjacent to Milton GO Station (Milton GO MTSA)
- Ontario Street (Regional Road 25) and Derry Road
- Ontario Street (Regional Road 25), between Louis St Laurent Avenue and Britannia Road
- Bronte Street and Steeles Avenue

Exhibit 3.6: Population Density by Census Dissemination Area



Source: 2021 Census of Population, Statistics Canada

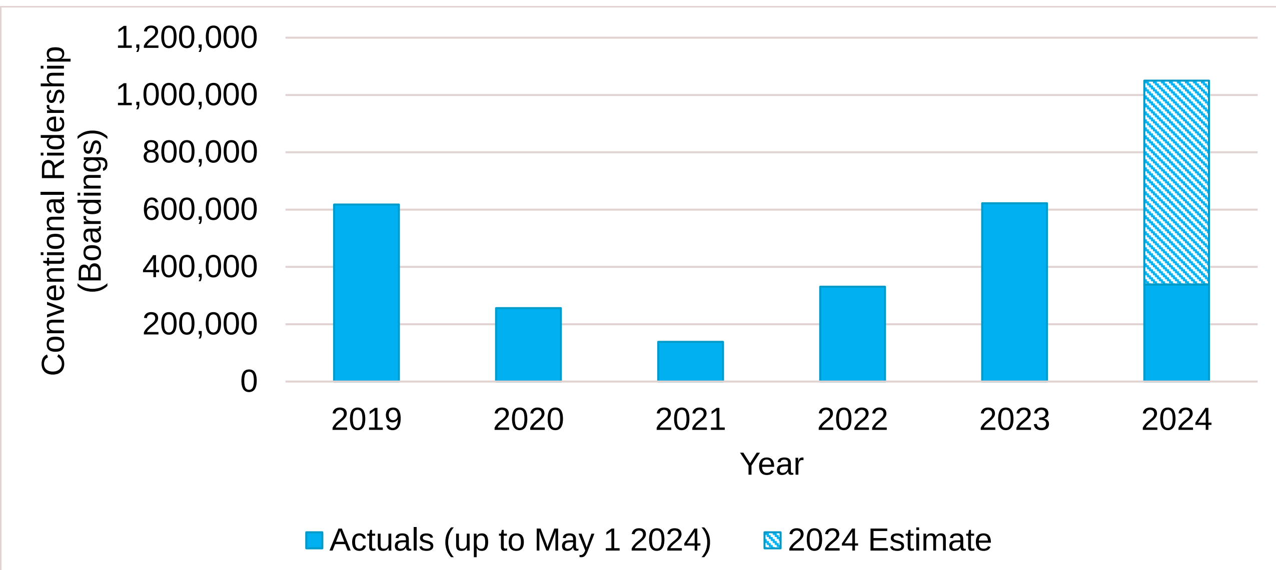
3.1.3 Operational Analysis

An analysis of Milton Transit's internal operational data, through to June 1st, 2023, was used to analyze two key metrics:

- **Ridership and post-pandemic recovery,** used to determine the desire and need of Milton residents to return to riding transit after the COVID-19 situation has stabilized.
- **Stop-level ridership,** used to understand where riders are travelling to and from the most.

While Milton Transit experienced steep declines in ridership levels during the peak of the pandemic, ridership has since recovered quickly. In 2023, fixed route boardings were 101% of pre-pandemic levels, before considering added OnDemand service which replaced two fixed routes in 2021 (Exhibit 3.7).

Exhibit 3.7: Milton Transit Conventional Ridership (Boardings) From 2019-2024



Source: Milton Transit Ridership Data, 2019-2024 (Note: Ridership data includes only fixed routes and does not include OnDemand or access+ trips)

Ridership has continued to climb sharply since 2023, with ridership in the first third of 2024 more than doubling ridership during the same period of 2023, and exceeding 2022's full-year ridership level. This is due to the success of Route 1, which was re-instated in January 2024 to serve the new Conestoga College satellite campus on Parkhill Drive, continued ridership growth on the cross-boundary 21 Steeles route, along with modest ridership increases on local routes. While the 2024 estimate is based on existing monthly trends, post-secondary enrollment is set to near-quadruple in September 2024, which will likely drive further ridership growth. This observation has quickly shifted the realities of transit utilization in Milton, with the system now expected to blow past previous ridership records and experience major capacity constraints without additional investment.

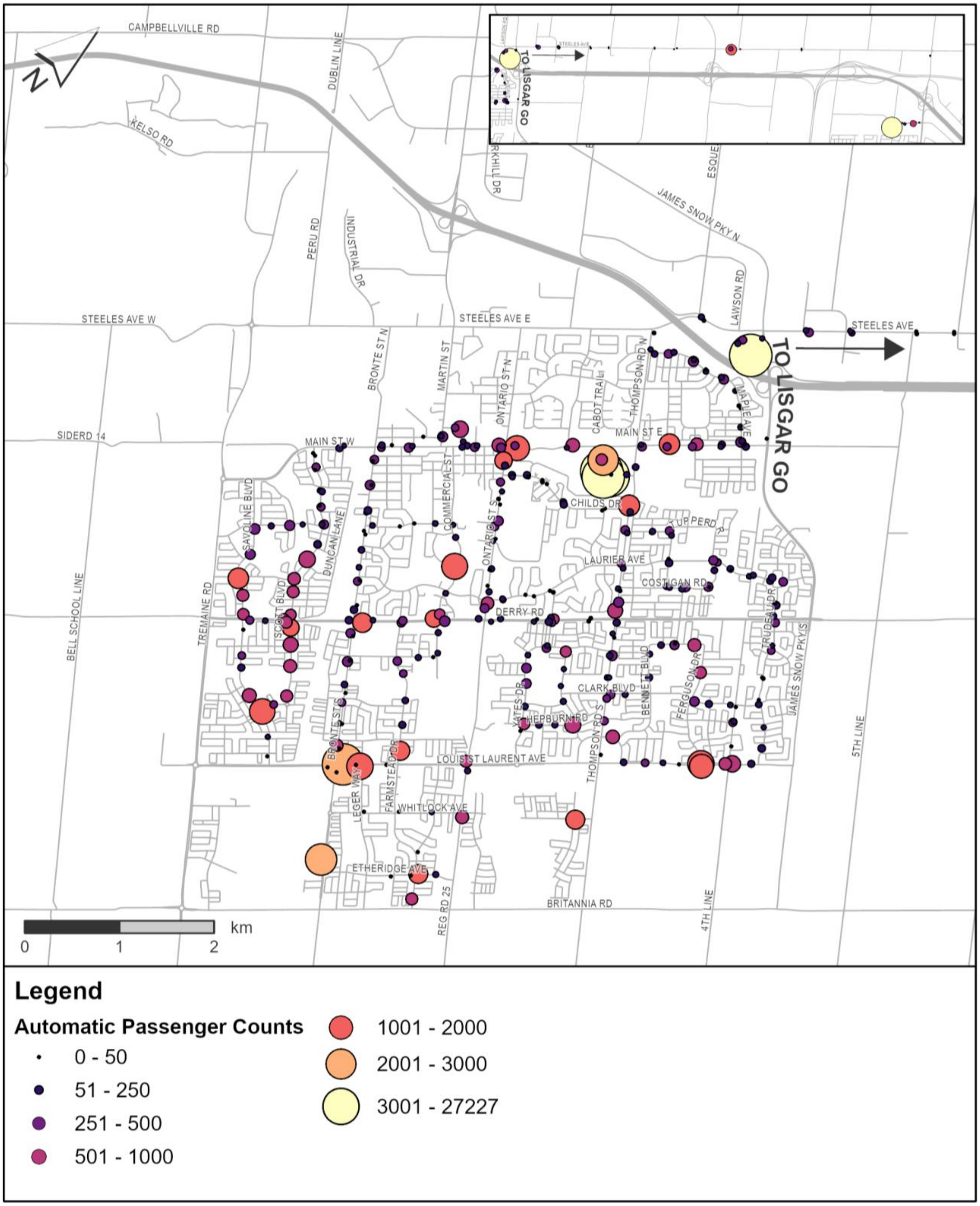
A spatial analysis of ridership at the stop-level was undertaken using Milton Transit's automatic passenger counter (APC) data. The results in Exhibit 3.8 demonstrate where demand is highest across the system. Major stops included the Milton GO Station, as it is the primary transfer point on the system, along with Walmart in the Milton Crossroads plaza, Lisgar GO Station in Mississauga, the intersection of Louis St Laurent Avenue & Bronte Street, and Elsie MacGill high school on Bronte Street south of Louis St Laurent Avenue. Secondary demand nodes included Milton Mall, the other high schools in Milton (Milton District, Craig Kielburger, Bishop Reding), as well as Scott Boulevard from Dymott Avenue to Farrington Crossing.

In addition, the historical performance of the transit system was analyzed over a 10-year period. The Canadian Urban Transit Association (CUTA) publishes data which was used to conduct this analysis. Three indicators were selected to explore the transit system's performance for various perspectives:

- **Annual ridership versus annual revenue vehicle-hours**, to explore the relationship between increased transit investment and utilization of the transit system.
- **Annual ridership versus service area population,** to determine the uptake of transit in response to changes in the town's population.
- **Cost recovery ratio** (share of operating costs covered by fare revenue), to understand how financial performance of the system has changed over time.

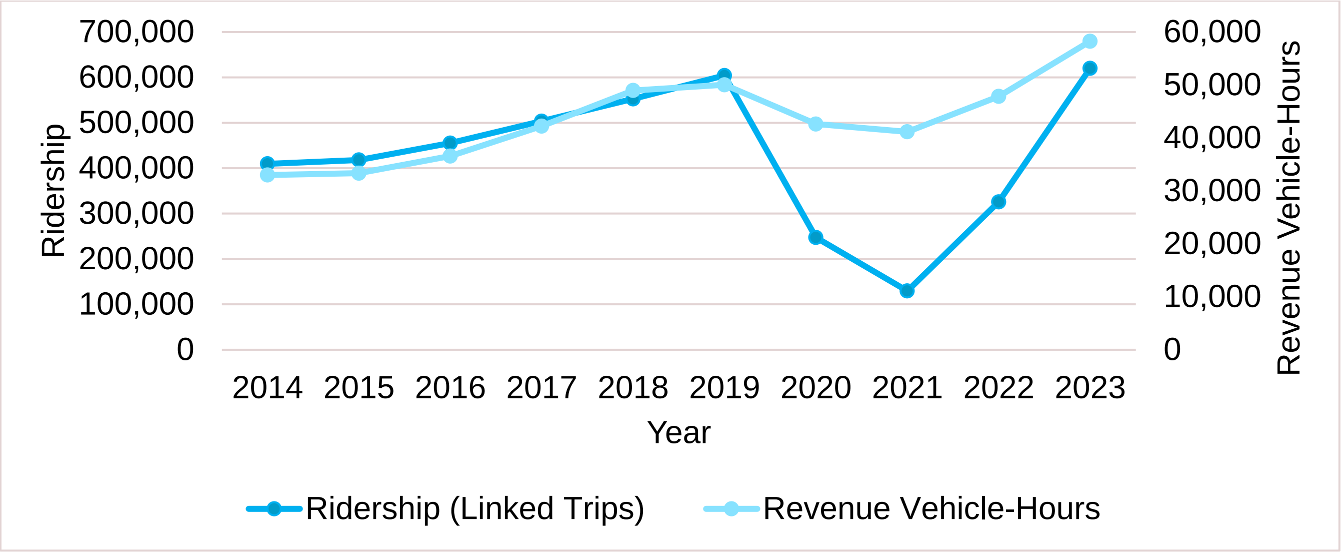
From 2014-2019, Milton's transit ridership grew nearly in lockstep with service hour growth - 48% ridership growth versus 52% service hour growth. From 2020-2022, the COVID-19 pandemic and related travel restrictions severely impacted ridership, with a 79% decrease in 2021 compared to 2019 levels. Service levels were not reduced to the same degree so that transit service could be maintained for essential workers. While data has not been officially released by CUTA for 2023, Town staff have reported that Milton Transit's 2023 ridership exceeded 2019 ridership, with a modest net increase in service hours (Exhibit 3.9).

Exhibit 3.8: Spatial Analysis of Milton Transit Ridership at the Stop-Level



Source: Milton Transit APC data (Jan 1st - Jun 1st, 2023)

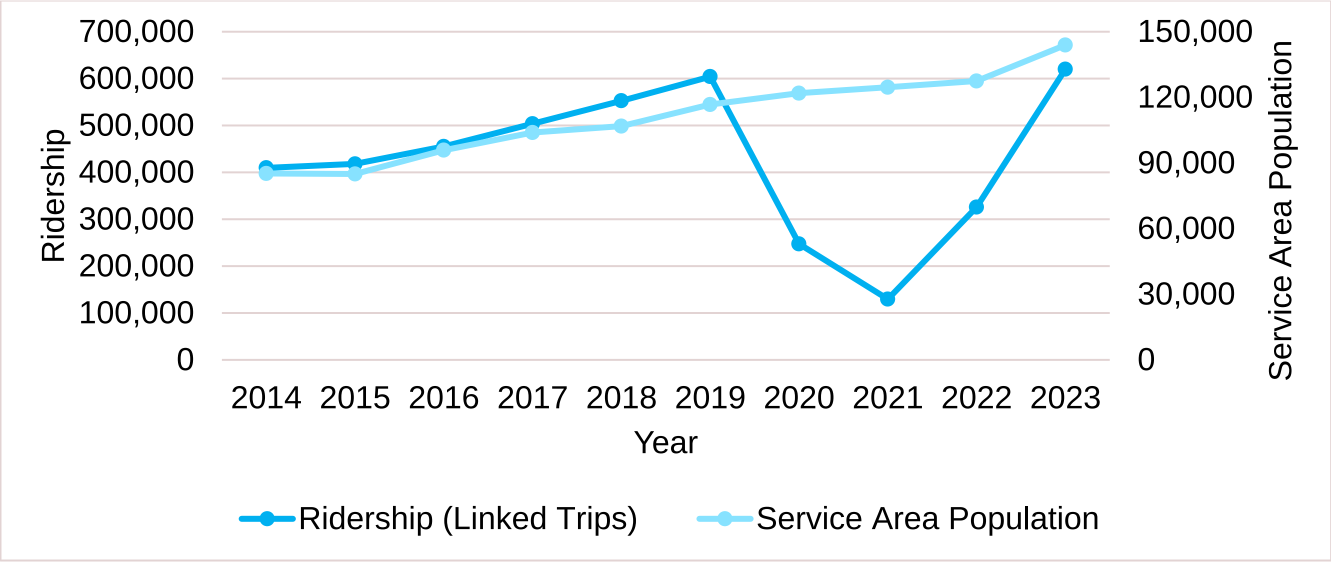
Exhibit 3.9: Milton Transit Ridership and Revenue Vehicle-Hours



Source: CUTA Fact Books (2014-2022), Milton preliminary data reported to CUTA (2023)

Pre-pandemic data shows that Milton Transit ridership increased substantially faster than population growth in the service area – 48% ridership growth versus 37% population growth from 2014-2019. This demonstrates that the trend of upwards ridership growth was driven more so by investment in additional transit service than strictly growth of the local population. During the pandemic, population continued to grow steadily while ridership dropped (Exhibit 3).

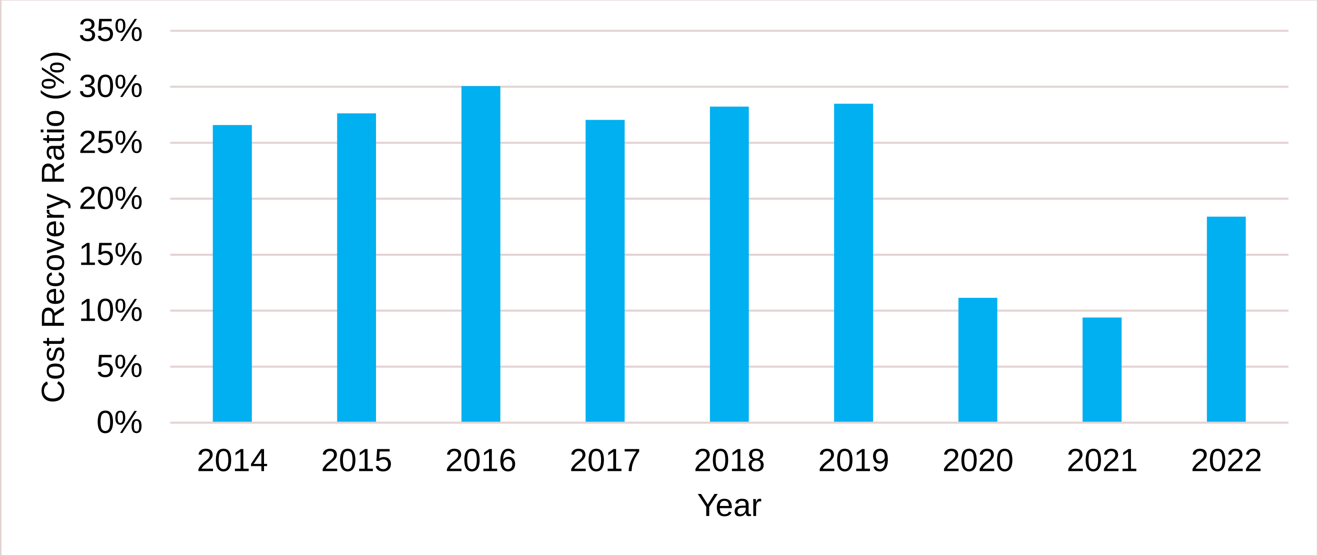
Exhibit 3.10: Milton Transit Ridership and Service Area Population



Source: CUTA Fact Books (2014-2022), Milton preliminary data reported to CUTA (2023)

Cost recovery of the system was slightly lower overall compared to peer performance (30%-40%). A moderate upward trend in cost recovery was observed pre-pandemic, with cost recovery reduced during the COVID-19 pandemic due to reduced fare revenues and ridership. It is expected that cost recovery in 2023 will return to pre-pandemic ranges based on initial internal reporting (Exhibit 3).

Exhibit 3.11: Milton Transit Cost Recovery Ratio



Source: CUTA Fact Books (2014-2022)

3.1.4 Key Takeaways

- Milton is facing rapid growth in population and employment which will require an expanded and optimized transit system to efficiently move people locally and regionally.
- The towns' demographic makeup includes a younger population and larger household sizes compared to the rest of Halton Region – both point to a higher transit propensity in newer areas of Milton.
- Major trip generators include Milton GO, Lisgar GO, Milton Mall, and local high schools.
- Ridership has fully recovered from COVID-related impacts and is continuing to break annual records. Despite this result, population and latent transit demand continued to grow during the pandemic, while investment in service growth was largely paused. Past data demonstrates that in Milton, ridership growth is tightly correlated with increases in service levels.

3.2 Route Review

A review of Milton Transit's individual routes was conducted to profile route details and relative performance.

3.2.1 Summary of Routes

Milton Transit operates nine (9) local routes (Route 1-9), one (1) cross-boundary route (Route 21), and five (5) school extras (Route 50-54). The table below (Exhibit 3.12) provides a high-level summary of each route, its performance, frequency, fleet requirement, service span and on-time performance.

On-time performance (OTP), or schedule adherence, is the percentage of trips in which the bus arrived on-time at its major stops (time-points). The average route OTP was 70% in 2023, which was significantly lower than the 90-95% OTP target established in the 2019-2023 Transit Master Plan. A trend of degrading OTP was observed over the past few years, as traffic congestion grew significantly in step with population growth. Route schedules have not been adjusted in several years, meaning that the scheduled run-times are no longer realistic in many cases due to slower road conditions. In addition to this, OTP is intentionally impacted by policy to hold buses to allow riders to make transfer between buses or from GO Trains.

Exhibit 3.12: Summary of Milton Transit Routes (2023)

Route	Ridership (2023)	Boardings per Revenue Vehicle-Hour	Frequency (mins)			Peak Fleet	Service Span		On-Time Performance
			Peak Weekday	Off-Peak Weekday	Saturday		Weekday	Saturday	
1 High Point	-[1]	25.4[1]	20	40	40	2	5:30AM-9:45PM	7:30AM-7:30PM	-[1]
2 Main	117,643	13.7	30	30	30	2	5:30AM-10:15PM	7:00AM-7:30PM	79%
3 Trudeau	58,814	14.8	30	60	60	1	5:30AM-10:15PM	8:00AM-7:30PM	74%
4 Thompson/ Clark	44,143	10.1	30	60	60	1	5:30AM-10:15PM	7:30AM-7:00PM	69%
5 Yates	30,656	9.2	30	60	60	1	6:00AM-10:15PM	8:00AM-7:30PM	74%
6 Scott	63,819	16.8	30	60	60	1	5:30AM-10:15PM	7:30AM-7:00PM	71%
7 Harrison	53,944	14.9	30	60	60	1	5:30AM-10:15PM	8:00AM-7:30PM	72%

[1] Route 1 did not begin operations until 2024. 2024 year-to-date (Jan 1-May 1 2024) ridership and revenue hours were used to calculated productivity.

Route	Ridership (2023)	Boardings per Revenue Vehicle-Hour	Frequency (mins)			Peak Fleet	Service Span		On-Time Performance
			Peak Weekday	Off-Peak Weekday	Saturday		Weekday	Saturday	
8 Willmott	52,569	17.0	30	60	60	1	6:00AM-9:45PM	7:30AM-7:00PM	69%
9 Ontario South	30,244	9.1	30	60	60	1	5:30AM-10:15PM	7:30AM-7:00PM	73%
21 Steeles	104,291	13.4	35	35	35	2	6:00AM-10:15PM	7:30AM-7:30PM	65%
50 School Special	23,234	118.3	-	-	-	1	7:30AM-8:00AM, 2:30PM-3:00PM	-	63%
51 School Special	13,588	60.6	-	-	-	1	7:30AM-8:00AM, 2:30PM-3:15PM	-	54%
52 School Special	14,575	51.4	-	-	-	1	7:30AM-8:00AM, 2:30PM-3:30PM	-	62%
53 School Special	7,433	21.7	-	-	-	1	8:00AM-8:30AM, 3:30PM-4:00PM	-	80%
54 School Special	7,490	42.9	-	-	-	1	7:45AM-8:15AM, 2:30PM-3:00PM	-	72%

Source: Milton Transit internal ridership and schedule adherence data (2023)

3.2.2 Local Routes

For each route, the function of the route, any operational issues, and adjacent areas of demand for potential route extension or re-design are outlined.

1 High Point

- **Function:** Connections to Conestoga Campus, GO Transit's 401 Park & Ride stop, and the 401 business parks.
- **Issues:** Capacity issues due to high ridership, service span doesn't reflect all class times.
- **Demand:** Travel further north to serve additional employers.

Exhibit 3.13: Route 1 High Point Ridership, 2024

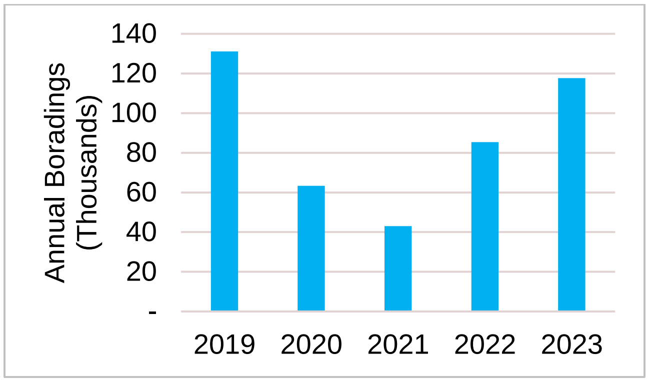
2024 Year-to-Date Ridership	49,619
Trips per Revenue Hour	25.4

2 Main

- **Function:** Consistent service along Main Street, connecting Old Milton, Milton District High School, downtown Milton, Milton GO, Maple retail area and the Crossroads plaza
- **Issues:** Operational challenges through downtown Milton (Millside Drive, Mill Street), traffic delay on Main Street, serves low-density areas of limited ridership potential, large one-way loop: Bronte Street, Derry Road, Commercial Drive, Heslop Road.
- **Demand:** Travel along Bronte Street continuing south of Derry Road

Exhibit 3.14: Route 2 Main Performance and Historical Ridership, 2019-2023

2023 Ridership	117,643
Trips per Revenue Hour	13.7
Population Density in 400m Walking Distance (per h.a.)	27.1
5-Year Population Density Change (2016-2021)	+12%

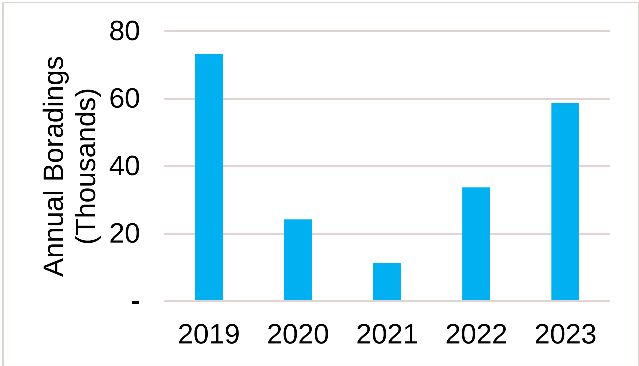


3 Trudeau

- **Function:** Connecting residential neighbourhoods in east Milton to Milton GO and Craig Kielburger Secondary School, including denser developments along Costigan Road.
- **Issues:** Serves limited trip generators and predominantly low-rise residential areas.
- **Demand:** Demand along Trudeau Drive south of Louis St Laurent Avenue, connections to Saint Kateri Tekakwitha Secondary School and retail plazas near Thompson Road.

Exhibit 3.15: Route 3 Trudeau Performance and Historical Ridership, 2019-2023

2023 Ridership	58,814
Trips per Revenue Hour	14.8
Population Density in 400m Walking Distance (per h.a.)	45.7
5-Year Population Density Change (2016-2021)	+18%

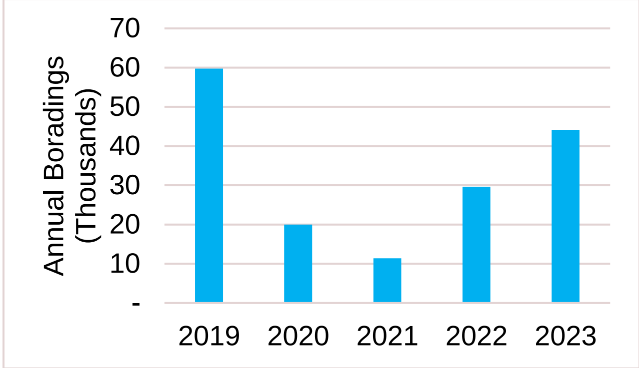


4 Thompson/Clark

- **Function:** Serving trips along Thompson Road and Louis St Laurent Avenue, including retail plazas secondary schools: Craig Kielburger and Saint Kateri Tekakwitha.
- **Issues:** Poor on-time performance, large one-way loop: Clark Boulevard, Bennett Boulevard, Ferguson Drive, Clark Boulevard, Fourth Line, Louis St Laurent Avenue, Thompson Road.
- **Demand:** Demand along Thompson Road south of Louis St Laurent Avenue, bi-directional journeys to local high schools.

Exhibit 3.16: Route 4 Thompson/Clark Performance and Historical Ridership, 2019-2023

2023 Ridership	44,143
Trips per Revenue Hour	10.1
Population Density in 400m Walking Distance (per h.a.)	45.8
5-Year Population Density Change (2016-2021)	+11%

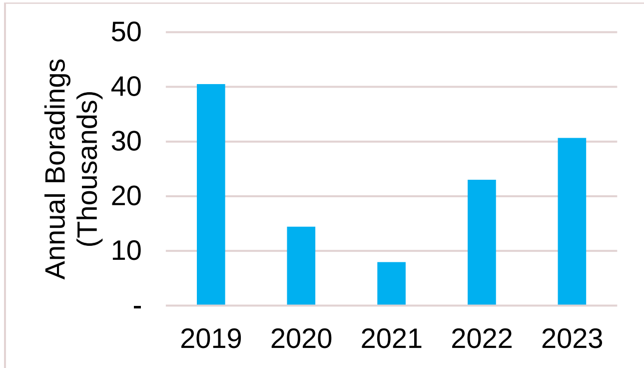


5 Yates

- **Function:** Providing coverage in the Coates neighbourhood, connecting along Ontario Street to Milton Mall, Allendale Long Term Care Facility and Milton GO.
- **Issues:** Low ridership and productivity, limited demand in counter-peak direction, large one-way loop: Yates Drive, Hepburn Road, Philbrook Drive.
- **Demand:** Demand south of Louis St Laurent to develop communities, however road network is currently disconnected.

Exhibit 3.17: Route 5 Yates Performance and Historical Ridership, 2019-2023

2023 Ridership	30,656
Trips per Revenue Hour	9.2
Population Density in 400m Walking Distance (per h.a.)	29.8
5-Year Population Density Change (2016-2021)	+7%

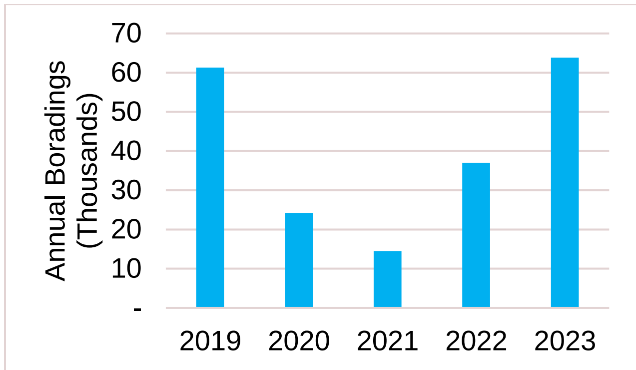


6 Scott

- **Function:** Providing coverage in the Scott neighbourhood, travelling through downtown Milton, connecting Milton Mall and Milton GO.
- **Issues:** Poor on-time performance, traffic delay on Main Street, large one-way loop: Scott Boulevard, Derry Road, Savoline Boulevard, Pringle Avenue.
- **Demand:** Demand to Sherwood Community Centre, retail plaza at Main Street and Tremaine Road. High demand to Milton District High School around bell times.

Exhibit 3.18: Route 6 Scott Performance and Historical Ridership, 2019-2023

2023 Ridership	63,819
Trips per Revenue Hour	16.8
Population Density in 400m Walking Distance (per h.a.)	34.1
5-Year Population Density Change (2016-2021)	+13%

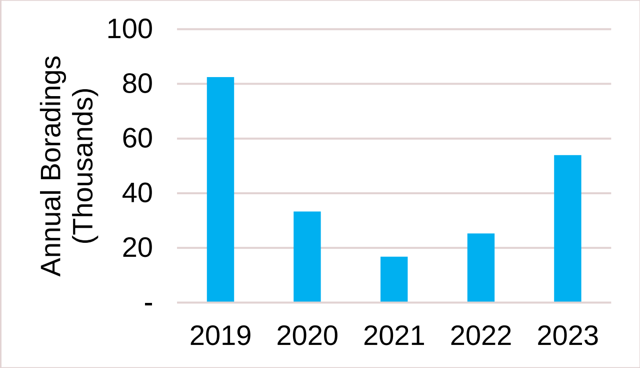


7 Harrison

- **Function:** Providing coverage in the Harrison neighbourhood, connecting to Milton District Hospital, Milton Sports Centre, Milton Mall and Milton GO.
- **Issues:** Delay at Derry Road to Ontario Street left-turn, large one-way loop: Scott Boulevard, Dymott Avenue, Savoline Boulevard, Derry Road.
- **Demand:** Demand south of Dymott Avenue to the Mattamy National Cycling Centre/future MEV lands.

Exhibit 3.19: Route 7 Harrison Performance and Historical Ridership, 2019-2023

2023 Ridership	53,944
Trips per Revenue Hour	14.9
Population Density in 400m Walking Distance (per h.a.)	34.6
5-Year Population Density Change (2016-2021)	+21%

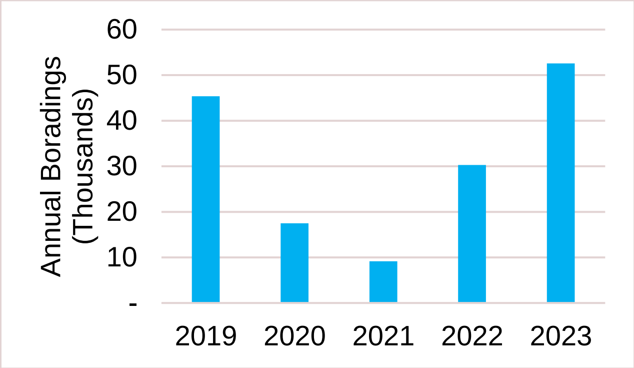


8 Willmott

- **Function:** Providing coverage in the Willmott neighbourhood, connecting to St. Francis Xavier Secondary School, Milton District Hospital, Milton Sports Centre, and Milton GO.
- **Issues:** Poor on-time performance, delay at Derry Road to Thompson Road left-turn, large one-way loop: Derry Road Bronte Street, Louis St Laurent Avenue, Farmstead Drive, McLaughlin Avenue, Santa Maria Boulevard.
- **Demand:** Demand south of Louis St Laurent Avenue to the Ford neighbourhood and Elsie MacGill Secondary School.

Exhibit 3.20: Route 8 Willmott Performance and Historical Ridership, 2019-2023

2023 Ridership	52,569
Trips per Revenue Hour	17.0
Population Density in 400m Walking Distance (per h.a.)	40.2
5-Year Population Density Change (2016-2021)	+38%

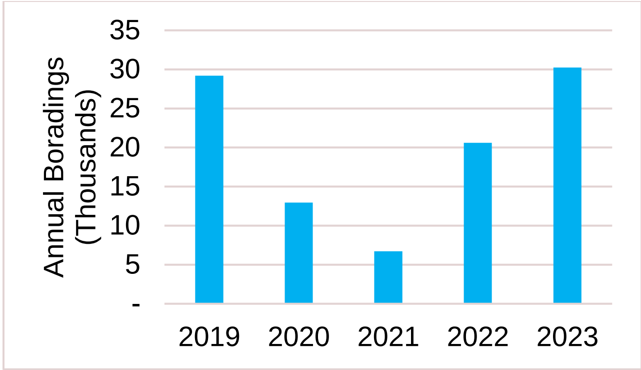


9 Ontario South

- **Function:** Serving demand along Ontario Street, connecting the growing Ford neighbourhood, high-density development at Derry Road, and Allendale Long Term Card Facility to Milton Mall, and Milton GO.
- **Issues:** Low ridership and productivity, area between Derry Road and Louis St Laurent Avenue has no ridership potential.
- **Demand:** Demand east and west near Britannia Road into emerging Ford and Cobban communities.

Exhibit 3.21: Route 9 Ontario South Performance and Historical Ridership, 2019-2023

2023 Ridership	30,244
Trips per Revenue Hour	9.1
Population Density in 400m Walking Distance (per h.a.)	25.1
5-Year Population Density Change (2016-2021)	+60%



3.2.3 Inter-Municipal Routes

21 Steeles

- **Function:** Connecting shoppers (and workers) to Toronto Premium Outlets, workers to industrial and logistics employment such as the Amazon Fulfillment Centre YYZ3, and providing a more frequent link between Milton Transit, MiWay, and Brampton Transit.
- **Issues:** Gaps in stop placement, urban design in industrial areas is not transit-supportive.
- **Demand:** Demand south of Lisgar GO to connect to the MiWay Meadowvale Town Centre terminal.

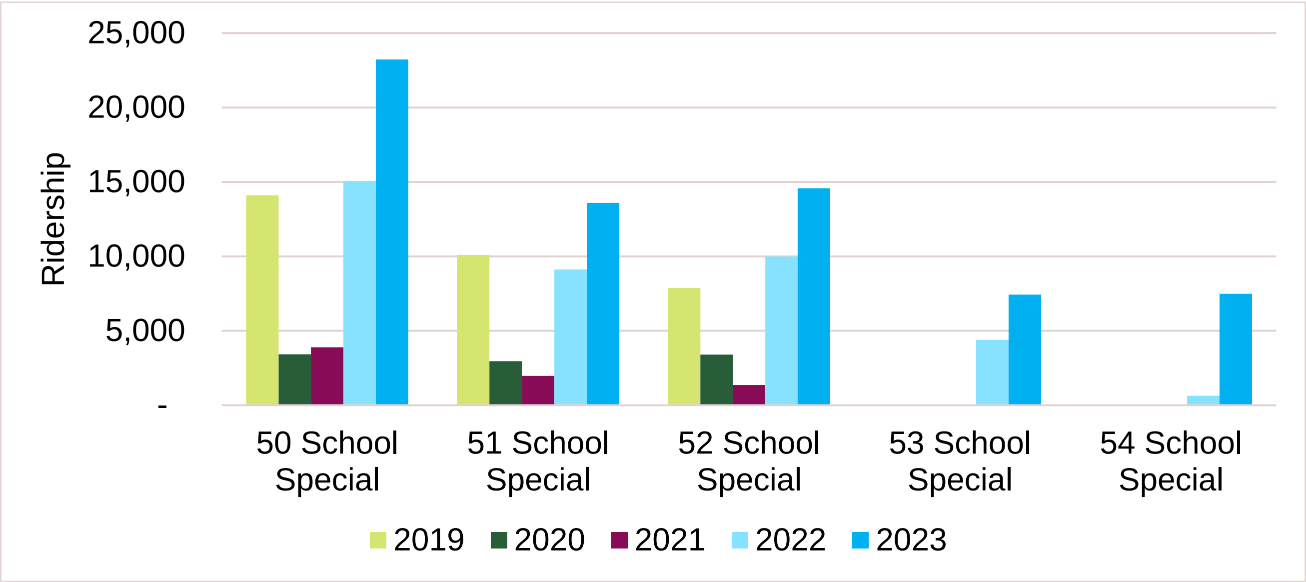
Exhibit 3.22: Route 21 Steeles Performance

2023 Ridership	104,291
Trips per Revenue Hour	13.4
*Population Density in 400m Walking Distance (per h.a.)**	27.5
**Milton residents only*	

3.2.4 School Extras

As Milton Transit is oriented around service to the Milton GO station, the system's conventional routes do not adequately serve most secondary schools. Therefore, Milton Transit offers five special school routes on all instructional school days, Routes 50-54, serving Milton's six public and Catholic secondary schools. The routes are generally designed to cover parts of each school's catchment area not served by regular Milton Transit routes, specifically timed around arrival and dismissal bell times. The historical five-year ridership on each route is provided in Exhibit 3.23 below:

Exhibit 3.23: Historical 5-Year Ridership on School Extras



Source: Milton Transit internal ridership data (2019-2023)

Halton Student Transportation Services provides dedicated school bus service for students more than 3.2 kilometres away from their local secondary school. Milton Transit's School Extras fill the transportation gap for students within the 3.2-kilometre distance while being outside of walking distance, while reducing traffic congestion by reducing reliance on automobiles. The extras also support independence for Milton's youth, allowing them to travel to school safely without a guardian.

While School Extras are highly productive, they create significant inefficiencies for Milton Transit's overall operations. To operate the extras, five buses are required during peak periods which only run for 1-2 hours of revenue service each daily. These buses could otherwise be re-allocated to improve frequency and/or coverage of the local routes throughout the entire week.

Furthermore, operator “split shifts” (shifts with long un-paid mid-day breaks) are less desirable and more difficult to staff.

The five (5) extras are outlined below:

School Special 50

School Special 50 serves the western catchment area of Milton District High School and St. Francis Xavier Secondary School. The route specifically serves the neighbourhoods of Scott and Willmott.

School Special 51

School Special 51 serves the western catchment area of Milton District High School and St. Francis Xavier Secondary School. The route specifically serves the neighbourhoods of Harrison and Willmott.

School Special 52

School Special 52 serves the catchment areas between Craig Kielburger Secondary School and St. Francis Xavier Secondary School, passing through the Coates and Beaty neighbourhoods. St. Kateri Tekakwitha Secondary School will open in September 2024, and is situated along the route at Thompson Road and Louis St Laurent Avenue.

School Special 53

School Special 53 serves the urban catchment area of Elsie MacGill Secondary School. The route travels between Milton GO to the high school, passing through the Harrison and Willmott neighbourhoods to pick up students. Elsie MacGill has later bell times than the other high schools, and this is reflected in the later schedules. The route was introduced in 2022, and ridership was initially than the other School Specials. This can be explained by the school opening in phases, with full grades 9-12 enrollment being achieved in September 2024.

School Special 54

School Special 54 began operating in November 2022 to serve the Craig Kielburger Secondary School and St. Kateri Tekakwitha Secondary School – currently at a temporary location at Whitlock Avenue and Thompson Road, with the permanent location at Thompson Road and Louis St Laurent Avenue opening in September 2024. The route connects the high schools to Milton GO, passing through the Coates and Beaty neighbourhoods. Ridership remains low, but the opening of the permanent location of St. Kateri Tekakwitha Secondary School may induce additional ridership.

3.2.5 Key Takeaways

- Milton Transit's highest-ridership routes in 2023 were 2 Main, 21 Steeles, 6 Scott. When factoring in trips per service hours provided, Milton Transit's most productive routes are 8 Wilmott, 6 Scott, and 7 Harrison. In 2024, initial data suggests Route 1 may eclipse ridership levels on other routes.
- Routes 5 Yates and 9 Ontario South see ridership and productivity notably lower than other conventional routes.
- School Specials are highly-productive services which provide supplemental capacity to transport high school students to and from classes.
- Many local routes include one-way loops which circulate within neighbourhoods. Stops along these loops often see lower ridership.
- On-time performance is low, with an average of 70% across all routes. This is partly a result of the intentional policy choice to hold buses and allow riders to transfer from GO Train or between other routes, even when late.
- There are emerging population and employment areas outside of the Milton Transit's existing service area.

3.3 OnDemand Alternative Service Delivery Review

Milton Transit OnDemand was launched in September 2021, allowing riders to book trips on vehicles which travel dynamically between requested stops using a smartphone app or by phone. OnDemand service connects to conventional transit at specified transfer points, such as Milton GO. The service was designed to be adaptable, using trip origin-destination data to identify travel patterns and support future conversion to conventional transit routes. There are four OnDemand zones in operation: 401 Industrial Zone, Boyne Zone 1, Boyne Zone 2 and Derry Green Zone.

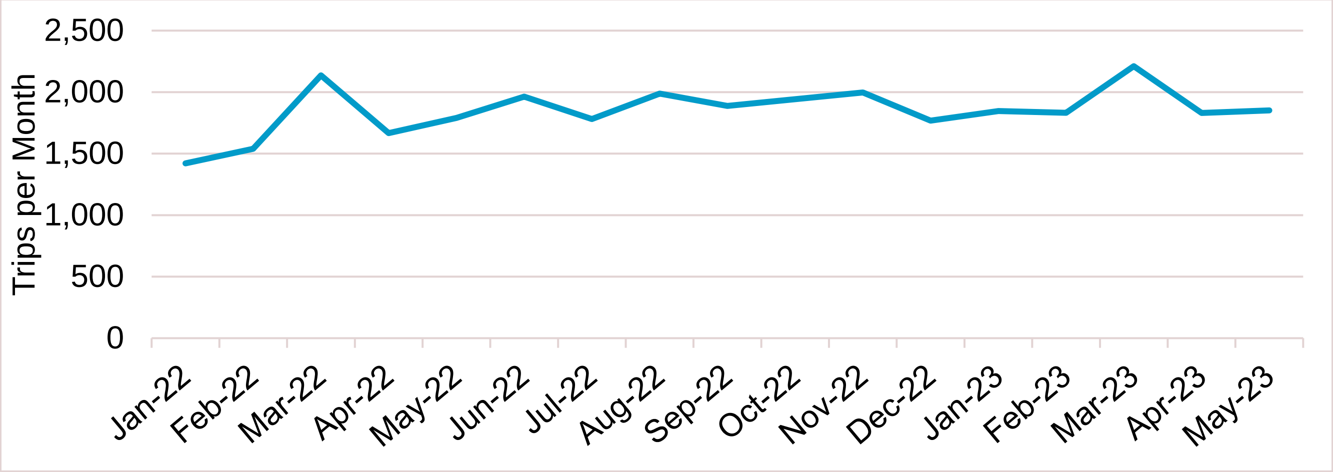
OnDemand service operates "stop to stop", meaning that riders must walk short distances to access the OnDemand vehicle at fixed locations. This approach is more efficient compared to "door to door" operations, as vehicles can maintain more direct routes which avoid excessive circulation through neighbourhood streets. Stops can be physical stops which existing infrastructure (such as a signpost, shelter, seating, etc.) or a "virtual stop" which is indicated in the app but does not have any physical infrastructure.

3.3.1 Ridership Review

401 Industrial Zone

The 401 Industrial Zone services the area which was formerly served by the 1 Industrial fixed route, in the north end of the Town. The zone is bordered approximately by No. 5 Side Road in the north, Main Street East in the south, Industrial Road in the west, and Esquesing Line in the east. The zone has one connection point to the conventional Milton Transit network, at the Milton GO Station. Monthly ridership within the zone is provided in Exhibit 3.24. Initial findings for 2024 show a reduction in OnDemand ridership as a result of Route 1 beginning service and connecting many of the popular origins and destinations within the zone.

Exhibit 3.24: 401 Industrial Zone Trips Per Month



Source: Spare Labs OnDemand ridership data, (Jan 1st 2022 – Jun 1st 2023)

Boyne Zone 1 & 2

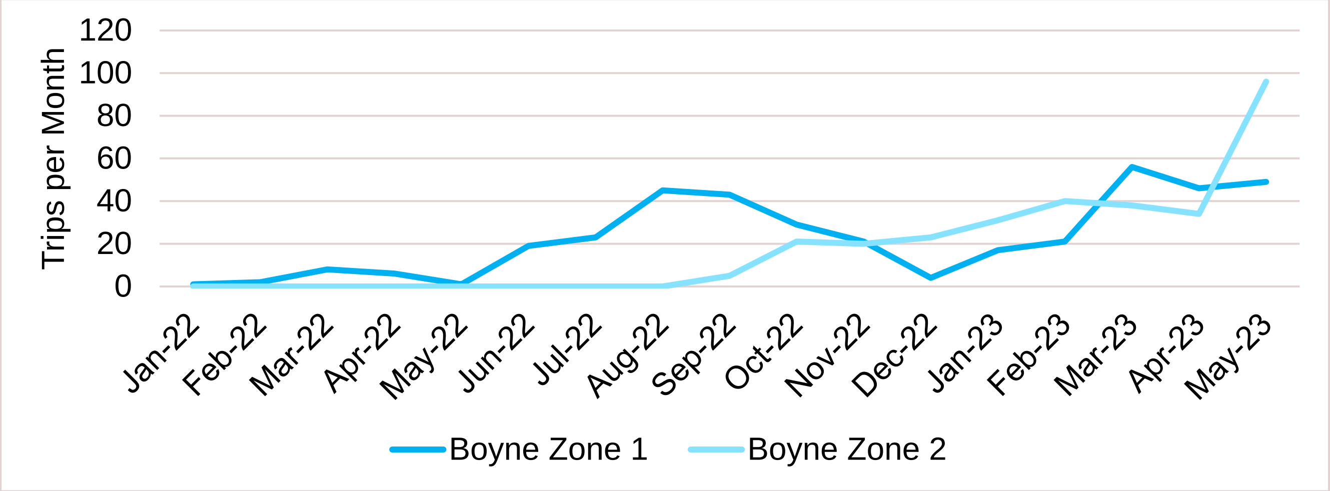
The Boyne Zone is divided into two separate sub-zones, each with their own transfer points. Boyne Zone 1 is located in a residential area bordered by Louis St Laurent Ave in the north, Britannia Rd in the south, Bronte Street South in the west and Thompson Road South in the east. Boyne Zone 2 is located in a residential area bordered by Louis St Laurent Avenue in the north, Britannia Road in the south, Regional Road 25 in the west and the CN Rail freight railway in the east.

The zone serves a quickly-growing residential development, with mixed-density housing and a transit-supportive street grid.

Boyne Zone 1 offers several transfer points onto the conventional Milton Transit network, including at Milton District Hospital, Milton Sports Centre, Commercial St/Derry Rd, and

Kennedy Circle/Bennett Blvd. An additional connection was added to the Mattamy National Cycling Centre (future MEV site) in September 2023. Boyne Zone 2 offers one connection, at Milton District Hospital. Monthly ridership within the zone is provided below in Exhibit 3.25.

Exhibit 3.25: Boyne Zone 1 & 2 Monthly Ridership



Source: Spare Labs OnDemand ridership data, (Jan 1st 2022 – Jun 1st 2023)

Derry Green Zone

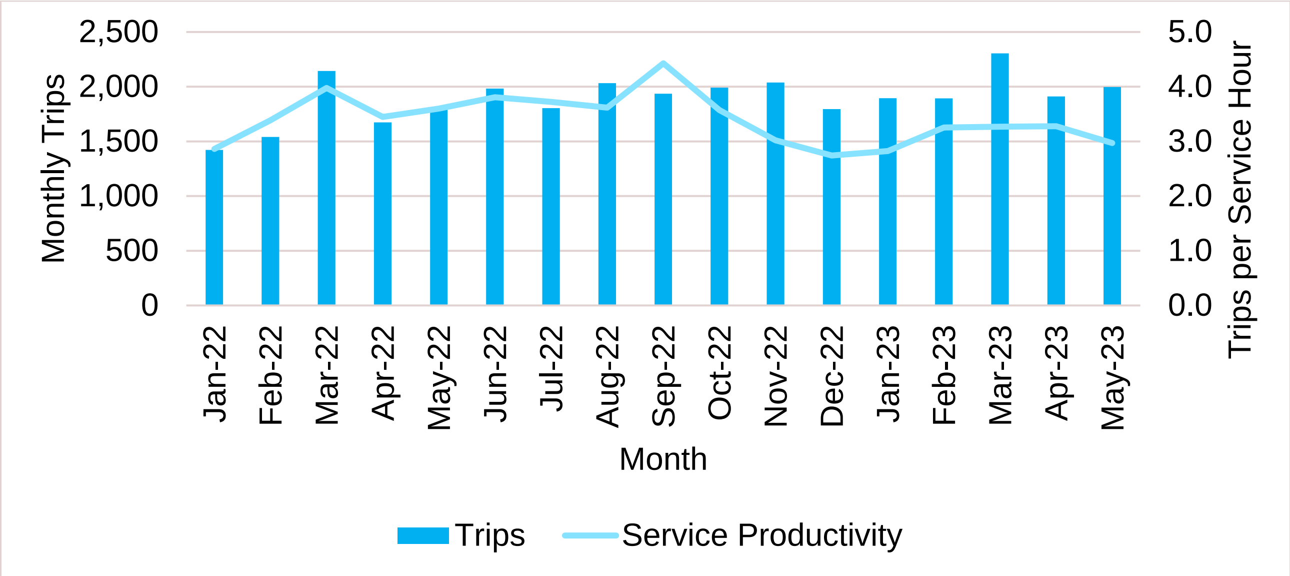
The Derry Green Zone is located in an industrial area centred on 5th Line, bordered by the Highway 401 corridor in the north and Derry Rd W in the south. The zone has one connection point to the conventional Milton Transit network, at Milton GO Station. No trips were recorded within the Derry Green Zone as of June 1st 2023.

Ridership and Productivity Analysis

Trips made using OnDemand have been growing steadily as the service has become more familiar to Miltonians. The busiest month on record was March 2023, which saw 60% more boardings than January 2022.

Despite this growth, the service productivity (trips per service hour) has declined from a peak of 4.4 trips per service hour in September 2022, to no more than 3.3 trips per service hour in 2023 (Exhibit 3.26). This coincides with the introduction of the new Boyne Zone 2, which diverts vehicles away from busier areas and increases the amount of deadheading (non-revenue service) required. The large service areas, outlying locations in Milton, and lack of connections to frequent transit limit the utility, and in turn productivity, of OnDemand service. Transitioning to conventional service in areas which could support it would improve the overall efficiency of the OnDemand service, and reduce operating cost per trip.

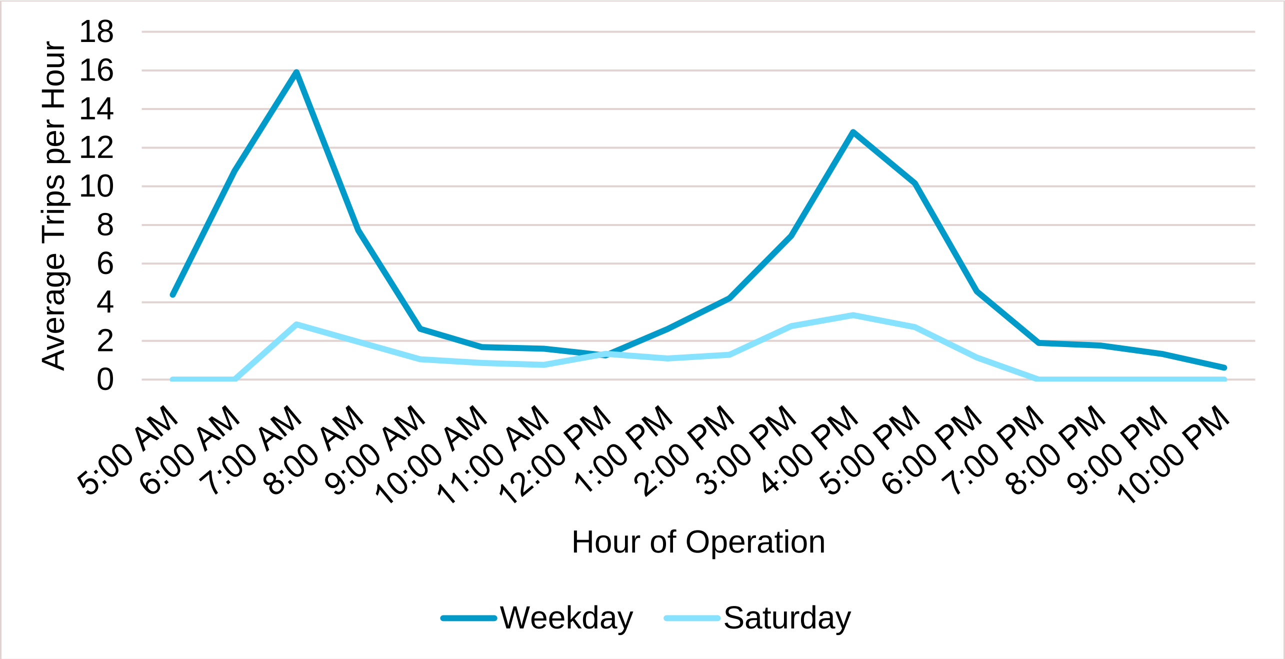
Exhibit 3.26: OnDemand Trips and Service Productivity



Source: Spare Labs OnDemand ridership and service hour data, (Jan 1st 2022 – Jun 1st 2023)

OnDemand reaches a peak average of 15.9 hourly trips on weekdays between 7:00-7:59AM. On Saturdays, a peak average of 3.3 trips occurs between 4:00-4:59PM (Exhibit 3.27).

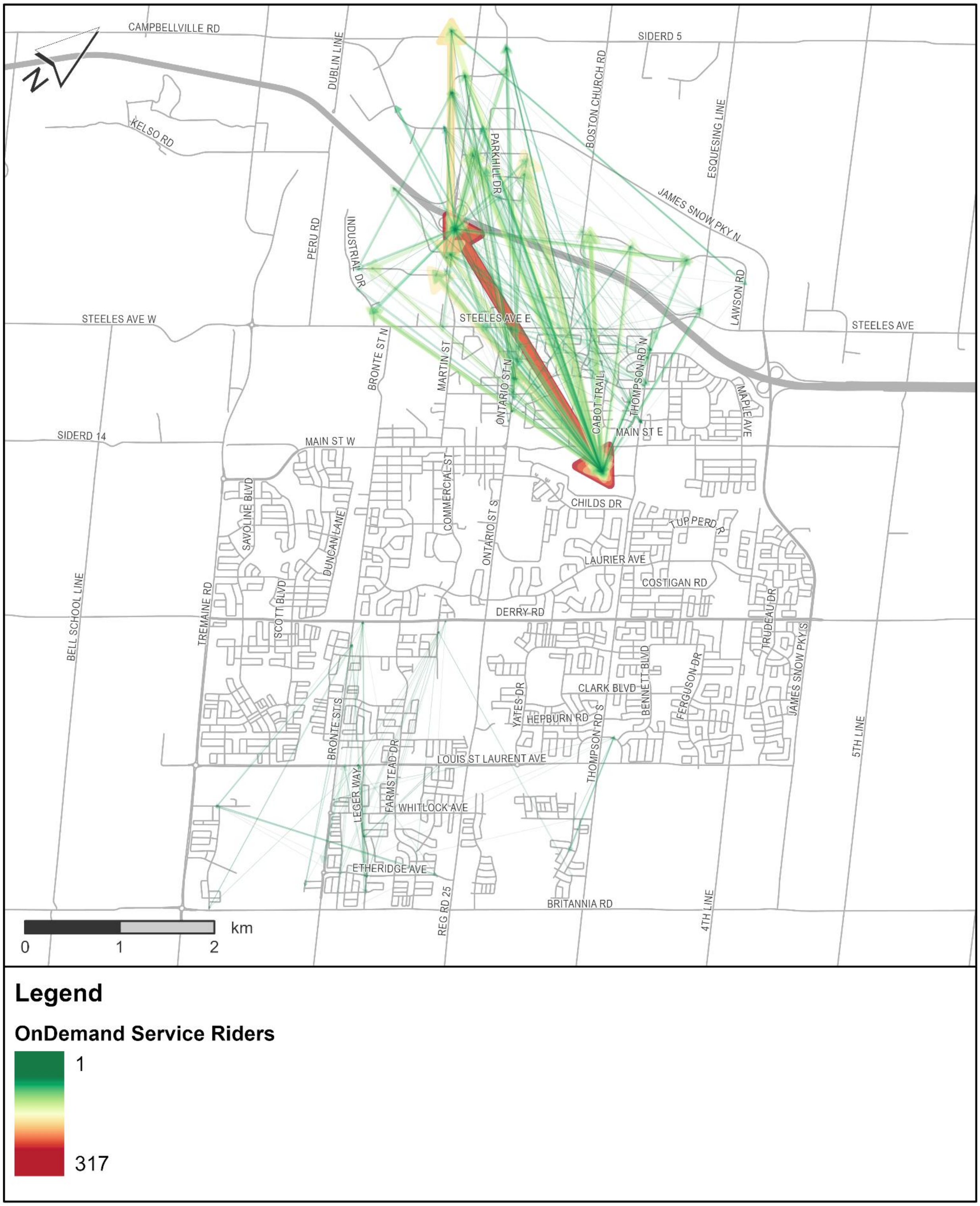
Exhibit 3.27: 2023 OnDemand Average Hourly Trips on Weekdays and Saturday



Source: Spare Labs OnDemand ridership and service hour data, (Jan 1st – Jun 1st 2023)

An origin-destination (O-D) analysis was conducted for OnDemand trips to identify dominant travel flows. The largest O-D pair was Milton GO to/from the GO Transit 401 Park & Ride. Additional major flows were noted from Milton GO to stops along Regional Road 25 and Parkhill Drive. The addition of Route 1 provides much-needed fixed route service between many of the main O-D pairs, relieving demand on the system to be able to reliably service other trips. Exhibit 3.28 shows that the vast majority of demand was within the 401 Industrial Zone, with occasional trips being made in the Boyne Zones to/from Milton Hospital and Milton Sports Centre.

Exhibit 3.28: Travel Flows for OnDemand Trips (Jan 1st – Jun 1st 2023)



Source: Milton Transit internal ridership data, (Jan 1st – Jun 1st 2023)

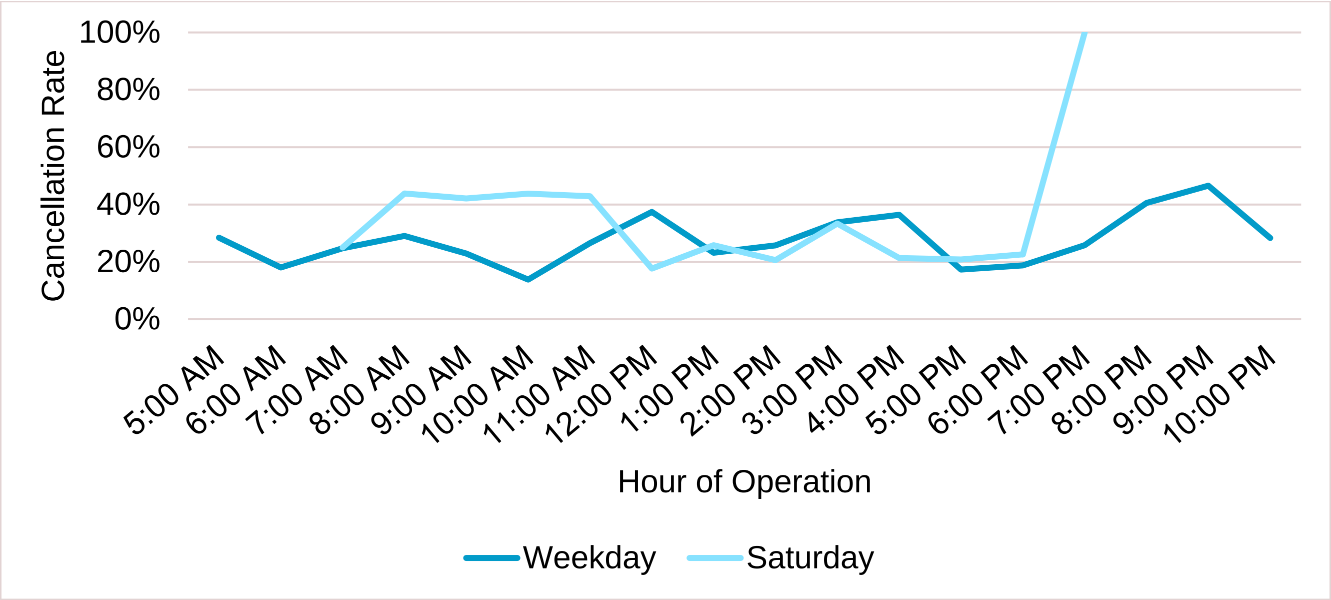
3.3.2 Service Reliability

Trip Cancellations

Cancellation of trips was investigated to determine the reliability of OnDemand service (Exhibit 3.29). A "cancellation" was defined as any trip which did not occur as scheduled, regardless of rider, driver, or system fault. This includes reasons such as rider no-shows, lack of driver availability, and schedule changes. Trip cancellation rates are generally related to the supply of service (number of active vehicles) relative to trip demand.

The cancellation rate was overall high, with a weekday peak average of 47% cancelled trips between 9:00-9:59PM. On Saturdays, the cancellation rate hovered above 40% between 8:00-11:59AM. Both instances are likely due to reduced service at these times, and may point to periods where service can be augmented in the future.

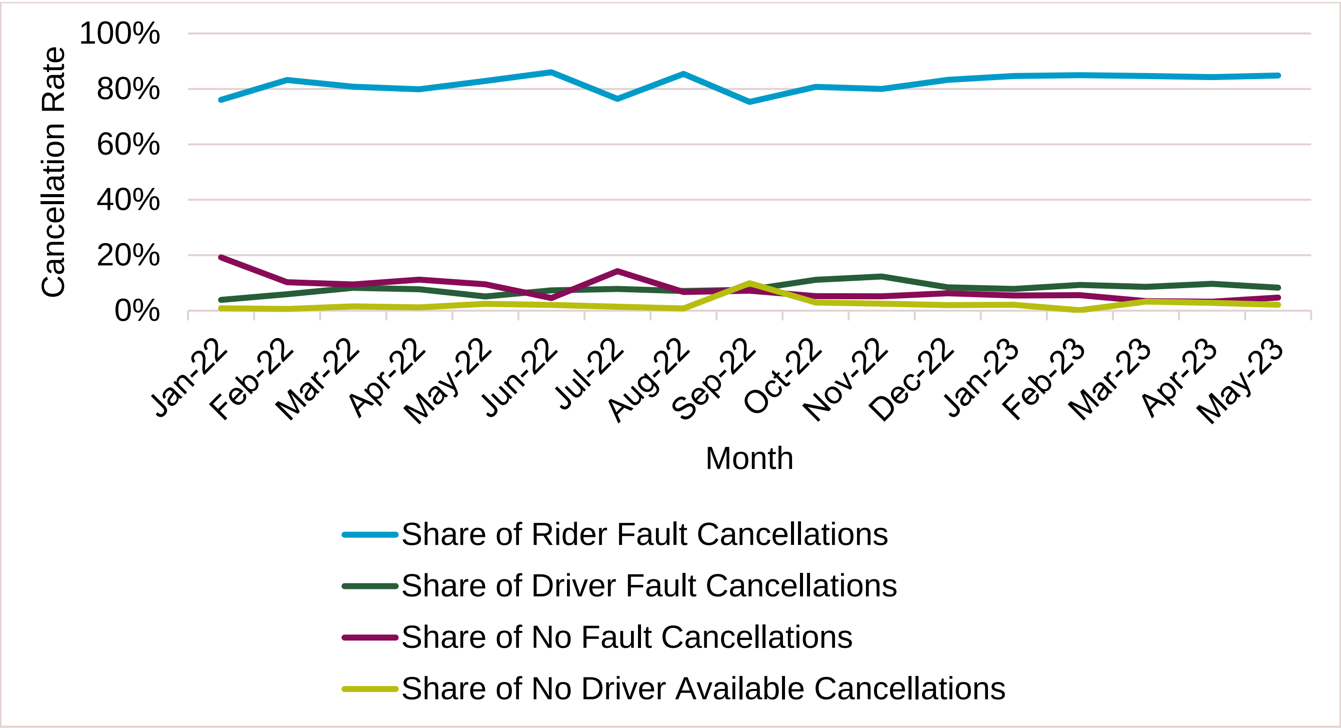
Exhibit 3.29: OnDemand Trip Cancellation Rate on Weekdays and Saturday



Source: Spare Labs OnDemand trip data, (Jan 1st – Jun 1st 2023)

The monthly trip cancellation rate has held steady, yet high, fluctuating between 25-30%. Broken down by reasons for cancellation, "rider fault" was overwhelmingly most common, between 75-85% of total cancellations (see Exhibit 3.30). It should be noted that anecdotally, OnDemand transit trip bookings are often cancelled by the rider if they cannot secure a convenient trip. Therefore a "rider fault" cancellation could still be influenced Town or operator policies or actions, such as the supply of additional service to improve trip matching rates.

Exhibit 3.30: Trip Cancellation Rate

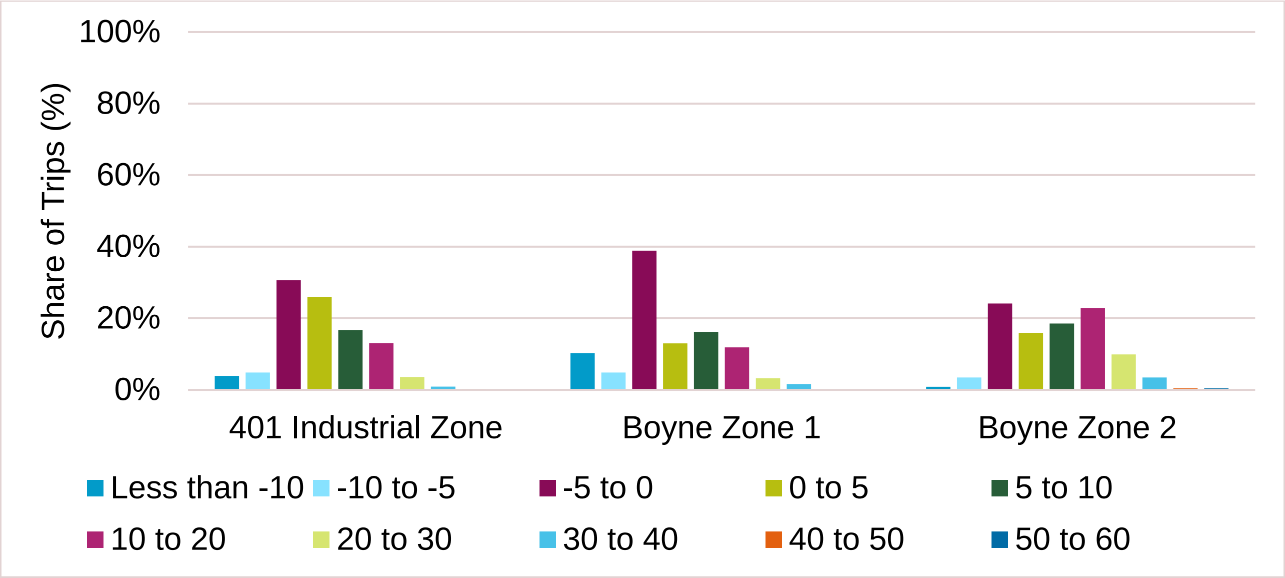


Source: Spare Labs OnDemand trip data, (Jan 1st 2022 – Jun 1st 2023)

On Time Performance

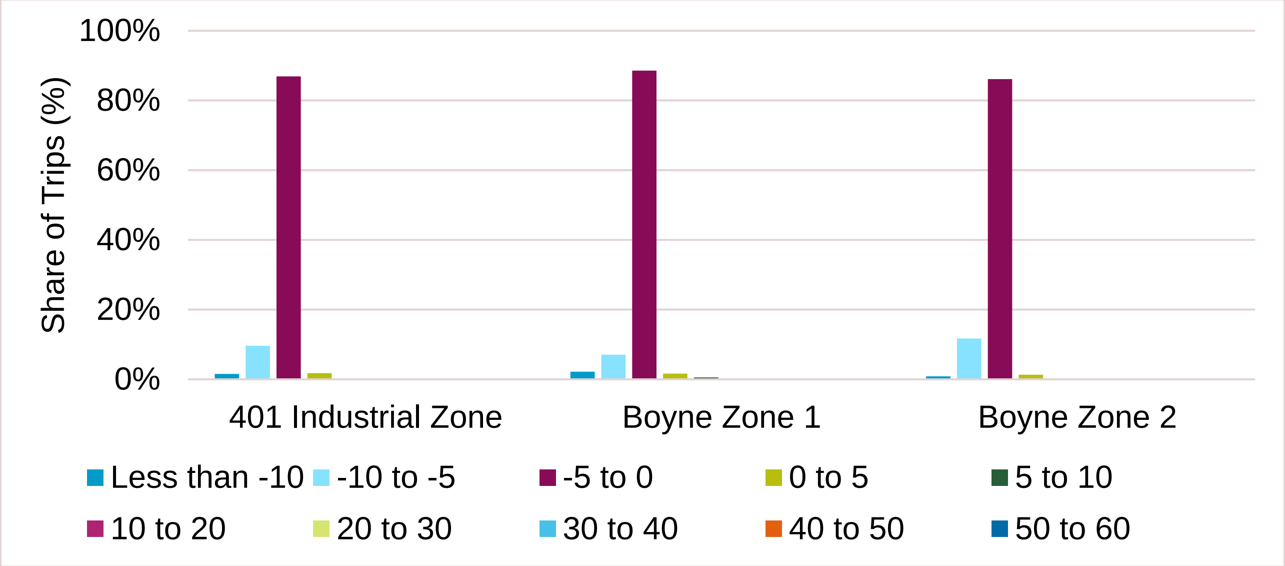
Trip on-time performance (OTP) was analyzed using 2023 data. Exhibit 3.31 provides a histogram of schedule adherence to requested pick-up time by zone. Requested pick-up time is the time which the rider had initially requested, prior to being given a confirmed scheduled pick-up time. Scheduled pick-up time is analyzed in Exhibit 3.32, and Scheduled OTP rates are significantly higher than Requested OTP. This points to limitations of the service to meet rider travel demand, rather than the ability of the back-end dispatching software to provide reliable service. Milton Transit’s existing OTP service standards are discussed in Section 6.1, although these are not specific to OnDemand service.

Exhibit 3.31: Deviation from Requested Pick-up Time by Zone (minutes)



Source: Spare Labs OnDemand trip data, (Jan 1st – Jun 1st 2023)

Exhibit 3.32: Deviation from Scheduled Pick-up Time by Zone (minutes)

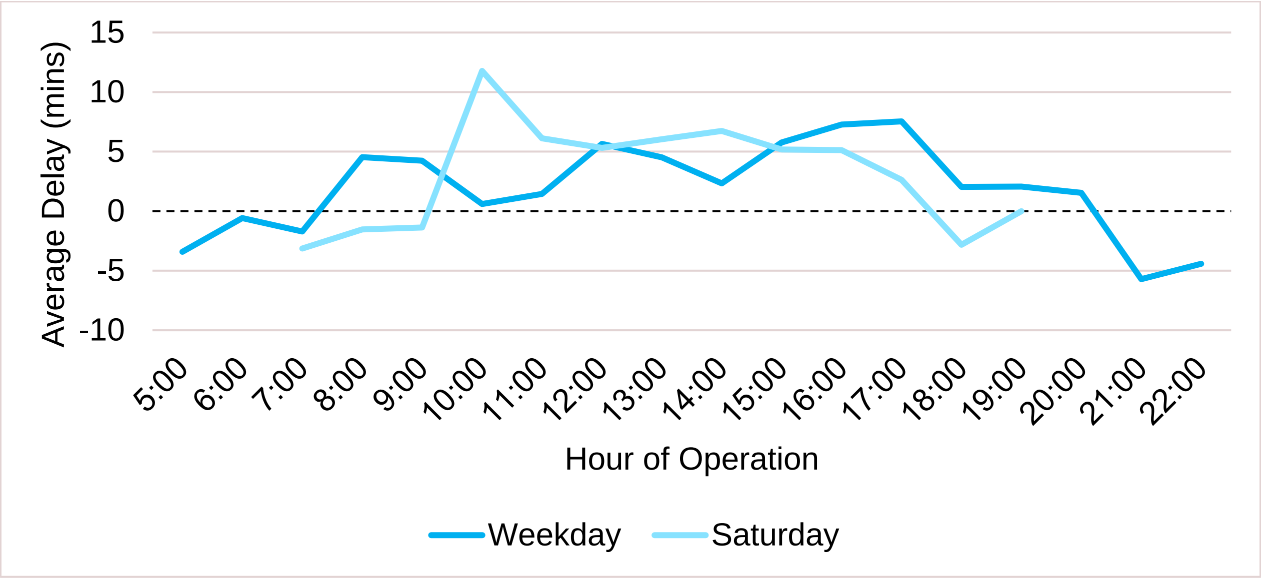


Source: Spare Labs OnDemand trip data, (Jan 1st – Jun 1st 2023)

The average delay (based on requested pick-up time) was calculated on an hourly basis to determine when the system struggles most to meet trip demand. Delay is not only influenced by overall trip demand, but also deliberate policy choices which are reflected in the trip matching software algorithm. For example, increasing rates of shared trip pooling by allowing further route deviations reduces operating costs and reduces waiting time, but impacts the directness (in-vehicle travel time) and uncertainty of delay due to longer trips.

Weekday average delays were more apparent in the PM rush hour. On Saturdays, an average delay of over 10 minutes was observed between 10:00AM-10:59AM, with generally worse delays than during the week throughout the day. (Exhibit 3.33).

Exhibit 3.33: OnDemand Average Requested Trip Delay on Weekdays and Saturday



Source: Spare Labs OnDemand trip data, (Jan 1st – Jun 1st 2023)

3.3.3 Key Takeaways

- **Ridership has been increasing** on the OnDemand system as riders familiarize themselves with the technology. Route 1, which began operating in January 2024, provides fixed route service which strongly aligns with existing OnDemand travel patterns, reducing demand and increasing reliability for remaining OnDemand riders.
- OnDemand zones exist at opposite ends of the urban periphery, which **impacts the performance and efficiency of comingled operations** with access+ service.
- The Boyne Zone is experiencing significant population growth, and **the existing service offers limited utility** (no direct connection to a transfer point, less chance of a vehicle being nearby), resulting in low ridership. **Conventional service in the Boyne area** will be better suited to provide a more convenient service and provide capacity for anticipated transit demand.

- The service is designed to **prioritize coverage and access over directness and reliability**, which limits the ability of the OnDemand service to meet riders' expectations for time-sensitive trips such as commuting.

3.4 Transit Investment Strategy

To fund the service recommendations contained within the Five-Year Service Plan and implement the change called for in the previous section. it is crucial that the Town's investment in transit service be reviewed. The Transit Investment Strategy proposed below is a measured and pragmatic approach which balances the Town's operational and fiscal realities with the need to support the Town's strategic objectives using enhanced transit service.

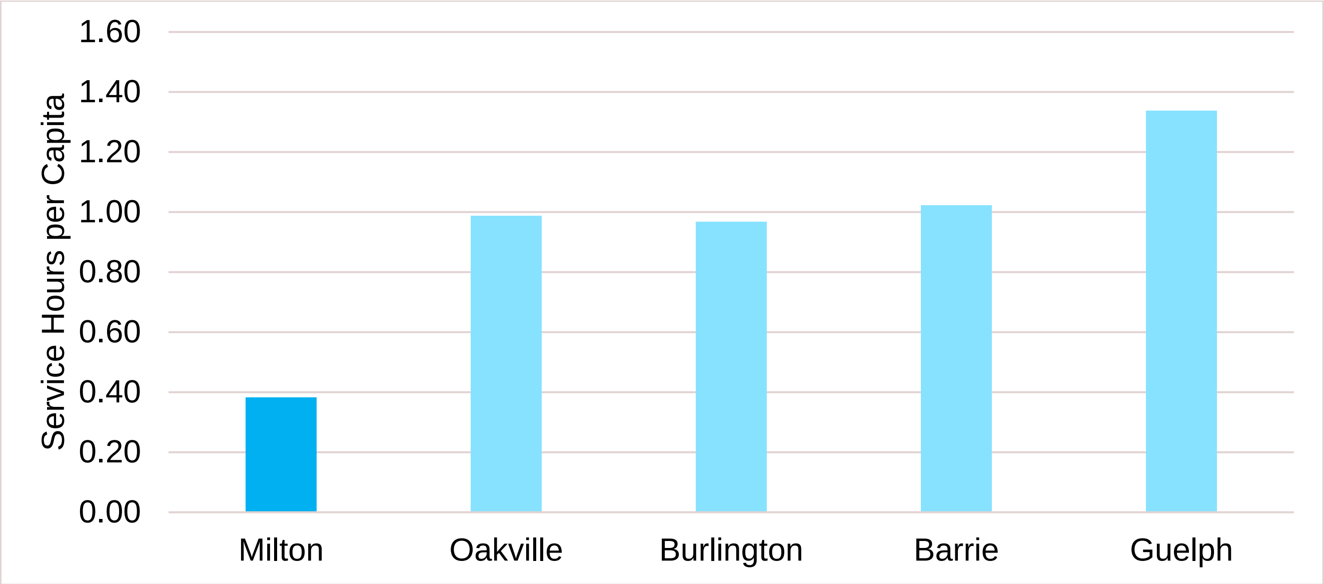
3.4.1 Peer Review

The peer analysis of transit investment below illustrates how other municipalities of a similar size invest in transit. Peers below are similar to Milton on the basis of population size, geography and travel patterns:

- Oakville
- Burlington
- Barrie
- Guelph

Service investment data indicates Milton is operating significantly less service than its peers when adjusted for population. The "service hour per capita" metric measures the quantity of transit service provided annually (in service hours), divided by the total population. In 2019, Milton Transit operated 0.38 conventional transit service hours per capita, compared to a peer average of 1.08 (Exhibit 3.34).

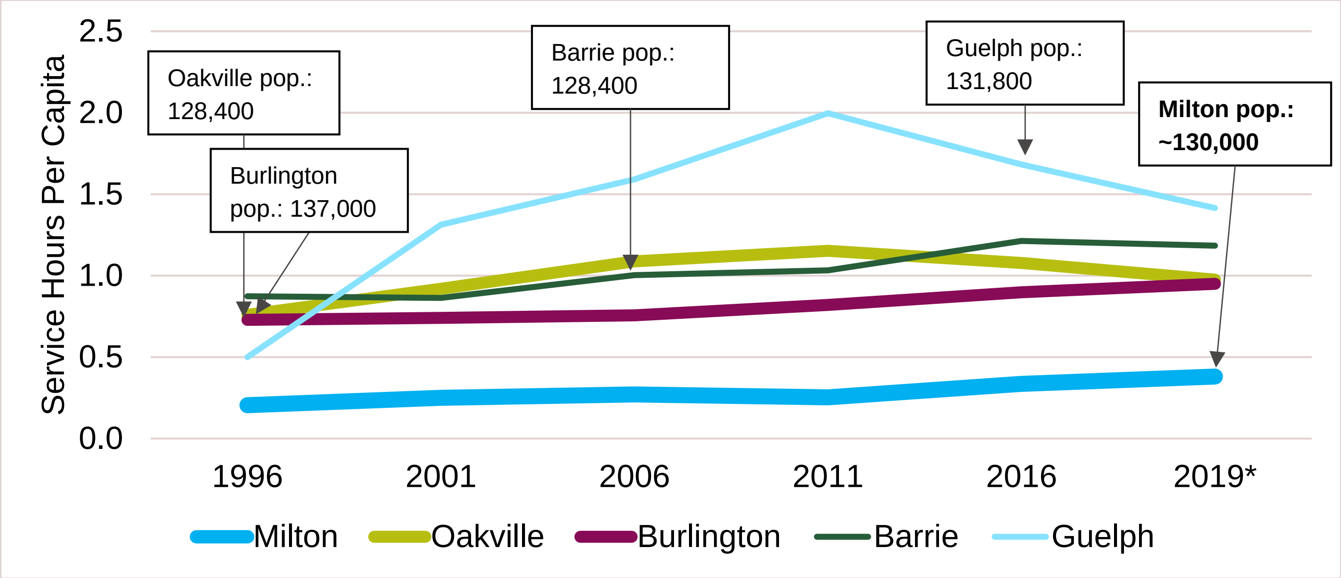
Exhibit 3.34: Service Hours Per Capita for Milton and Similar Municipalities (2019)



Source: CUTA Fact Book (2019)

Furthermore, historical transit investment levels of peers were investigated to understand how investment has changed over time as communities have grown. Exhibit 3.35 shows that even when peer municipalities of Burlington and Oakville were of a similar size to Milton (in 1996), they operated nearly double the per-capita amount of transit service. Today, this gap has widened to 2.5 times the service for these peers.

Exhibit 3.35: Service Hours Per Capita for Milton and Similar Municipalities (1996-2019)



*Source: CUTA Fact Book, 1996-2019 (*2019 data used to reflect most recent data not affected by COVID-19 impacts)*

3.4.2 Investment Scenarios

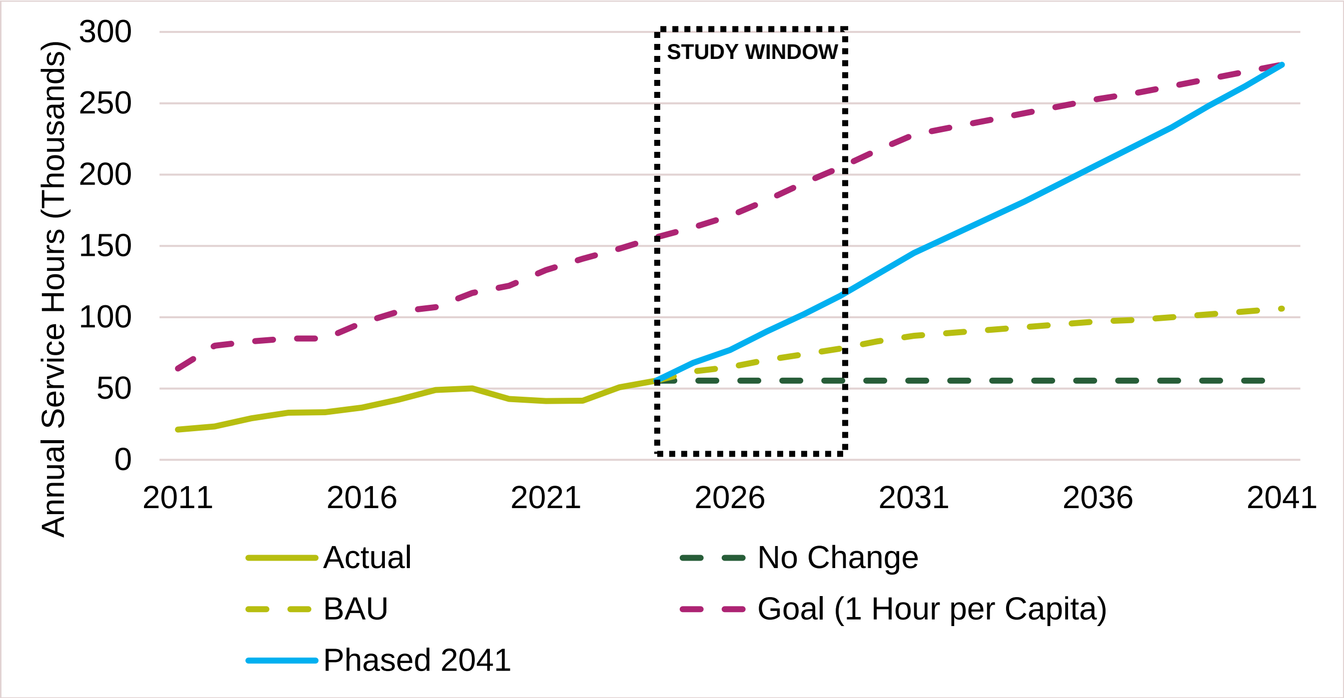
To enable the service levels required for Milton to become the transit-supportive environment which it's 2051 Vision calls for, it is necessary that the Town strives to harmonize investment levels with peers and aim for a goal of **one (1) service hour per capita**.

Achieving this goal would provide Milton Transit with the ability to enhance its transit services to meet community needs. Examples of realistic improvements which could be implemented at this level of service investment include:

- Frequent 15-minute service on key routes to improve connections to GO Transit and local routes.
- Service later into the night to support shift workers.
- Service on Sundays to meet essential mobility needs.
- Wider geographic coverage for new communities.
- Schedules with realistic runtimes to improve service reliability and schedule adherence.
- New regional connections to attract employment and workforce to Milton.

In light of Milton's rapid population growth, reaching this one (1) service hour per capita goal by 2029 would require a quadrupling of Town operating investment in transit service, along with capital investments in fleet and garages to provide the service. It was determined that it would not be operationally feasible to meet the service hour goal by the end of this Five-Year Plan. Therefore, an alternative scenario was developed to reach the goal by **2041,** with the near-term objective of **doubling Town investment in conventional transit service by 2029**, as shown in Exhibit 3.36.

Exhibit 3.36: Historical/Projected Service Hours by Transit Investment Scenario (2011-2041)



Source: CUTA Fact Book (1996-2022), Milton Transit internal service hour budgets (2023-2024)

3.4.3 Key Takeaways

- Milton's peers are operating, and investing in, **significantly more transit service**, even when adjusted for population.
- Even when Milton's peers were the **size of Milton today**, they continued to historically invest much more in transit on a per-capita basis.
- A short-term target was set of **doubling Town investment in fixed route transit service** by 2029 (the final year of the Plan).
- A long-term goal was established to achieve **"1 service hour per capita"** of transit service invested by the Town by 2041.

3.5 Regional Transit Connections

Regional transit service is offered to Milton residents, connecting them to numerous destinations across the GTHA. Transit services include GO Bus, GO Train, and Milton Transit (via Route 21 Steeles, I partnership with Halton Hills), providing connections to shopping centres, post-secondary institutions, downtown Toronto, and other major transit hubs such as Finch Bus Terminal, Square One GO, and Union Station. Exhibit 3.37 and Exhibit 3.38 below detail the current transit routes that service Milton, key destinations and weekday frequency including AM peak, PM peak, and non-peak service.

Exhibit 3.37: Map of Regional Transit Servicing Milton GO

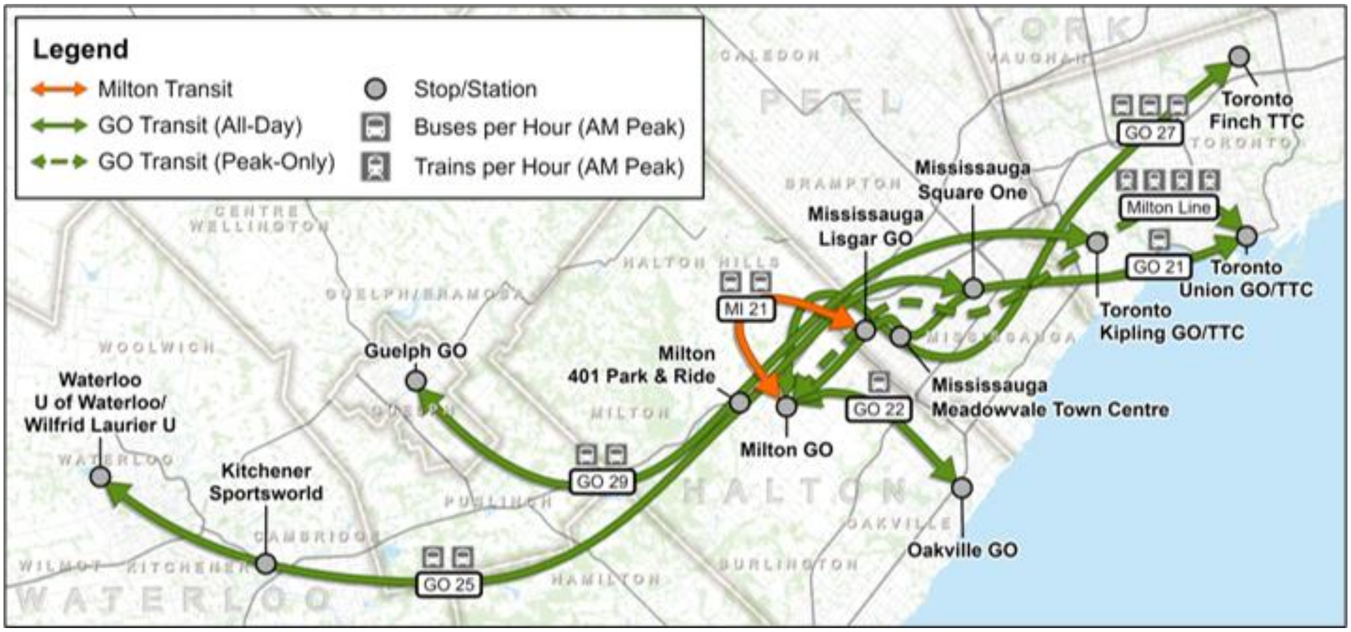


Exhibit 3.38: Regional Transit Routes Servicing Miltion GO

Route	Direction	Key Destinations	Weekday Frequency (AM Peak)	Weekday Frequency (PM Peak)	Weekday Frequency (Non-Peak)
GO 21	East Towards Union Station and West Towards Milton GO	Square One, Union Station	1 Bus per Hour (Westbound Only)	1 Bus per Hour (Eastbound Only)	1 Bus per Hour (Eastbound), 2 Buses per Hour (Westbound)[2]
GO 22	South Towards Oakville GO and	Sheridan College, Oakville GO	1 Bus per Hour (per direction)	1 Bus per 2 Hours (per direction)	N/A

[2] Representative of services at Milton GO, higher frequencies provided east of Milton.

Route	Direction	Key Destinations	Weekday Frequency (AM Peak)	Weekday Frequency (PM Peak)	Weekday Frequency (Non-Peak)
	North Towards Milton GO				
GO 25	East Towards Square One	Toronto Premium Outlets, Square One	1 Bus per Hour	2 Buses per Hour[3]	2 Buses per Hour
GO 25	West Towards University of Waterloo	University of Waterloo, Wilfrid Laurier University	2 Buses per Hour	1 Bus per Hour	1 Bus per Hour
GO 27	East Towards Finch Bus Terminal and West Towards Milton GO	Yorkdale Mall, Finch Bus Terminal (Connection to TTC and YRT)	3 Buses per Hour (per direction)	2 Buses per Hour (per direction)	1 Bus per Hour (Westbound Only)[4]
GO 29	West Towards Guelph GO	University of Guelph	2 Buses per Hour	1 Bus per Hour	1 Bus per Hour
GO 29	East Towards Kipling Bus Terminal	Square One, Kipling Bus Terminal (Connection to TTC and MiWay)	1 Bus per 2 Hours	2 Buses Hour	1 Bus per Hour
Milton Line	West towards Milton GO and East Towards Union Station	Union Station, Kipling Station (Connection to TTC and MiWay)	4 Trains per Hour (Eastbound Only)	3 Trains per Hour (Westbound Only)	N/A

[3] Some non-express trips provided on Thursdays and Fridays only.

[4] Representative of services at Milton GO, higher frequencies provided east of Milton.

Route	Direction	Key Destinations	Weekday Frequency (AM Peak)	Weekday Frequency (PM Peak)	Weekday Frequency (Non-Peak)
MI 21	East towards Lisgar GO and West towards Milton GO	Toronto Premium Outlets	2 Buses per Hour (per direction)	2 Buses per Hour (per direction)	2 Buses per Hour (per direction)

Integration with Milton Transit

To maximize convenience and utilization of regional transit connections, strong linkages must exist to the local transit network. Milton Transit operates 30-to-60-minute frequencies on the majority of its routes, meaning it can be difficult for riders to connect to regional services within a reasonable timeframe without significant effort to align schedules. In the case of the Milton Line GO Train service, trains depart every 15-20 minutes in the peak hour, while most routes are operating 30-minute headways during this period. This means it may not be possible to take the rider's desired train, and on the return journey, long waits for the Milton Transit bus to travel home. Therefore, more frequent service enhances not only local journeys within Milton, but also enables convenient regional connections.

The Town is engaged in advocacy efforts to support 2-Way All-Day (2WAD) service on GO Transit's Milton Line. The implementation of 2WAD will be a catalyst for an increased level of connections at Milton GO, with Milton Transit acting as the first/last-kilometre connection to regional rail service.

3.5.1 Key Takeaways

- Milton is currently serviced by several GO services, including the Milton Line GO Train, that connect the community to the rest of the GGH.
- Given Milton Transit's current low-frequency local service, transfers to/from regional services presents challenges for customers, and more frequent local service would enable easier transfers.
- Regional service offerings offer robust coverage in the near-term to accommodate regional travel to neighbouring municipalities.
- The Town of Milton continues to advocate to Metrolinx and the Province for enhanced regional transit services to serve its residents.

3.6 Recommended Service Plan

Based on the needs identified in the sections above, a recommended service plan was developed for Milton Transit.

3.6.1 Conventional Transit Needs

The recommended 2029 Transit Network seeks to address the following needs, identified within Sections 2, 3, 4, and 5:

- Schedules which improve Milton Transit's ability to meet its on-time performance standards.
- Service coverage in new and developing neighbourhoods and employment areas.
- More direct routes to increase the speed and convenience of transit service.
- New transfer points to enable cross-town travel without requiring routing through Milton GO Station.
- Increased service span to support travel needs on evenings and weekends.
- More frequent service on major corridors which support higher-density communities.
- Build on post-pandemic ridership growth by enhancing the overall attractiveness of the transit service.

To establish the amount of service which would be allocated to transit needs, the service hour target of "1 service hour per capita by 2041" was applied. Based on this target, the 2029 service hour allocation from the Town is 115,000. When combined with estimated post-secondary service requirements to MEV and other satellite campuses, as well as assumed expanded contribution from Halton Hills for service growth on route 21 (based on 50% cost share), the total service hour allocation for 2029 is 161,700 service hours.

These needs were summarized into a series of key drivers, provided in the table below (Exhibit 3.39):

Exhibit 3.39: Key Drivers of Conventional Transit Needs

Network Design Drivers	Service Level Drivers
• More direct routes which are bi-directional where possible • Plans for an MEV transit hub • Potential for second transit hub in south-east Milton • New communities and employment areas on urban periphery	• Expansion of service coverage • Improved on-time performance • Sunday service • Weekday and Saturday service span expansion • Conversion of OnDemand services into conventional routes where appropriate • Post-secondary enrollment estimates • Growing traffic congestion and delay

Working sessions with Milton Transit staff were held regarding network design and its key drivers, and a preference emerged for a re-designed network with the opportunity to enhance frequency on key routes where possible while maintaining a balance of reasonable service coverage within the town. Several rounds of revisions were made to the network to develop the best solution based on the key drivers above.

3.6.2 Proposed 2029 Network

The proposed network for 2029 is outlined below (see Exhibit 3.40).

The new network is designed to reflect changing travel patterns, and enable local trips beyond Milton GO station. It features two new transfer points, at the future Milton Education Village (Britannia/Tremaine), and in the Kennedy Circle area (Thompson/Louis St Laurent), along with new east-west routes along Derry Road and Louis St Laurent Avenue. The network also features more frequent service along the major corridors of Main Street, Bronte Street, and Thompson Road. The proposed service levels are provided in Exhibit 3.41.

Exhibit 3.40: Proposed 2029 Milton Transit Network

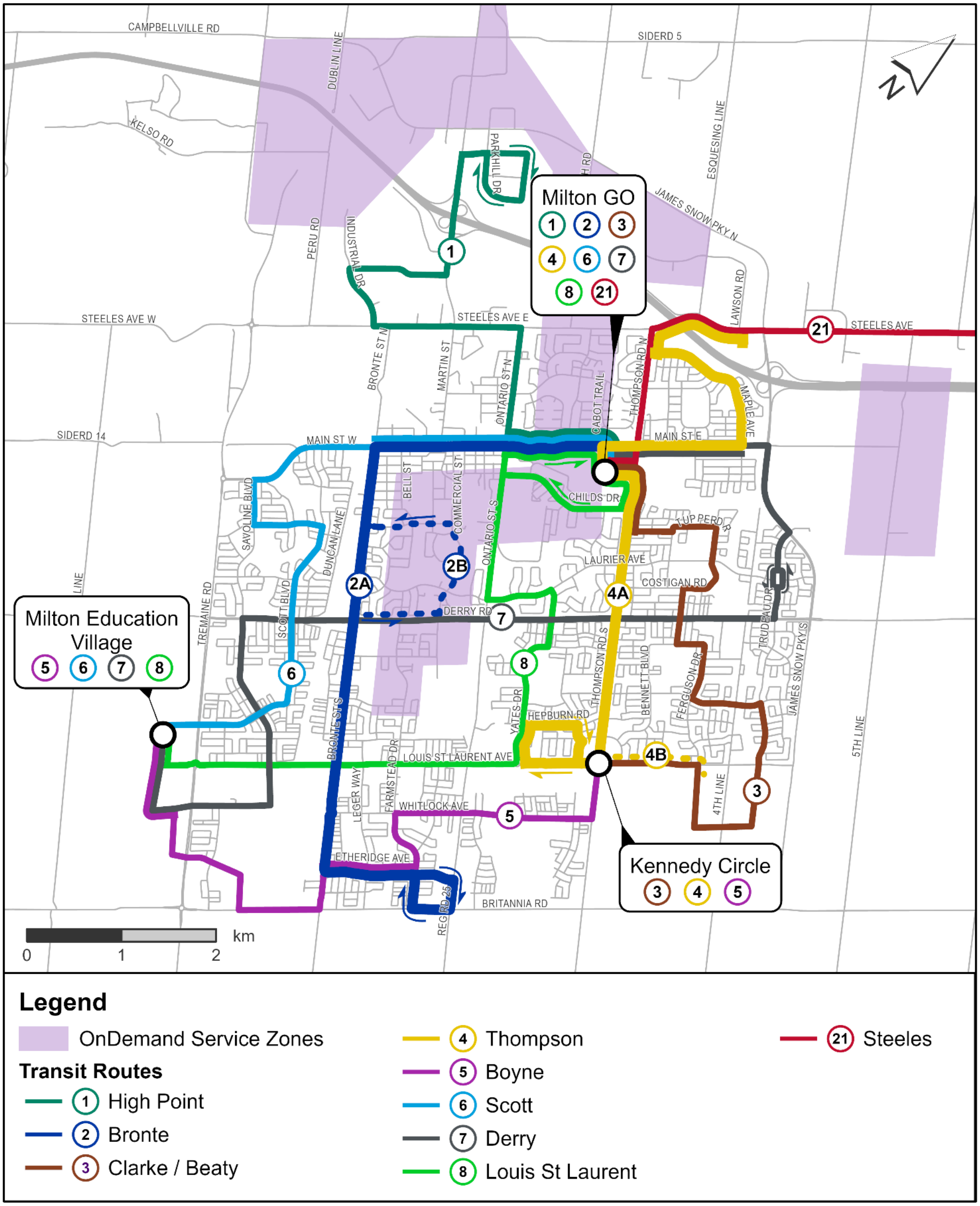


Exhibit 3.41: Proposed Service Levels for Milton Transit (2029)

Route*	Weekday AM/PM Peak	Weekday Off-Peak (Early AM, Mid-PM, Late PM)	Saturday	Sunday
1 High Point	20	30	30	30
2 Bronte	10^	20	30	30
2A via Bronte	15	20	30	30
2B via Commercial	30	-	-	-
3 Clarke/Beaty	30	30	30	30
4 Thompson	15	20	30	30
4A via Hepburn	30	20	30	30
4B via Ferguson	30	-	-	-
5 Boyne	30	30	30	30
6 Scott	30	30	30	30
7 Derry	20	30	30	30
8 Louis St Laurent	30	30	30	30
21 Steeles	35	35	35	35
Monday-Friday: 5:30AM-11:30PM Saturday: 6:30AM-11:30PM Sunday: 7:00AM-7:00PM				

**Note: Route names are conceptual and subject to change. ^Maximum frequency achieved on overlapping route segments during limited peak periods.*

The new network will provide the following benefits:

- Buses running along major corridors every 15-20 minutes on weekdays
- Buses running at least every 30 minutes, week-long, across all local routes
- Expanded operating hours, with weekday and Saturday service until 11:30PM
- Introduction of Sunday service from 7:00AM to 7:00PM
- Fixed route service to replace existing OnDemand service in the Boyne area

To understand sensitivity of service levels to the proposed U-Pass program (discussed in Section 8.3.2), an alternate service plan was developed. This service plan, shown in Exhibit

3.42, assumes no U-Pass program, and outlines how route frequencies and service spans could likely change as a result of reduced investment. Service reductions are bolded – many routes would revert to hourly service on weekends, and peak frequency would be reduced on Route 1. Service span would also decrease to similar hours to today, in addition to Sunday service operating the same hours as today's Saturday service.

Exhibit 3.42: Proposed Service Levels for Milton Transit (2029) Without U-Pass

Route*	Weekday AM/PM Peak	Weekday Off-Peak (Early AM, Mid-PM, Late PM)	Saturday	Sunday
1 High Point	**30**	30	30	**60**
2 Bronte	10^	20	30	**60**
2A via Bronte	15	20	30	**60**
2B via Commercial	30	-	-	**-**
3 Clarke/Beaty	30	30	**60**	**60**
4 Thompson	15	20	30	**60**
4A via Hepburn	30	20	30	**60**
4B via Ferguson	30	-	-	**-**
5 Boyne	30	30	**60**	**60**
6 Scott	30	30	30	**60**
7 Derry	20	30	**45**	**45**
8 Louis St Laurent	30	30	**60**	**60**
21 Steeles	35	35	35	35
Monday-Friday: 5:30AM-**10:30PM** Saturday: **7:00AM-7:00PM** Sunday: 7:00AM-7:00PM				

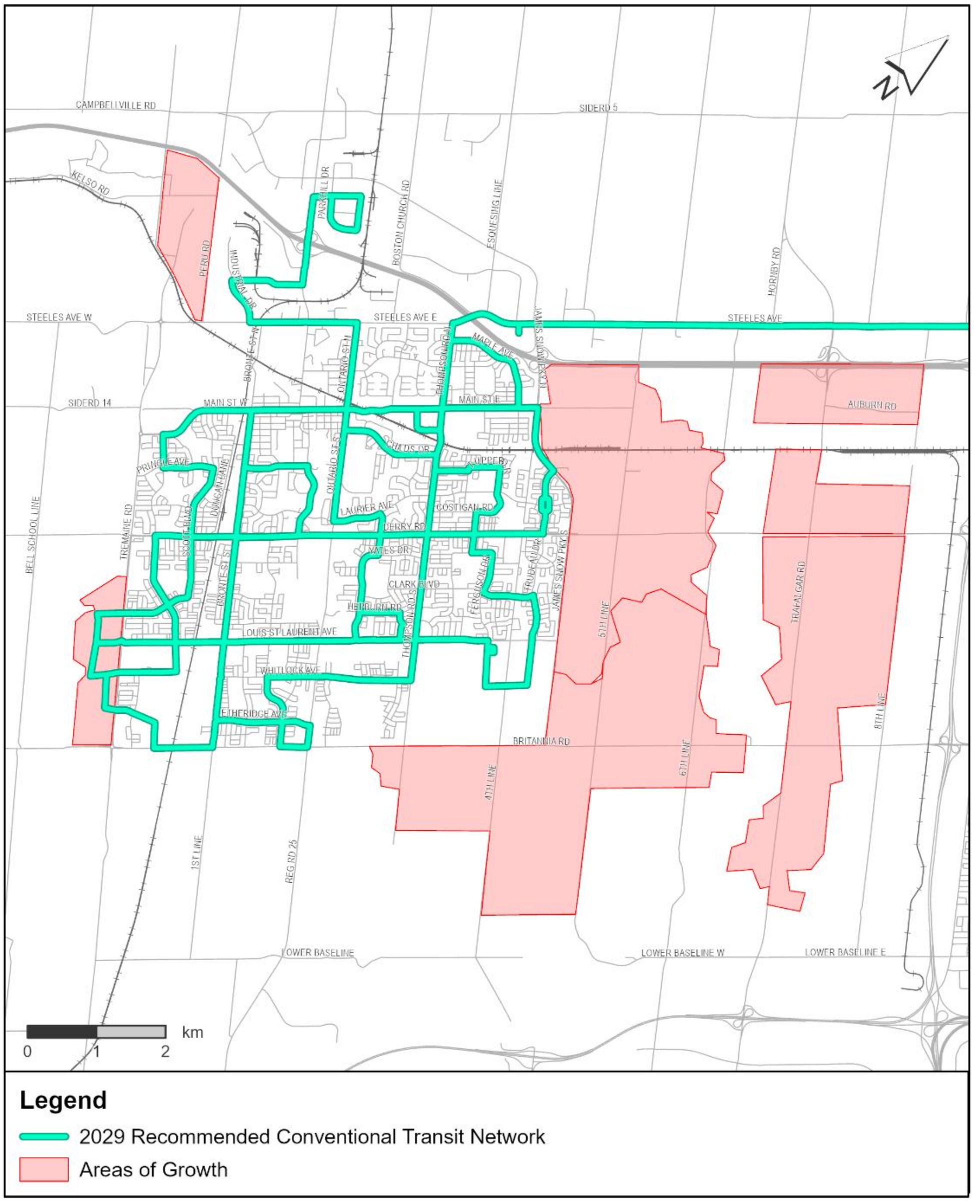
**Note: Route names are conceptual and subject to change. ^Maximum frequency achieved on overlapping route segments during limited peak periods.*

3.6.3 Additional Service Design Considerations

Urban Expansion Area Services

In addition to the local transit network, it was acknowledged that new transit services will be required to serve new growth areas being developed in Milton in the next 5-10 years. These include the mixed-use and residential areas of Milton Education Village (MEV), Trafalgar, Britannia, Milton Heights, and employment/industrial areas of Derry Green and Agerton. Conceptual transit routes are outlined in Exhibit 3.43 below.

Exhibit 3.43: Conceptual New Transit Services to Serve Milton Urban Expansion Areas



Service hours have been allocated separately to begin to operate transit service in these growth areas. Regional population projections estimate that over 30,000 residents and nearly 27,000 jobs will be situated in these areas by 2031. As developments are subject to uncertain timelines, the assumption is that growth area transit services would begin in 2027, but flexibility is built into the plan if development is delayed.

As Milton's urban boundary grows towards Mississauga and Oakville, it is expected that the need for cross-boundary services will increase. It is recommended that routes serving urban expansion areas are planned for potential connections into terminals in Mississauga and Oakville. Potential terminal locations include:

- Meadowvale Town Centre (Mississauga)
- City Centre / Square One (Mississauga)
- Erin Mills Transitway Station (Mississauga)
- Trafalgar Road & Highway 407 GO Park & Ride (Oakville)
- Palermo Terminal (Oakville, planned)
- Oakville Trafalgar Memorial Hospital (Oakville)

Employment Transportation

Existing industrial areas are largely served by OnDemand transit, which may be limited in effectiveness for future shift-based employment needs. OnDemand vehicles have limited capacity and productivity, while shift timings require a high volume of workers to access their places of employment in a narrow window of time. The possibility of an Employer Pass fare program is explored in Section 8.3.4- this program could be used to create a sustainable pool of fare revenue which would in turn be used to fund enhanced fixed-route transit service to participating employment areas.

3.6.4 Network Phasing

The 2029 Proposed Network would be implemented in three phases, to reflect the following factors and constraints:

- Annual service hour growth
- Available fleet
- Fleet storage capacity (i.e. Town-owned Garage discussed in Section 7.1)
- Post-secondary student enrollment
- New land developments
- Construction of new transit terminals (discussed in Section 7.4.3)

The three (3) phases of network implementation are as follows:

Phase 1 (September 2025 Implementation)

The first phase is designed to be implementable with the existing fleet complement as of September 2025. The network includes the following changes relative to the existing network (see Exhibit 3.44):

- **1 High Point** is extended to Market Drive (Milton Transit may implement this change in 2024-2025 prior to Phase 1)
- **2 Main**'s western segment and **8 Willmott** are replaced by new **2 Bronte**
- **4 Thompson/Clark** and **2 Main**'s eastern segment are replaced by new **4 Thompson/Crossroads**
- **5 Yates** and **9 Ontario South** are replaced by new **8 Louis St. Laurent**
- **6 Scott** routing is altered to service Sherwood Community Centre and cycle time is extended to 45 minutes
- **7 Harrison** routing is altered to use Thompson Road instead of Ontario Street and cycle time is extended to 45 minutes – interlined with **6 Scott**
- **3 Trudeau, 21 Steeles** are maintained
- Reduction of 1 **School Extra**, due to new direct service along Bronte to Elsie MacGill and St. Francis Xavier Secondary Schools.
- New **Central Zone** including the Dorset Park neighbourhood, Childs Drive, stops served by limited-service **Route 2B**, and the Willmott neighbourhood
- **401 Industrial Zone** is extended to Milton Heights area (pending development)
- Service in **Boyne Zone** is removed where/when fixed route service exists
- **Sunday service** from 7:00AM-7:00PM
- Minor extension of Monday-Saturday service span

Exhibit 3.44: Phase 1 Network Changes

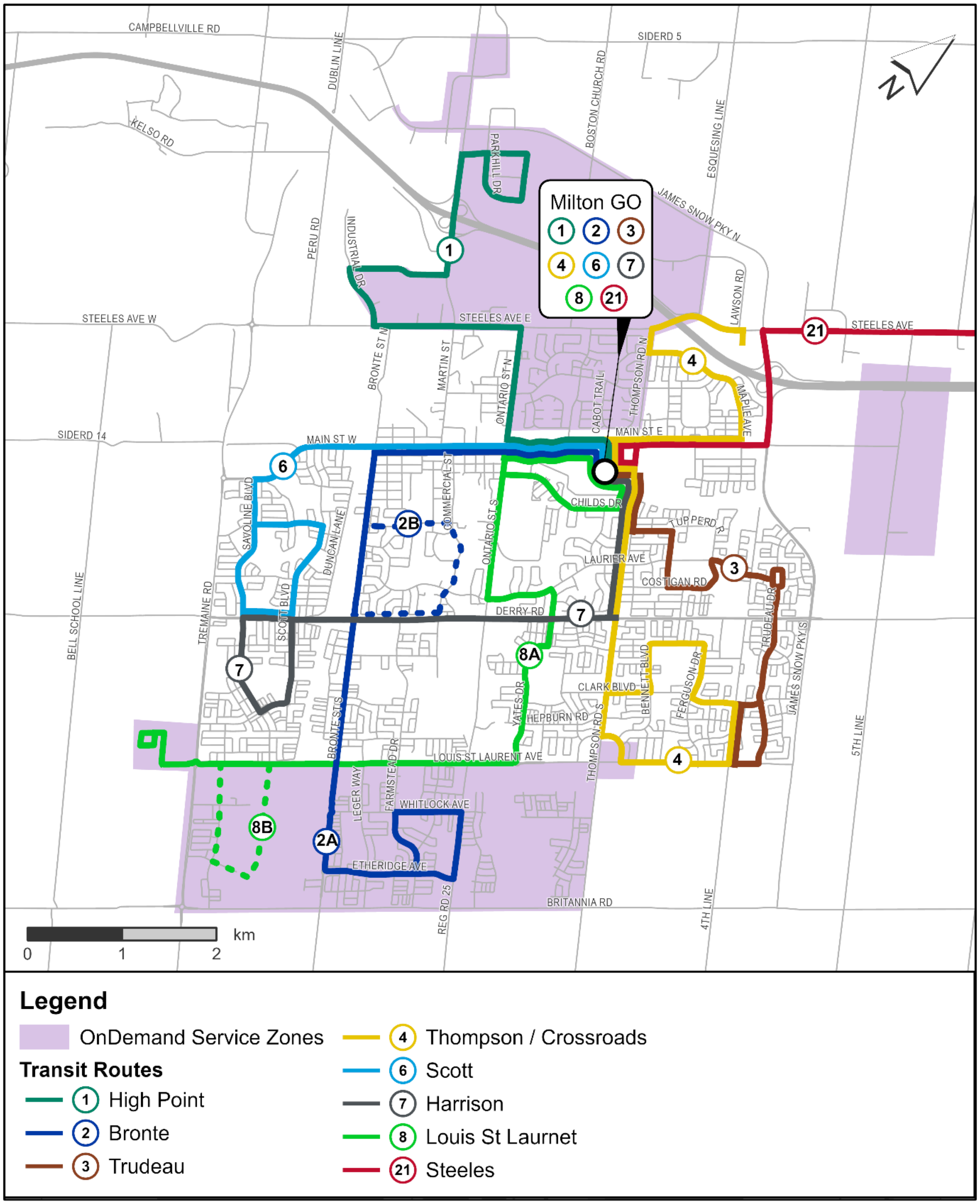


Exhibit 3.45 below outlines the service levels for each route and overall service span. Changes from the existing network are bolded.

Exhibit 3.45: Phase 1 Service Levels and Overall Service Span

Route*	Weekday AM/PM Peak	Weekday Off-Peak (Early AM, Mid-PM, Late PM)	Saturday	Sunday
1 High Point	20	**30**	60	**60**
2 Bronte	**15^**	**30**	**30**	**30**
2A via Bronte	**30**	**30**	**30**	**30**
2B via Commercial	**30**	**-**	**-**	**-**
3 Trudeau	30	30	30	**30**
4 Thompson/Crossroads	**30**	**30**	**30**	**30**
6 Scott	30	**30**	**30**	**45**
7 Harrison	30	**30**	**30**	**45**
8 Louis St Laurent	**30**	**30**	**60**	**60**
21 Steeles	35	35	35	35
Monday-Friday: 5:30AM-10:30PM Saturday: 6:30AM-10:30PM Sunday: 7:00AM-7:00PM				

**Note: Route names are conceptual and subject to change. ^Maximum frequency achieved on overlapping route segments during limited peak periods.*

Phase 2 (September 2027 Implementation)

The second phase would occur two years after Phase 1, to implement additional changes in the route network to move towards the overall 2029 Proposed Network design. The initiation of the U-Pass agreement will be instrumental in providing additional service hours to enable this phase. This network includes the following changes relative to Phase 1 (see Exhibit 3.46):

- **3 Trudeau** is replaced by new **3 Clarke/Beaty** and cycle time is extended to 45 minutes – interlined with **6 Scott**
- **4 Thompson/Crossroads** is renamed **4 Thompson** as new service pattern becomes more familiar with riders

- New **5 Boyne** route is implemented to replace the **Boyne Zone**. Provision for this route to be interlined with **4 Thompson**
- **7 Harrison** is extended along Derry Road to Trudeau Drive, James Snow Parkway, and Main Street, and renamed **7 Derry**
- **1 High Point, 2 Bronte, 6 Scott, 8 Louis St Laurent, 21 Steeles, School Specials** and **OnDemand Zones** are maintained
- Extension of Monday-Saturday service span to 11:30PM
- Informal transfer points at the **Mattamy National Cycling Centre** (future MEV site) and **Kennedy Circle** area

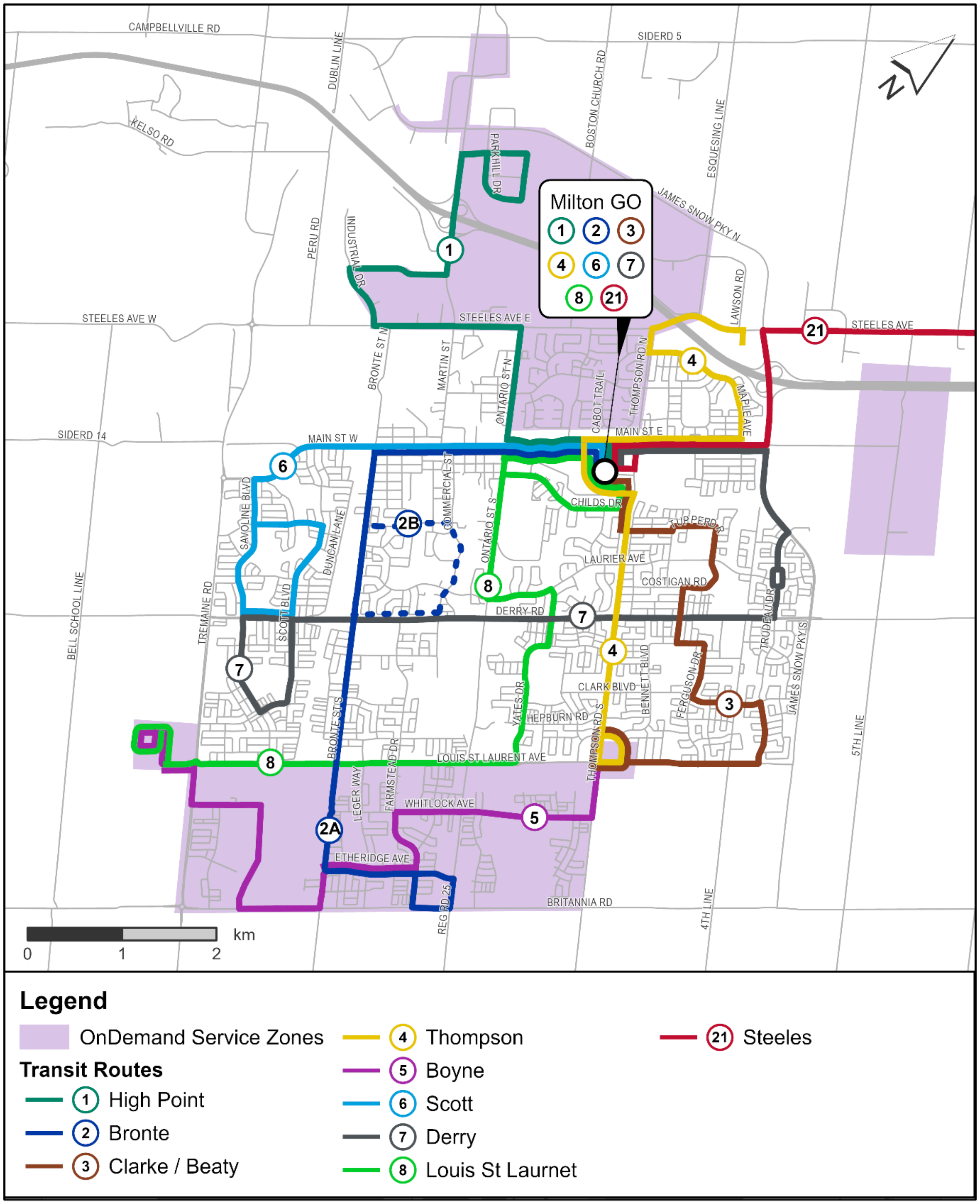
Exhibit 3.47 below outlines the service levels for each route and overall service span. Changes from the existing network are bolded.

Exhibit 3.46: Phase 2 Service Levels and Overall Service Span

Route*	Weekday AM/PM. Peak	Weekday Off-Peak (Early AM, Mid-PM, Late PM)	Saturday	Sunday
1 High Point	20	30	60	60
2 Bronte	15^	30	30	30
2A via Bronte	30	30	30	30
2B via Commercial	30	-	-	-
3 Clarke/Beaty	**30**	**30**	**30**	**30**
4 Thompson	**20**	30	30	30
5 Boyne	**30**	**30**	**60**	**60**
6 Scott	30	30	30	**30**
7 Derry	**30**	**30**	**30**	**30**
8 Louis St Laurent	30	30	60	60
21 Steeles	35	35	35	35
Monday-Friday: 5:30AM-**11:30PM** Saturday: 6:30AM-**11:30PM** Sunday: 7:00AM-7:00PM				

**Note: Route names are conceptual and subject to change. ^Maximum frequency achieved on overlapping route segments during limited peak periods.*

Exhibit 3.47: Phase 2 Network Changes



Phase 3 (September 2029 Implementation)

The final phase would occur in September 2029 to coincide with the opening of the Milton Education Village and near-doubling of post-secondary student enrollment. This phase would implement the final changes to complete the 2029 Proposed Network. The network includes the following changes relative to Phase 2:

- **3 Clarke/Beaty** extended along Trudeau Drive, Whitlock Avenue, and Ferguson Drive to serve new development in the area south of Louis St Laurent Avenue
- **4 Thompson** split into a "A/B" branch service to serve the Coates area with **4A** and Craig Kielburger and St. Kateri Tekakwitha Secondary Schools with limited-service branch **4B**
- **6 Scott** extended to the MEV Terminal
- **7 Derry** extended to the MEV Terminal
- **1 High Point, 2 Bronte, 5 Boyne, 8 Louis St Laurent, 21 Steeles,** and **OnDemand Zones** are maintained
- Reduction of 2 **School Extras** due to frequent service and increased capacity to secondary schools during bell times
- Formal establishment of **Frequent Service** on **Route 2** and **Route 4**
- Formal establishment of **30-Minute Base Service** on all routes
- Terminals at the **MEV** and **Kennedy Circle** area open

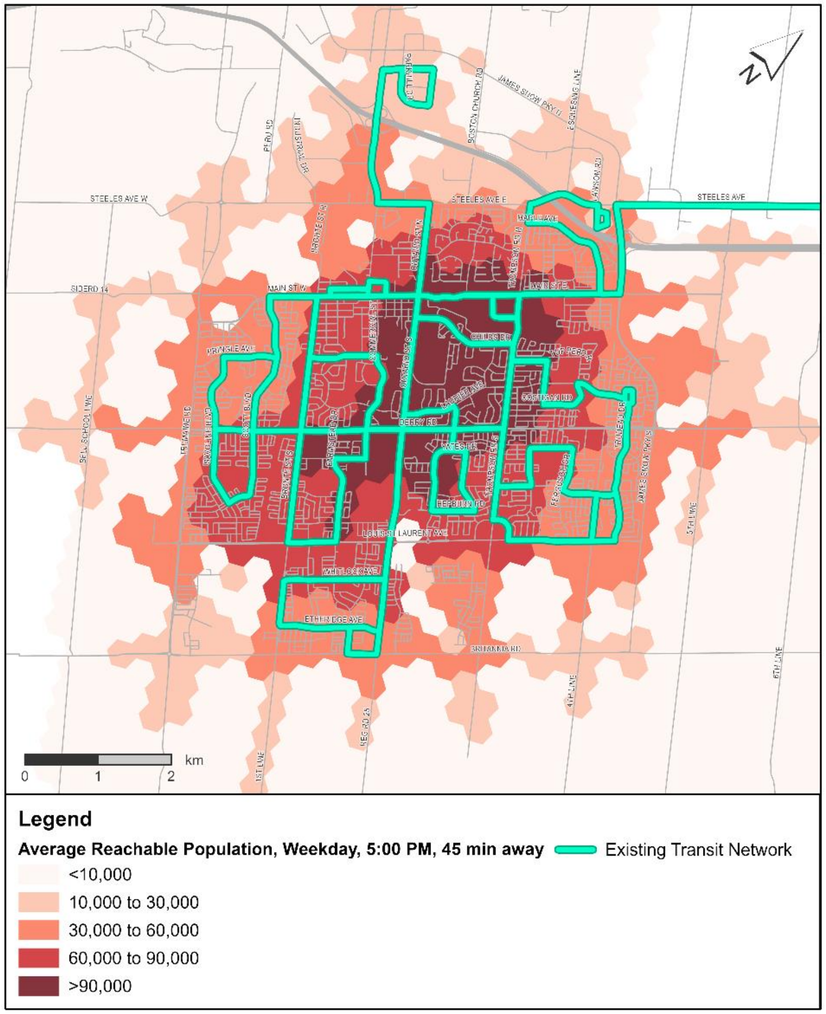
The route network map and service levels for Phase 3 are provided above in Section 3.6.2.

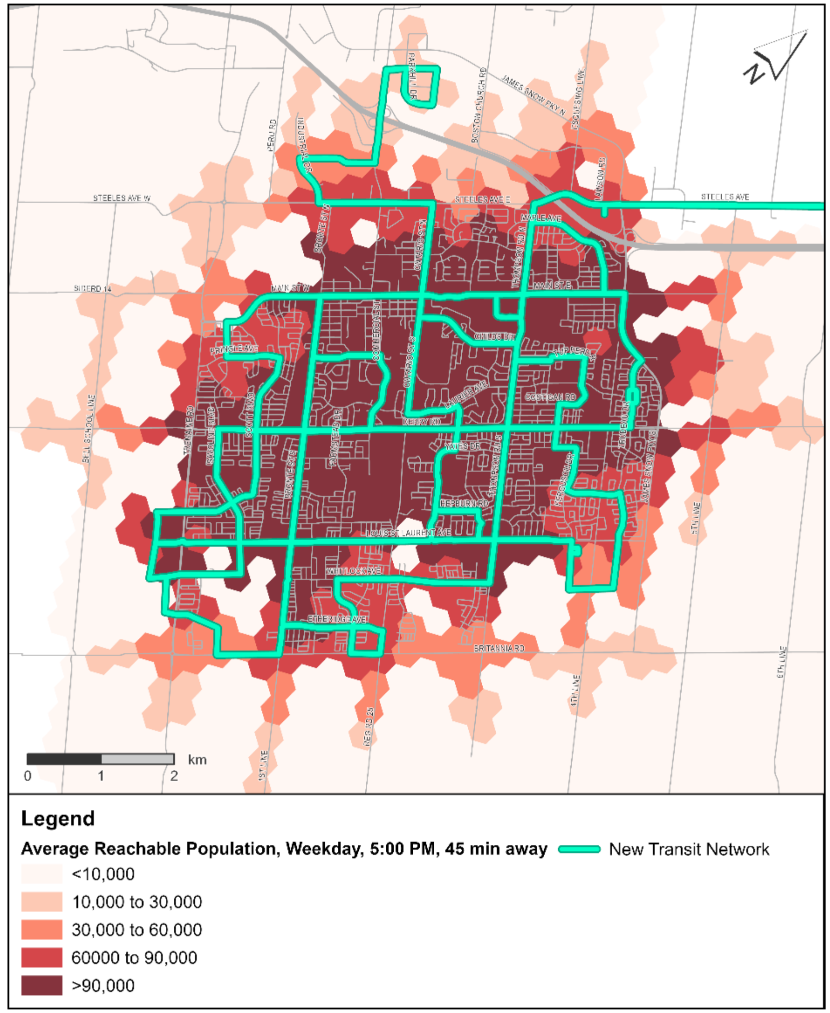
3.6.5 Access Analysis

Arcadis conducted an analysis of transit access to compare the existing and 2029 Proposed Network and quantify benefits of the network improvements. Each hex in Exhibit 3.48 represents an area of Milton, and darker shading indicates that more population is reachable from the hex. If shading is darker in the 2029 Proposed Network map than the Existing Network map, it means that more population is accessible from this area upon implementation of the network improvements. The analysis below demonstrates a vast increase in transit access- while in the Existing Network hexes with reachable population over 90,000 are mainly bounded by Main Street East, Ontario Street South, Thompson Road, and Derry Road, this is true of the majority of the town's urban area in the 2029 Proposed Network.

In addition, more than 57,000 residents will be within walking distance of a bus stop with frequent transit service.

Exhibit 3.48: Comparison of Transit Access for Existing and Proposed 2029 Transit Networks





Source: Remix (Note: Analysis does not consider OnDemand zones)

3.6.6 Key Takeaways

- The **2029 Proposed Network** addresses many of the issues and inefficiencies with the current network, while building on its successes.
- To support enhanced cross-town travel, **two new transfer hubs** are being planned, at the MEV and Kennedy Circle
- Additional transit service will be required to connect new **urban expansion areas**, being built on the urban periphery in greenfield areas. Flexibility will be required to account for uncertain development timelines.

4 Specialized Transit Review

This section provides an assessment of Milton Transit's specialized transit service, known as Milton access+, which provides transit service for eligible persons with disabilities. This section includes a description of the existing service and eligibility requirements, performance of the existing service, and recommendations for future improvements.

4.1 Service Overview

Milton's access+ service is the Town's door-to-door, shared ride specialized public transit service designed for persons with disabilities who are unable to use the accessible, fixed route conventional transit system. The Town's private contractor operates dedicated service with a fleet of 10 accessible small vans. Service is available Monday to Friday from 5:20 a.m. to 10:11 p.m. and on Saturdays from 7:10 a.m. to 7:40 p.m., operating during the same hours as the conventional transit service as required under the Accessibility for Ontarians with Disabilities Act (AODA). Service eligibility is based on an assessment of an applicant's ability to use the conventional transit service, and an evaluation of documentation submitted by/on behalf of the applicant through the application process.

The *Accessibility for Ontarians with Disabilities Act* (AODA) has clear implications for conventional and specialized transit service in Ontario. Specialized transit service in Milton must satisfy the requirements of the AODA in general and the Provincial Transportation Standards (the *Integrated Accessibility Standards* (Ontario regulation 191/11)) specifically. There is an opportunity for the Town's specialized transit services to remove barriers for people with disabilities and satisfy community requirements in a cost-effective manner.

4.1.1 Specialized Transit Industry Challenges

The Milton access+ program faces similar challenges (and opportunities) as many specialized transit services throughout Ontario, including:

- The need for legislative compliance;
- The need to effectively manage demographics and growth in travel demand;
- The need to address a range of functional disabilities including cognitive, sensory, etc.; and
- The need to address program administration and trip management considerations to address increasing costs, fiscal accountability and service and scheduling efficiencies.

4.1.2 Key Takeaways

- Milton Transit operates a specialized transit service which must adhere to AODA standards, while satisfying community requirements in a cost-effective manner.
- Milton access+ is experiencing challenges that are commonly faced by agencies with specialized transit services in Ontario, spanning legislative compliance, managing growing travel demand, a range of functional disability, and program administration and operational considerations.

4.2 Eligibility and Registration

The role of Milton access+ providing door-to-door specialized transit means that it requires a significantly higher subsidy to provide an equal level of mobility. As such, to be responsible to the integrity of service, eligibility requirements are put in place to ensure that people using the service have a true need for it.

Virtually every specialized transit service across North America incorporates some type of eligibility criteria and registration process before a person can become a registered customer.

The Town's eligibility and certification process is provided under a tri-party arrangement with Burlington Transit and Oakville Transit through the use of a third-party eligibility assessor. Town staff manage correspondence with applicants/registrants and database updates.

Eligibility for Milton access+ is determined based on the applicants' ability to consistently use conventional transit services because of a disability. Eligibility is not based on a particular

Specialized Service Eligibility Categories:

UNCONDITIONAL [eligible for all trips] Applies to a person with a disability that prevents them from using conventional transit for all trips, regardless of weather, distance to the stop, time of day, etc.

CONDITIONAL [eligible for some trips with barriers that limit ability to use conventional transit] Applies to a person with a disability that prevents them from consistently using conventional transit due to certain conditions, such as physical or environmental barriers. The individual is reasonably expected to make some trips on the conventional service. On some days accessible conventional transit is possible, and on other days it is not.

TEMPORARY [eligible for unconditional or conditional categories, for a limited time] Applies to a person with a temporary disability that prevents them from using conventional transit for a limited time (example: surgery recovery). This person will be assessed every 6 months, to ensure the specialized service is still required.

disability, age, income level or lack of availability of conventional transit in the applicant's area. Visitors can qualify for a Temporary term. The specialized service is not intended for those who find it inconvenient or more difficult to use conventional transit or for those who are reluctant or unwilling to use conventional transit for other reasons. The service is also not an attendant care service, a subsidized taxi service or an emergency medical service. Eligibility for the specialized service is measured against a person's ability to use the conventional transit system. The eligibility and registration process reflects an applicant's functional limitation. Further, the client database includes the categories of 'unconditional', 'conditional' and 'temporary' which are consistent with AODA – IASR-191/11.

Peer Specialized Transit Eligibility

In addition to Milton, Burlington Transit's eligibility and certification process for specialized transit is also provided under agreement with Oakville Transit. This means that Milton, Oakville, and Burlington all use the same specialized service eligibility categories. Both Thunder Bay and Barrie also use the same three specialized service eligibility categories. Niagara Region uses a similar set of categories to Milton, however they use the term "Permanent" instead of "Unconditional". Brantford and Sault Ste. Marie do not use these three categories, however they both have varying levels of eligibility depending on whether specialized transit service is needed on a permanent or temporary basis.

4.2.1 Key Takeaways

- Eligibility for access+ is administered under a tri-party arrangement with Burlington Transit and Oakville transit, and includes three categories with varying levels of eligibility: Unconditional (all trips), conditional (some trips), and temporary (unconditional or conditional for a limited time) which is consistent with the AODA.
- This eligibility system is generally consistent with peer specialized transit systems.

4.3 Performance Analysis

A review of Milton access+ data from 2022 (Jan 1-Dec 31) was conducted to develop a better understanding of how the system is performing from the rider perspective. This includes both a temporal and spatial analysis.

4.3.1 Operating Statistics

The Canadian Urban Transit Association (CUTA) provides annual operating statistics for conventional and specialized transit agencies across the country. The list below outlines key statistics from the CUTA Specialized Fact Book for 2022:

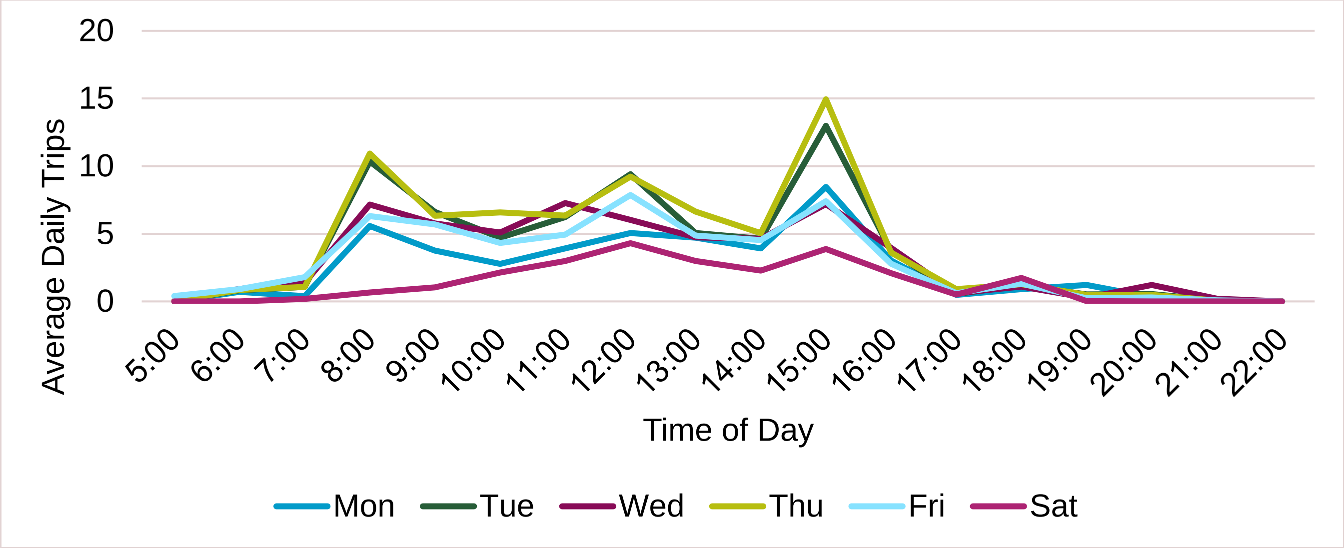
- Annual Ridership: 15,200
- Registrants: 240
  - 74% Unconditional Eligibility
  - 4% Conditional Eligibility
  - 22% Temporary Eligibility
- Total Operating Cost: $1.83 million
- Cost per Trip: $103.38
- Cost per Hour: $181.85
- Passengers per Hour: 1.93

It should be noted that Milton Transit operated a co-mingled service model in 2022 where OnDemand and access+ trips shared the same vehicle in some instances. Co-mingled services are not provided by all transit agencies in the country, and the composition of ridership between on-demand and specialized transit trips vary for the agencies that do co-mingle these services. Given these data constraints, Milton Transit's access+ key statistics are not directly comparable with peer municipalities.

4.3.2 Temporal Analysis

Exhibit 4.1 below breaks out the overall average ridership demand by time of day and day of week. Demand is noticeably higher from 8:00am-5:00pm for all days where service is provided. There are peaks noted particularly on Tuesdays and Thursdays around 8:00am-9:00am and from 3:00pm-4:00pm. A less significant "third peak" from 12:00pm-1:00pm on Tuesdays, Thursdays, and Fridays was also noted.

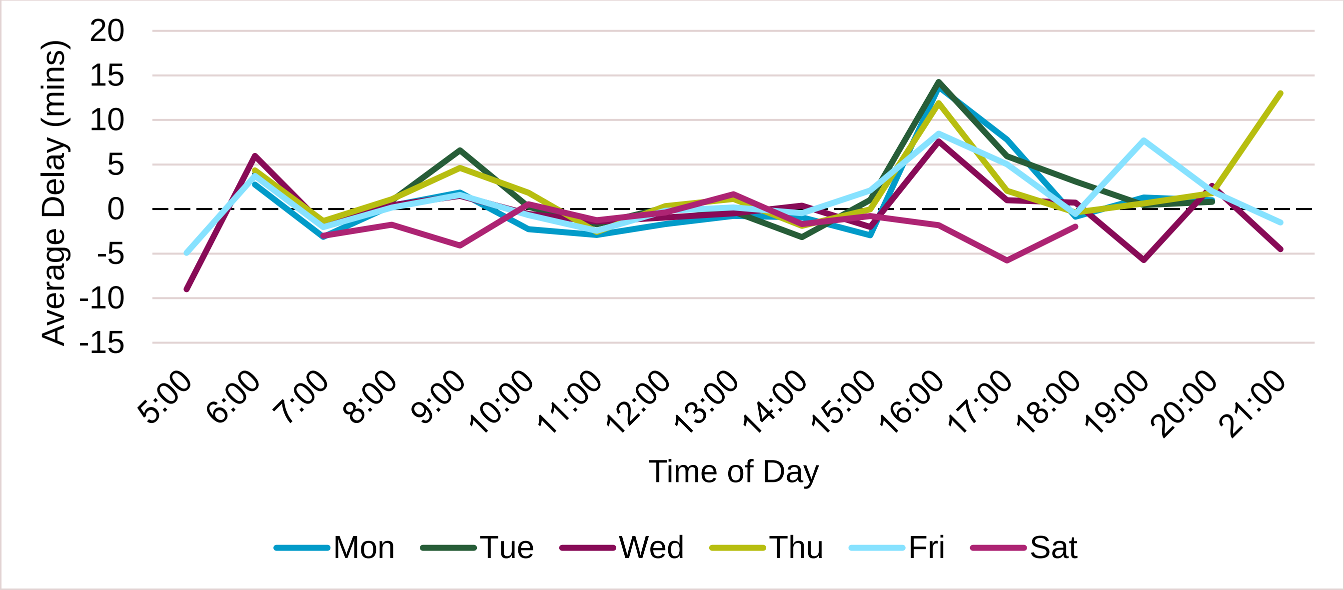
Exhibit 4.1: Average Daily Trips on Weekdays and Saturday



Source: Spare Labs access+ trip data (2022)

The demand profile noted above does not consistently result in significant delays (see Exhibit 4.2). The weekday afternoon peak (4:00pm-5:00pm) is the one period which experiences consistent delays, likely due to traffic congestion. However, there are significant number of early trips which occur on weekdays. Early trips often result due to the trip matching software algorithm which will seek to minimize wait times for non-scheduled trips. There is potential to mitigate this issue by modifying the back-end trip matching software algorithm in partnership with the software vendor, Spare Labs.

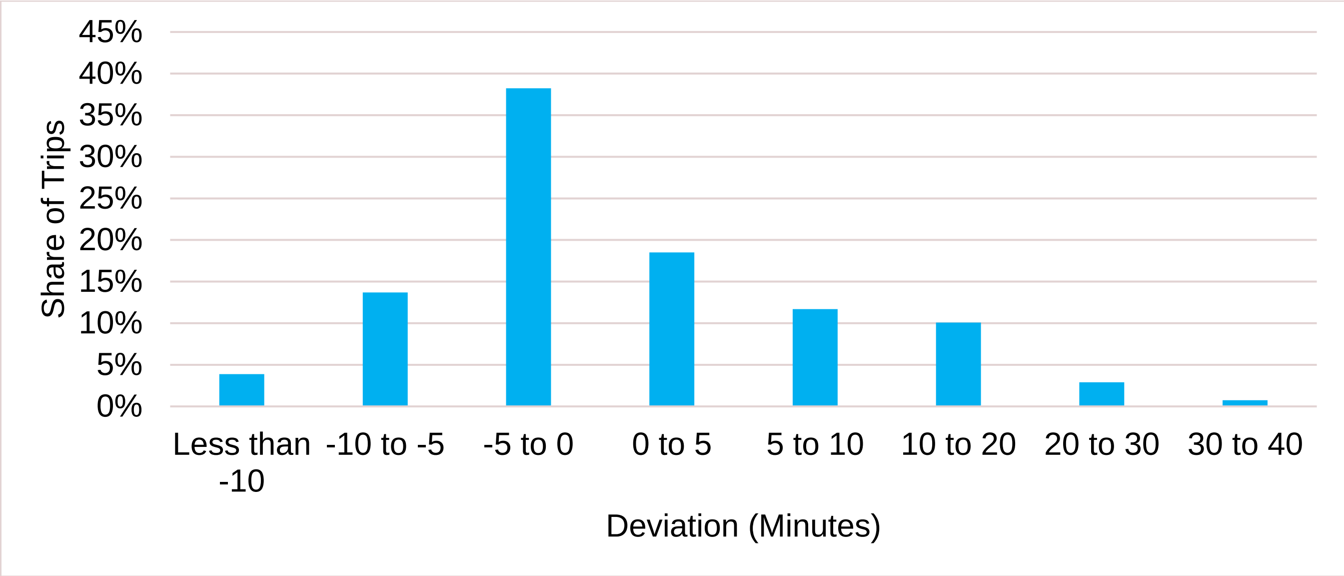
Exhibit 4.2: Average Delay by Hour and Day of Week



Source: Spare Labs access+ trip data (2022)

When observing magnitude of trip delay by share of trips, the majority of trips are shown to arrive within -5 to 5 minutes of requested pickup time. Concerningly, 7.5% of trips arrive more than 20 minutes after, or more than 10 minutes before, the requested time (see Exhibit 4.3). Very late or very early trips, in comparison to the requested pick-up time, impact the ability for the rider to rely on the service. Many access+ riders use the service to get home from medical appointments, so early trips in particular can lead to no-shows and riders left without transportation.

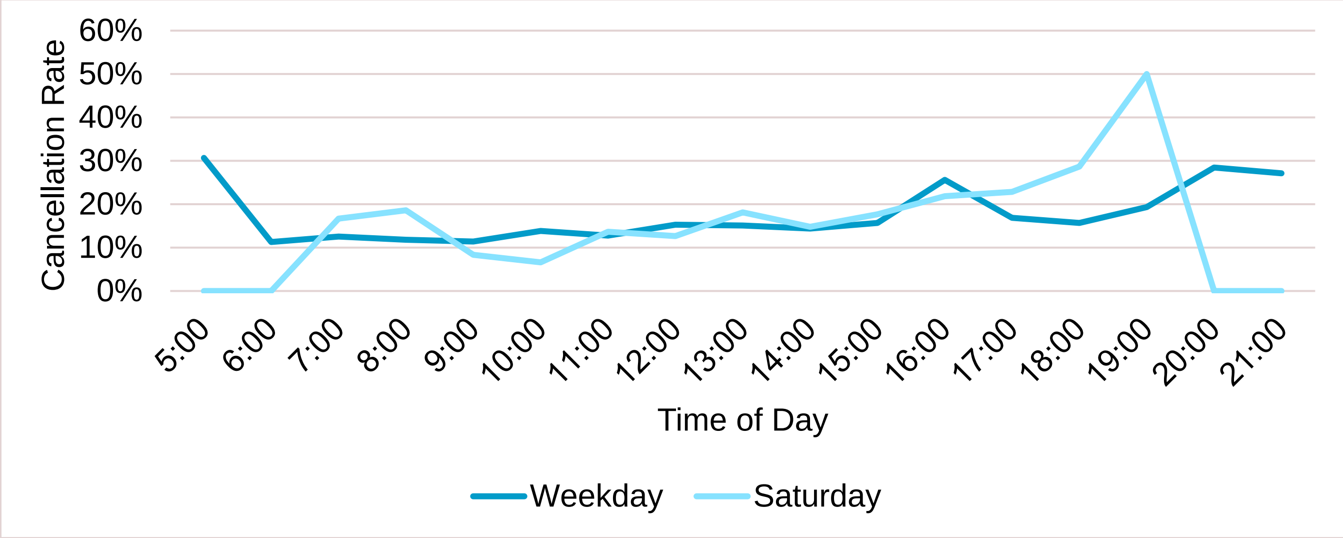
Exhibit 4.3: Deviation from Requested Pick-up Time (mins)



Source: Spare Labs access+ trip data (2022)

The cancellation rate remains relatively steady (between 10%-20%) throughout the daytime, beginning to pick up into the late afternoon and evening. Cancellation rates also peak (30%-40%) in the first and last hour of service (see Exhibit 4.4).

Exhibit 4.4: Cancellation Rate by Hour



Source: Spare Labs access+ trip data (2022)

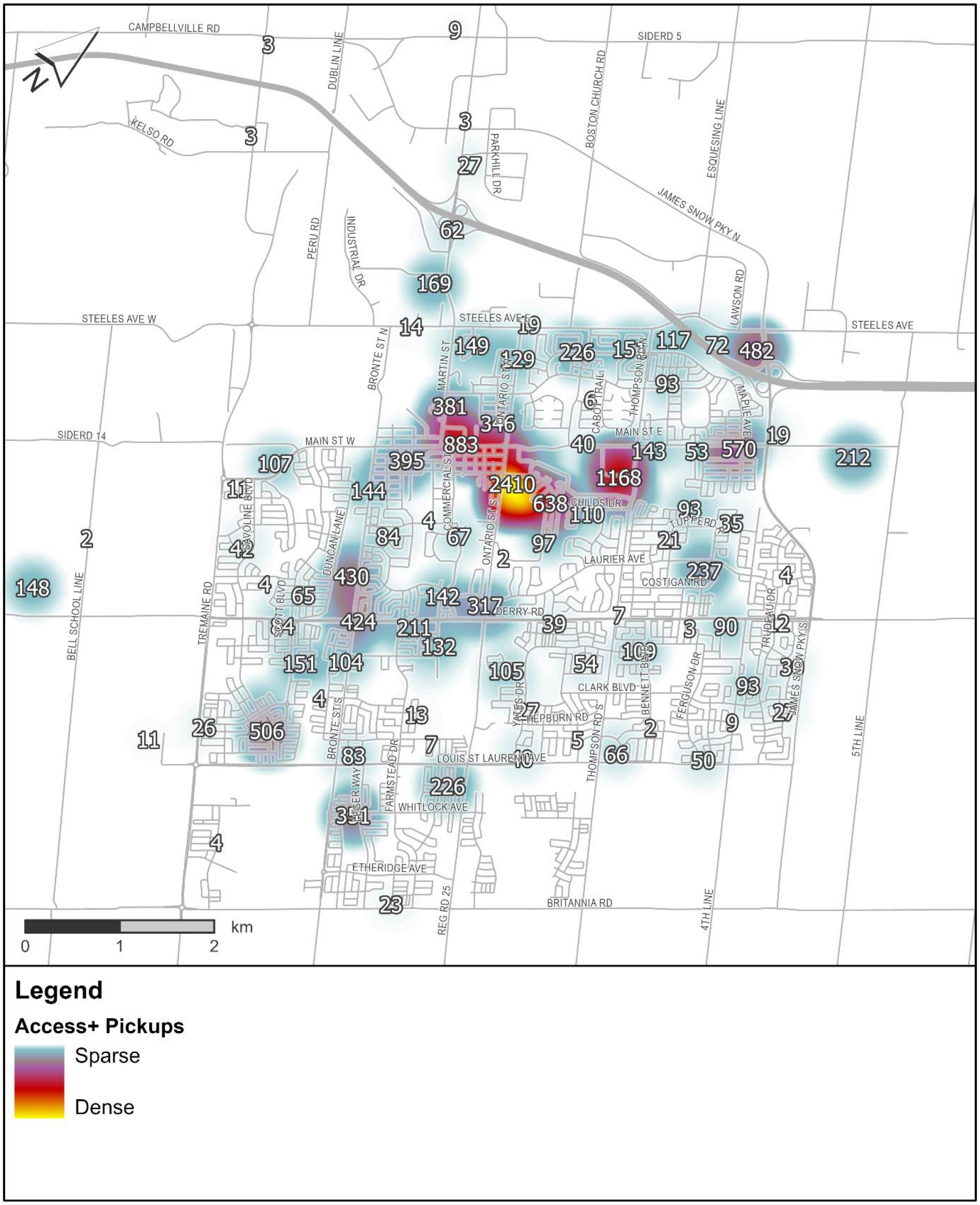
4.3.3 Spatial Analysis

Milton access+ trip pick-ups are largely concentrated within Milton's urban area. The highest concentration of trip pick-ups is located around Milton Mall. Additional nodes of dense concentrations of access+ pick-ups include Milton Common, the commercial area near Milton Pond, the residential areas around Harrison Park, and the Walmart Supercentre plaza (Highway 401/James Snow Pkwy). While the service area boundary for Milton access+ is the Town's municipal boundary, there are available connections with Halton Hills Activan and Peel TransHelp for inter-municipal trips.

There are a small number of access+ pick-ups that are scattered throughout the outer rural areas in Milton. While the volume of trips in these outer rural areas is low, they pose significant operational challenges. Since these pick-ups are located far away from the majority of trip pick-ups, it results in substantial dead-heading time. This also increases wait times and trip lengths, particularly when trips are co-mingled with OnDemand users. This also decreases overall access+ productivity.

The access+ trip pick-up densities around Milton are shown below in Exhibit 4.5.

Exhibit 4.5: Distribution of access+ Trip Pickups (2022)



Source: Spare Labs access+ trip data (2022)

4.3.4 Key Takeaways

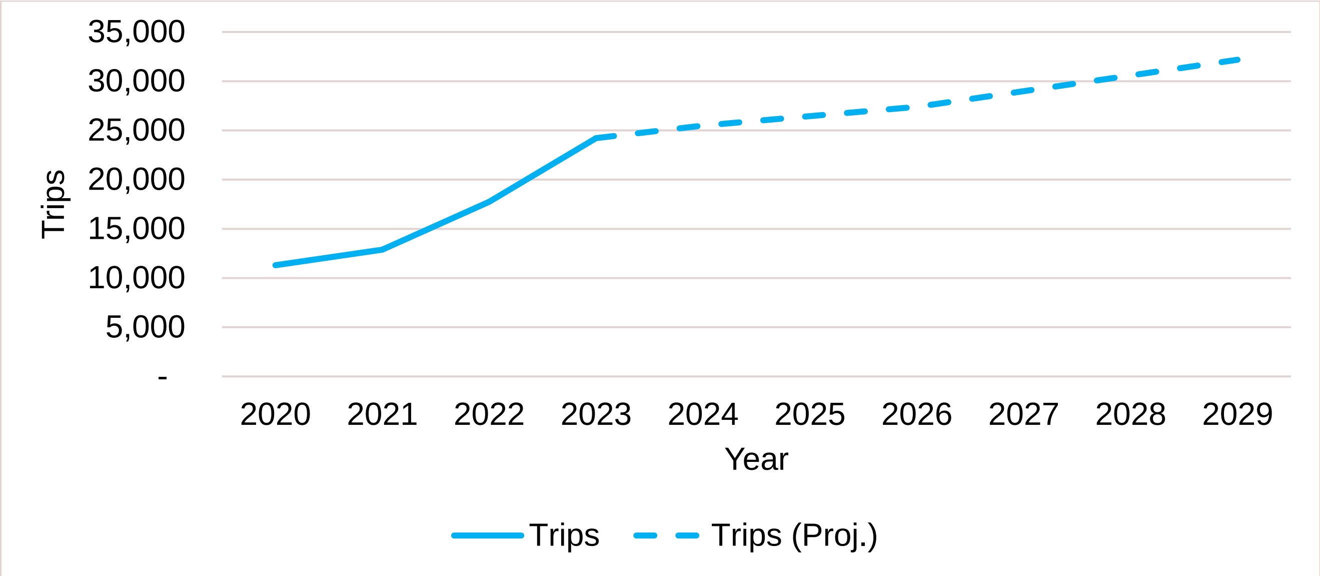
- Milton access+ travel demand peaks at 8:00am-9:00am and from 3:00pm-4:00pm. The peaks are larger on Tuesdays and Thursdays.
- There are a significant number of early trips which occur throughout the week, many of which are driven by the parameters of the trip matching software algorithm.
- There are a significant number of very late or very early trips -- 7.5% of trips arrive more than 20 minutes after, or more than 10 minutes before the requested time.
- Cancellation rates peak during the first and last hours of service.
- There are a small number of Milton access+ pick-ups in outer rural areas of Milton that result in long wait times, trip lengths, and low productivity.

4.4 Demand Forecasting

Unlike conventional transit services, Milton access+ offers door-door trips that are requested by individual users. This application requires Milton access+ vehicles to operate when a trip is requested and scheduled, and not a regular timetable like a conventional fixed-route bus. Growth in the user base drives growth in service registrants and overall ridership.

The forecast of future demand listed below in Exhibit 4.6 incorporates overall population growth as well as the changing share of the senior population. The figure below shows how Milton access+ ridership rebounded from the COVID-19 pandemic, as well as how it is expected to grow at a steadier pace over the next five years. The Milton access+ service prior to 2020 was delivered using non-dedicated vehicles and therefore data from this period is not directly comparable to post-2020 data.

Exhibit 4.6: access+ Trips and Expected Growth Per Year



Source: Milton Transit access+ ridership data (2020-2023)

To maintain similar service quality to today, it is expected that service hours would need to increase in line with projected ridership growth. Based on the demand forecast above, it is expected that Milton access+ will require 10,000 service hours in 2025, increasing by 500 service hours annually to 12,000 hours in 2029.

4.4.1 Key Takeaways

- Milton access+ specialized transit trip demand has recovered from the COVID-19 pandemic.
- Trip demand is projected to increase at a steady pace over the next five years, however at a slower rate compared to 2020-2023 growth.

4.5 Recommendations

Ongoing Consideration

The following recommendations are provided to enhance the effectiveness of the Milton access+ specialized transit service over the full 5-year plan:

- Continue to leverage comingling between OnDemand and specialized transit users to maximize use of existing assets.
- Procure additional vehicles to enable long-term growth of the service (specifics provided in Section 7.2)
- Improve accessibility of the conventional service to facilitate better integration with access+ (specifics provided in Section 7.4).

Medium-term Recommendations

The following recommendations are provided to enhance the effectiveness of the Milton access+ specialized transit service in the medium term (3-4 years):

- Consider new partnerships or added resources to support travel demand for dialysis and other recurring healthcare services – particularly targeted to meet busiest periods and time periods with significant numbers of trips arriving early for pick-ups.

Long-term Consideration

The following recommendations are provided to enhance the effectiveness of the access+ specialized transit service in the long-term (5 years):

- Explore agreements with taxi and/or ride-hailing services to dispatch trips to their accessible fleet for trips to rural Milton or Lisgar GO Station in Mississauga – this measure will reduce deadheading of the co-mingled fleet, improve productivity of the service and reduce wait times.

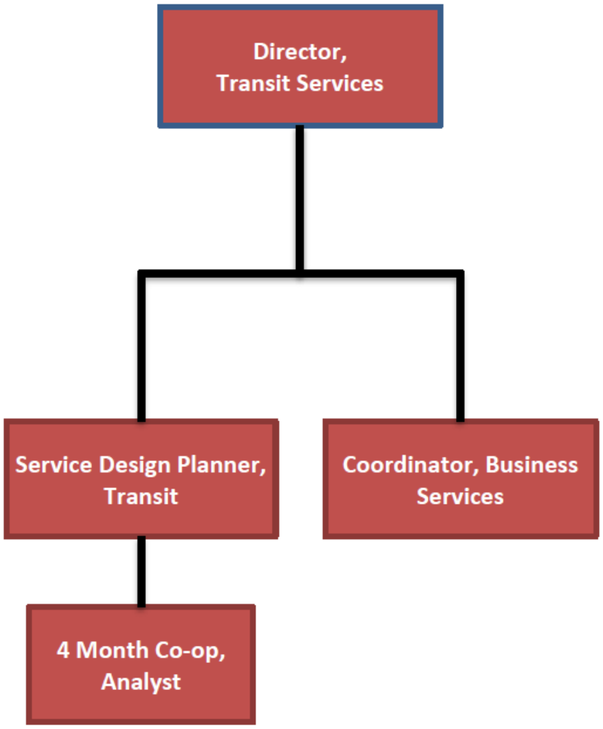
5 Administrative Support and Service Delivery

A review of Milton Transit and its relationship with the contractor, PWTransit, was conducted to identify administrative and business needs and recommend solutions to address these needs.

5.1 Organizational and Business Process Review

This review in this section pertains to the identification of staffing needs for Milton Transit as it grows over the next five years and implements the recommendations contained in the Plan. First, a review of Milton Transit's organizational structure was conducted. Milton Transit's current staffing complement consists of three full-time equivalents (FTEs) and a co-op student. The organizational chart is provided in Exhibit 5.1.

Exhibit 5.1: Milton Transit Organizational Structure



The day-to-day operations of Milton Transit, including physically operating the conventional, Milton access+, and OnDemand services, conducting vehicle maintenance, trip reservation and customer service inquiries, are contracted out to PWTransit. Milton Transit has an operating contract with PWTransit which outlined each party's responsibilities with respect to the provision of transit services.

In addition to the Transit Division and PWTransit teams, Corporate Support Services are provided by Town departments in the areas of Operations & Facilities, Administration/Customer Service, IT Support, and Marketing/Communications. These services are provided as part of a "shared services" model, so no FTEs are specifically dedicated to the Transit Division.

A review of Milton Transit's business processes and organizational structure was conducted to identify gaps and additional resourcing required to implement the plan recommendations (Exhibit 5.2).

Exhibit 5.2: Milton Transit Business Process Areas

Business Process Area	Current State	Gap Identification	Resourcing Implications
Revenue processing, reconciliation and management	Farebox revenue is collected by a third-party contractor	Daily receipts are not reconciled with ridership data on a frequent basis to mitigate revenue loss.	Yes – oversight of contractor and transit technology management
Internal/ external marketing and communications support	The Town's Corporate Support Services department provides marketing/communications support to Milton Transit under a shared services model.	This arrangement means that it can be difficult to obtain proper resources to conduct transit marketing and communications initiatives.	Yes – marketing and communicatio ns
Customer service	Customer service, such as responding to customer concerns and publishing service alerts, is managed by PWTransit. The access+ application process and the customer service email inbox are managed by the Town.	As a contractor responsibility, the effectiveness and responsiveness of customer service is not directly managed by Milton Transit. Milton Transit is resource constrained in its ability to ensure relevant contract commitments are upheld.	Yes – oversight of contractor
Advocacy/ outreach	Milton Transit conducts advocacy initiatives internally, providing updates as needed to Council, along with external advocacy as part of industry groups such	None	None

Business Process Area	Current State	Gap Identification	Resourcing Implications
	as the Ontario Public Transit Association.		
Data analytics/ IT supports	Milton Transit utilizes a growing suite of transit technologies, such as registering fareboxes, Computer-aided Dispatch/Automatic Vehicle Locators (CAD/AVL), Automatic Passenger Counters (APC), CCTV, digital fare payment, and other systems. The Town's IT department works on a shared services model and supports Milton Transit.	The Town is lacking dedicated resources for ongoing management (data analysis, installation, maintenance, sensitive data handling) of transit technology systems. Data generated by existing systems is not fully leveraged due to resource constraints.	Yes – transit technology management/ IT
Service delivery contract administration and management	Milton Transit's leadership and senior staff support the management of the service delivery contract with PWTransit. The relationship between the Town and PWTransit is constructive and effective.	As responsibilities of existing staff grow, the ability to manage the contract and provide proper oversight of the contractor has been constrained.	Yes – oversight of contractor
Fleet and asset management	As the contractor, PWTransit is responsible for fleet and garage operation and maintenance. Milton Transit oversees procurement and high-level asset management decision-making.	Milton Transit is not able to conduct frequent inspections of fleet and assets due to constrained resources.	Yes – oversight of contractor

Business Process Area	Current State	Gap Identification	Resourcing Implications
Safety and security	PWTransit is responsible for safety and security policies and oversight as the operator of the service.	The service delivery contract is not specific about contractor requirements for providing safety and security training and oversight.	Yes – oversight of contractor
Service planning/ design	Milton Transit has one dedicated transit service planner and one co-op student responsible for the design and implementation of periodic service changes and ad-hoc route detours. In 2024, Milton Transit had budgeted for one additional service planner to assist in the implementation of the Five-Year Service Plan under a contractual arrangement.	Operational data generated by existing transit technology systems is not fully leveraged to inform service planning activities due to resource constraints. The addition of a second full-time service planner will ease existing resource constraints in the near-term.	None

5.1.1 Key Takeaways

- The Transit Division's organizational structure includes **three dedicated FTEs**.
- Gaps were identified in the organizational structure with respect to **transit technology/IT and marketing/communications**.

5.2 Service Delivery Contract Review

The current service delivery contract was reviewed to evaluate opportunities and identify possible changes in the contractor's functional responsibilities to maximize value. Milton Transit's existing contract with PWTransit ends in 2026, creating opportunity to implement improvements in the next operating contract. The contract was reviewed for this purpose, and changes to the following business areas were explored to identify opportunities for improved contract outcomes (Exhibit 5.3).

Exhibit 5.3: Recommendations to Improve Contract Outcomes

Business Process Area	Recommendation	Rationale
Customer service	Maintain contractor responsibility	The contractor is responsible for the day-to-day operation of the service and is better positioned to react to urgent customer concerns. Improved contractor oversight by Milton Transit should include ensuring the contractor is providing customer service reporting as required by the contract.
Trip reservation, vehicle dispatching	Maintain contractor responsibility	The contractor is responsible for the dispatch and operation of Milton access+ and OnDemand trips, so maintaining a single line of communication with the rider would reduce potential customer service pain points.
Vehicle maintenance	Maintain contractor responsibility	The contractor is solely responsible for operation of the transit service, and vehicle maintenance is a critical function to ensure continuity of operations.
Technology support	Shift responsibility to new Milton Transit FTE responsible for general oversight of systems, while contractor continues to handle routine maintenance	Milton Transit staff should continue to be responsible for technology oversight and strategy. Responsibilities such as sensitive data handling, and supplier coordination for system installation, maintenance, and procurement, are outside of the main purview of the contractor.

Opportunities for performance-based contracting were explored. Performance-based contracting is a type of contracting method which leverages financial penalties and/or incentives to attempt to improve performance outcomes. This method is more common amongst larger transit systems which rely on contracted service delivery.

Given the relatively smaller scale of Milton Transit's operation, the potential benefits of a performance-based contracting approach would be minimal while requiring significant staff resources to monitor contractor performance against contract metrics. This contracting method also has the possibility to negatively impact the constructive relationship the Town has with the existing contractor. It should be noted that enforcement of the existing contract requirements is challenging due to resource constraints. Instead of a performance-based contact, it is anticipated that improved performance outcomes can be delivered via the staffing plan presented in Section 7.1.1.

Lastly, it was noted that the existing contract has been subject to many revisions and amendments over the years which have produced areas of the contract language which can appear redundant, outdated or contradictory. The next revision of the contract should include housekeeping amendments to streamline the contract language and improve its comprehensibility.

5.2.1 Key Takeaways

- It was recommended that **most existing contractor responsibilities are maintained**, with the exception of a clearer and expanded role of the Town to manage transit technology/IT systems.
- **Performance-based contracting was not recommended** due to the significant resources required to administer such contracts.
- The next revision of the contract should contain **significant housekeeping amendments** to improve its legibility & clarity and remove inconsistencies.

5.3 Key Performance Indicators

Milton Transit currently publicly tracks the following key performance indicators (KPIs) as part of quarterly/annual reporting:

- **Service Hours:** Total amount of revenue service hours operated
- **Unlinked Boardings:** All trips recorded, including transfers
- **Revenue Passenger-Trips:** Number of fare-paying trips recorded, less transfers
- **Revenue Passenger Trips per Service Area Population:** Number of fare-paying trips per resident serviced by transit (within 400 metres of a bus stop)
- **Boardings per Service Hour:** Number of total trips per amount of operated service
- **Revenue Passenger Trips per Service Hour:** Number of fare-paying trips per amount of operated service
- **Net Operating Cost per Revenue Passenger-Trip:** Municipal subsidy per fare-paying trip

- **Revenue/Cost Ratio:** Overall cost recovery from external revenue sources (sources other than municipal subsidy)

Four peer transit systems were identified to understand which KPIs are commonly used in municipalities of similar size to Milton (Exhibit 5.4).

Exhibit 5.4: KPIs Commonly Reported Publicly in Municipalities of Similar Size to Milton

KPI	Milton	Barrie	Brantford	Kingston	Guelph
Service Hours	X				
Unlinked Boardings	X				
Revenue Passenger-Trips	X	X	X		X
Revenue Passenger Trips per Service Area Population	X	X	X	X	
Service Hours per Service Area Population				X	
Boardings per Service Hour	X				
Revenue Passenger Trips per Service Hour	X	X	X		X
Net Operating Cost per Revenue Passenger-Trip	X			X	X
Revenue/Cost Ratio	X	X	X	X	X
On Time Performance		X	X		X
AODA Stop Compliance		X			
Accidents per 100,000 km			X		
Missed Trips			X		
Net Operating Cost per Service Hour				X	X

5.3.1 Key Takeaways

- Peer transit systems are tracking a **variety of KPIs** which may benefit Milton in its future reporting to Council.
- Milton Transit may benefit from tracking additional KPIs pertaining to **accessibility, safety, and reliability**.

5.4 Recommendations

Recommendations for Section 5.1-5.3 are provided below with respect to administrative support and service delivery.

5.4.1 Organizational and Business Process

The business process review yielded three particular areas of focus for Milton Transit's staffing complement to eliminate existing gaps in their business processes and associated resourcing:

- Contractor oversight
- Transit technology management/IT
- Marketing and communications

It is recommended that contractor oversight activities are continued to be the responsibility of Milton Transit management. It is recommended that Milton Transit seek to build on relationships with the Corporate Support Services department to **dedicate two FTEs to Milton Transit operations by 2029,** one in 2025 and one in 2026. It is expected that these resources, in addition to the budgeted service planner role, will reduce resource constraints and allow Milton Transit management to focus on relevant oversight activities. The two FTE roles are described below:

- **Transit Technology/IT Specialist:** Responsible for the day-to-day management and long-term planning of all technologies used on the Milton Transit service, along with supporting back-end IT systems. Technologies would be expected to include Fleet Electrification, Computer-aided Dispatch/Automatic Vehicle Locators (CAD/AVL), Automatic Passenger Counters (APC), CCTV, digital fare payment, and other systems.
- **Marketing, Programs, and Partnerships Specialist:** Responsible for implementing campaigns, developing service programs and coordinating system communications with PWTransit, and overseeing partnerships with community stakeholders.

The roles identified above are **specific to the needs identified in this Plan**, and should not preclude Milton Transit from expanding its staffing complement in future years as additional needs arise. This could include areas such as contract administration, quality assurance, service planning, change management and/or oversight of major capital projects.

5.4.2 Service Delivery Contract

The service delivery contract review identified the following recommendations to occur in the short to medium term to occur in the next contract **upon the current contract's expiry in 2026**:

- Clarify the enhanced responsibilities of Town staff with respect to transit technology systems, and continued responsibilities of the contractor for the systems' routine maintenance.
- Enhance oversight of the existing contract requirements instead of implementing performance-based contracting methods.
- Introduce housekeeping amendments to streamline and clarify the overall contract structure and language. This could be conducted by the Town's Legal department or via engagement of an external consultant to conduct a contract review.
- All contract recommendations to be implemented within the next contract as part of the Request for Proposals services procurement process.

5.4.3 Key Performance Indicators

Based on the Town's needs along with the outcome of the peer benchmarking exercise, the following KPIs are recommended **to be reported by Milton Transit over the full 5-year plan**. KPIs were also developed to align with CUTA Fact Book reporting definitions. KPIs should be reported by mode where possible.

- **Passenger Trips:** Number of fare-paying trips recorded, less transfers
- **Passengers per Capita:** Number of fare-paying trips per resident serviced by transit (within 400 metres of a bus stop)
- **Passengers per Service Hour:** Number of fare-paying trips per amount of operated service
- **Revenue Passenger Trips per Service Hour:** Number of fare-paying trips per amount of operated service
- **Service Hours per Capita:** Amount of operated service per resident – used to track progress with respect to the Plan short-term- and long-term transit investment targets
- **Revenue/Cost Ratio:** Overall cost recovery from external revenue sources (sources other than municipal subsidy)
- **Conventional On Time Performance:** Percentage of conventional trips which arrived between 0 and 5 minutes after scheduled arrival
- **Comingled On Time Performance (Requested Time):** Percentage of access+ or OnDemand trips which arrived within the 'search window' time period provided by the Spare Labs app based on the rider's requested time (varies depending on trip parameters, between 5-25 minutes before/after requested time)
- **Comingled On Time Performance (Scheduled Time):** Percentage of access+ or OnDemand trips which arrived within the 'OTP window' time period provided by the Spare

Labs app upon trip confirmation and scheduling (varies depending on trip parameters, between 0-10 minutes before/after scheduled time)

- **AODA Stop Compliance:** Percentage of bus stops which meet AODA-mandated accessibility requirements
- **Missed Trips**: The number of scheduled 'runs' which were not operated due to issues such as operator/fleet unavailability, schedule adherence issues, etc.

6 Policies and Service Standards

Service standards are an effective tool which use objective, quantitative measures to monitor and adjust the provision of transit service. This section provides a review of Milton Transit's existing service standards and cancellation/no show policies and identifies recommendations for improvement.

6.1 Existing Standards

Milton Transit's last Council-endorsed service standards were developed in 2010. The standards simply state the following:

- Base service should see frequencies between 30-60 minutes.
- Route frequency should be increased when vehicle capacity is exceeded.
- Route frequency should be reduced when less than 10 trips/hour are being made on the route.

In the previous Five-Year Service Plan, published in 2019, more detailed standards were developed which consider the implementation of future OnDemand services and Frequent route classifications. The standard is as follows:

- OnDemand: Less than 10 trips/hour on a previous fixed route.
- Base Service (60-minute frequency): More than 10 trips/hour or 150 daily trips in an existing OnDemand zone.
- Frequent Service (15–60-minute frequency): More than 15 trips/hour on a Base Service route, or combined population and employment density of 30 persons & jobs per hectare.
- Route frequency should be increased further if more than 20 trips/hour is exceeded on a Frequent Service route.

These standards were reviewed, and it was found that warrants for frequent service are vague, and generally lower, than peers. In addition, on-demand transit services such as Milton Transit OnDemand and peer services typically struggle to achieve productivity greater than 10 trips/hour due to limitations of the service type. The Transit Alternative Service Delivery Strategy, reported to Council in June 2021, outlines other factors which may be considered when deciding to implement OnDemand service, including cost-benefit/productivity objectives, strategic/value-based objectives, transit propensity and development patterns, and service integration complexities.

6.1.1 Key Takeaways

- Existing service standards contradict each other with respect to warrants for service level changes and OnDemand implementation, and guidelines surrounding population and employment density are not tailored to Milton's local context.

6.2 Cancellation/No Show Policies

Currently, access+ and OnDemand trips are booked using the Spare Labs software platform, and allow for trips to be cancelled at any point prior to the vehicle arrival. Milton Transit has a cancellation rate of 24% for access+ and 27% for OnDemand, which is high compared to peer transit systems. Trips can be cancelled for many reasons, which are typically grouped into "rider fault cancellation" or "driver fault cancellation". Rider fault cancellations can occur for valid reasons, but can also include no-shows, or "trip fishing", where riders book multiple trips to obtain a variety of possible trip timings, and then cancel the less favourable trips. Driver fault cancellations can occur if they cannot complete the trip due to delay, vehicle issues, or other unexpected occurrences.

6.2.1 Key Takeaways

- A high rate of cancellations and no shows occur on the Milton Transit access+ and OnDemand services, both due to rider- and driver-related reasons.

6.3 Recommendations

Recommendations for service standards and cancellation/no show policies are provided below.

6.3.1 Service Standards

A new service standard was developed for the consideration of Milton Transit to recognize the need for improved base service levels before frequency can be achieved, in line with long-term planning goals, **for application throughout the entire 5-year plan**. The proposed service standards also seek to tie service changes to vehicle loading and density, strategies discussed in the Province's Transit-Supportive Guidelines, while reflecting the unique context of Milton Transit. [5]

[5] https://www.library.mto.gov.on.ca/SydneyPLUS/Sydney/Portal/default.aspx?component=AAAAIY&record=1ee42421-b5f0-404b-8181-c41b087acdd9

- OnDemand and/or Fixed Route Specials (limited-service routes): Consider implementing service if combined population and employment density exceeds 10 persons & jobs per hectare based on Town Best Planning Estimate (BPE) areas.
- Base Service (30-minute frequency): Consider implementing service if any of the following occur:
  - Combined population and employment density exceeds 10 persons & jobs per hectare based on Town BPE areas.
  - 200 daily trips are exceeded in an existing OnDemand zone.
- Consider adding buses to enhance frequency if any of the following occur:
  - The daily route productivity exceeds 20 trips/hr.
  - The route productivity within a 3-hour period exceeds 25 trips/hr.
  - The vehicle seated capacity within a 3-hour period is exceeded by 40%.

The proposed standards are designed to provide flexibility to adjust frequency as needed to best respond to demand. They are meant to act as guiding principles for Milton Transit to implement future service changes, and do not preclude changes which do not strictly adhere to the standards.

6.3.2 Cancellation/No Show Policies

The following recommendations are provided for both OnDemand and Milton access+ services:

Short-term Consideration

The following short-term recommendations (1-2 years) are based off a synthesis of industry best practices and specific peer examples:

- Explore the ability to pay for fares in-app upon trip booking, to ensure psychological “skin in the game” and reduce willingness to cancel the trip (trip cancellation would remain free).
- Implement in-app/email education campaigns for riders who are identified as “repeat offenders” who frequently cancel trips or are no-shows.
- Consider temporary account suspensions for “repeat offender” riders.

Medium-term Consideration

The following medium-term recommendations (3-4 years) are based off a synthesis of industry best practices and specific peer examples:

- Improve service efficiency or re-allocate resources to improve the ability of the service to provide trips at riders’ requested times.

- Explore the in-app limitations around multiple trip bookings between the same origin and destination stop within the same time periods, to reduce incidences of “trip fishing”.
- Consider implementing a minimal cancellation fee ($0.50-$1.00), only charged when a rider cancels the trip within a certain amount of trip after trip confirmation. This should be treated as a last resort measure, only to be implemented if other methods are not effective.

7 Fleet and Infrastructure

To enable the service plan for conventional and specialized transit outlined in Sections 3 & 4, this section explores necessary fleet and infrastructure requirements.

7.1 Town-Owned Garage

Milton Transit currently operates out of a small facility on Morobel Drive, leased by PWTransit to store and maintain the transit fleet. This facility was not originally designed to act as a transit bus facility, and despite modifications to the facility, it is not able to adequately fulfill its required maintenance and storage functions in an optimal manner. The facility is also at capacity, so additional buses are currently being stored on an interim basis at the Milton Civic Operations Centre (MCOC) on Regional Road 25. While the MCOC may have capacity for a limited number of additional vehicles, buses must travel out of service across town to the Morobel facility to any maintenance needs, an inefficient and time-consuming process.

Without a new, expanded bus garage, Milton Transit will be critically limited in its ability to add more transit service in the future.

Milton Transit has developed plans to construct a Town-Owned Garage (TOG) which will be purpose-built by the Town of Milton as a state-of-the-art transit facility. The TOG will have capacity for a total of 110 conventional and specialized/OnDemand vehicles, expected to meet Milton Transit's fleet needs beyond the 10-year capital forecast period of this plan. The TOG will be approximately 143,000 sq-ft, and be located in the south of Milton to accommodate expected development patterns.

A Feasibility and Functional Design Study was conducted in 2019 outlining projected cost estimates. The costs for the TOG have already been incorporated in the Towns capital budget and forecast, including ICIP funding, and have therefore been excluded from this Plan.

7.1.1 Key Takeaways

- The Town-Owned Garage is a **key enabler of the 2029 Proposed Network** and generally improved transit service within Milton.
- The Town has begun planning for the construction of the new garage, to be **completed within the Service Plan horizon**. The Plan is foundationally based upon the assumption that this garage will be operational in this timeframe.

7.2 Fleet

Milton Transit current owns and operates 22 conventional buses and 14 specialized vehicles used for access+/OnDemand services. Of the 22 conventional buses, five are beyond the 12-year useful life, and are being refurbished to support the operations of Route 1. In addition to the revenue fleet, three non-revenue vehicles are used by staff to support operations. The full fleet complement is described below in Exhibit 7.1:

Exhibit 7.1: Milton Transit Full Fleet Complement

Service	Fleet	Quantity	Size	Year Procured	Retirement Year
Conventional	M0901-M0903	3	12m	2009	2025*
Conventional	M1001-M1002	2	12m	2010	2025*
Conventional	M1201-M1203	3	12m	2012	2026*
Conventional	M1701-M1702	2	12m	2017	2029
Conventional	M1801-M1804	4	12m	2018	2030
Conventional	M1901-M1902	2	12m	2019	2031
Conventional	M2001	1	12m	2020	2032
Conventional	M2201-M2205	5	12m	2022	2034
Specialized	M1921-1924	4	6m	2019	2026
Specialized	M2021-M2022	2	6m	2020	2027
Specialized	M2031-2032	2	8m	2020	2027
Specialized	M2231-M2234	4	8m	2022	2029
Specialized	M2321-M2322	2	6m	2024	2031
Support	M4171-M4172	2	-	2017	2029
Support	M3181	1	-	2018	2030

*Source: Milton Transit. *Note: 5 buses are currently past their useful life but are being used on a provisional basis to operate Route 1 until 2025. 3 buses which were slated to be retired in 2024 will be held back two years as spares to support Phase 1 of the Service Plan. The conventional M1701-M1702 vehicles are electric buses that have been converted from diesel vehicles.*

Based on Milton Transit's existing fleet forecast, by the end of 2029 it will operate 36 conventional vehicle and 18 specialized vehicles, and by the end of 2034 its fleet will comprise of 43 conventional vehicles and 22 specialized vehicles. It is noted that existing supply chain issues result in a lag time of approximately 18-24 months between when a new vehicle is ordered and when that vehicle begins active service.

7.2.1 Key Takeaways

- Milton Transit operates a variety of bus types (12m, 8m, 6m)
- Existing fleet forecasts project a sharp increase in fleet size, to nearly double, by 2029

7.3 Electrification

The Town of Milton has already taken proactive steps to investigate and plan for the transition of their bus fleet from diesel to zero-emissions vehicles. This section describes fleet electrification work conducted to date, benefits of fleet electrification, and how this work integrates with this Five-Year Service Plan.

7.3.1 Fleet Electrification Feasibility Study

The Town of Milton, in collaboration with consulting firm HDR, released a Zero Emission Bus Feasibility Strategy & Fleet Transition Plan ("Fleet Transition Plan") in April 2024. This study was intended to serve as a road map for Milton Transit to convert their existing transit fleet to be entirely zero emission by 2040. This study included consultation with both internal and external stakeholders.

The list below outlines the key findings of the study that have implications for this Plan:

- **Zero emission vehicles should be introduced through a pilot program:** The Fleet Transition Plan calls for the introduction of zero emission vehicles through a pilot first to provide the Town with real-world experience operating and managing alternative-powered vehicles. This should be followed by a gradual introduction of more zero emission vehicles towards full fleet conversion by 2040.
- **Fleet electrification spans both conventional and specialized services:** To achieve full fleet electrification by 2040, zero emissions vehicles must be introduced for both conventional and specialized services. Like conventional implementation, zero emission vehicles should be introduced to specialized services through a phased approach.
- **Vehicle charging at the Town-owned garage:** Zero emission buses can be charged both at a depot/garage and on-route. Currently, the Fleet Transition Plan recommends depot/garage charging only due to the complexities of infrastructure management, property

ownership, and coordination required for on-route charging. It is recommended that the Town conduct a re-evaluation closer to 2030 based upon available vehicle battery technology to determine if on-route charging should be implemented in the future.

- **External funding opportunities:** Infrastructure Canada offers funding sources that can be used to support fleet electrification. This includes the Zero Emission Transit Fund and the pending Permanent Transit Fund. At this time, funding has not yet been secured by Milton Transit.

7.3.2 Benefits of Fleet Electrification

Electrifying Milton Transit's bus fleet offers two main benefits to the Town and to its residents:

- **Industry trends towards fleet electrification:** Transit agencies across the country are working to completely transition their fleets to zero emissions vehicles. Based on this trend, future transit vehicle supply is likely to be focused around zero emissions vehicles. This means that new transit technology innovations (like data collection, connected and autonomous vehicles, fare payment and more) may only be available on zero emissions vehicles. If Milton Transit does not follow this industry trend of fleet electrification, there is a risk that the agency will not be able to easily procure replacement parts and/or technology innovations that are equipped on newer vehicles. Fleet electrification will be critical for Milton Transit to provide a similar or better quality and level of service as peer municipalities in the future.
- **Greenhouse gas emissions reductions:** The Fleet Transition Plan estimated that zero emission vehicles will reduce emissions by approximately 76,900 tonnes from 2024-2040. This is equivalent to approximately 185 tonnes of CO_2 saved per year, per bus.

7.3.3 Fleet Electrification Implications for this Five-Year Service Plan

Based on the fleet electrification work conducted to date (Section 8.2.1) and the benefits of fleet electrification (Section 8.2.2), this Plan recommends that fleet electrification should be implemented as per the recommendations of the Fleet Transition Plan. Arcadis conducted a high-level energy modelling analysis to understand if deviation from the Fleet Transition Plan would be required to support the 2029 Proposed Network. This analysis is not as exhaustive as the one conducted for the Fleet Transition Plan, and further work may be required to validate the initial findings below.

Results of the energy modelling effort indicated that nearly all blocks in a theoretical blocking plan were compatible with the battery capacity constraints of either the NovaBus LFSe+ or the New Flyer Xcelsior CHARGE NG XE40 BEBs. The only exceptions were the two blocks operating on Route 21, which exceeded the recommended 80% maximum depth-of-discharge constraint – however no changes to the route are proposed in this Plan, so the Fleet Transition Plan has already captured these implications.

The methodology used to conduct this analysis is provided in Appendix A.

7.3.4 Fleet Electrification Requirements

The Fleet Transition Plan outlines infrastructure and program requirements to support the implementation of zero emission buses. Key requirements for Milton Transit are summarized below:

- **Town-owned bus garage charging:** As stated above in Section 8.2.1, the Fleet Transition Plan recommends charging at the Town-owned bus garage (TOG). The TOG will need to be designed in a manner that facilitates electric bus chargers. These should be placed indoors, and a single DC fast charger can be connected to up to three fixed route buses. It is recommended that DC chargers be implemented through a phased approach. The Fleet Transition Plan includes buildout conditions and a conceptual site plan for charging infrastructure at the TOG.
- **Software systems:** Introducing zero emission vehicles will require updated software systems to monitor the fleet. This includes four main system types. First, vehicle monitoring systems are used to track vehicle data including energy consumption, battery levels, and vehicle propulsion efficiency. Second, charging and energy management systems are used to schedule and manage charge sessions between vehicles. Third, digital yard management systems are used to inform staff of which buses are ready or not ready for service. Finally, scheduling software is used to ensure zero emission vehicles are fully charged by the time they are due to enter active service (this can often be paired with charging and energy management and digital yard management systems).
- **Staff training:** The introduction of zero emission buses will require a comprehensive staff and training plan. This should include updated safe workplace policies and standards, personal protective equipment, and training curriculum and materials for different work streams. These needs would vary depending on whether the maintenance program is in-house or contracted to an external party. If Milton Transit implements an in-house maintenance program, there may be opportunities to develop an apprenticeship program. Staff training would be implemented by the Transit Technology/IT Specialist (Section 5.4.1)

7.3.5 Key Takeaways

- The Town published the Zero Emission Bus Feasibility Strategy & Fleet Transition Plan in April 2024, which recommends Milton Transit convert their existing transit fleet to be entirely zero emission by 2040. These recommendations have been carried forward with select updates based on the future 2029 transit network.

- All service blocks in a theoretical blocking plan are viable within the constraints of the existing Fleet Transition Plan, for all new/modified routes in the 2029 Proposed Network.

7.4 Passenger Amenities

Milton Transit riders interact with passenger amenities such as bus stops, shelters, and the Milton GO terminal daily as part of their journeys. This section explores the current state of Milton Transit's passenger amenities.

7.4.1 Bus Stop Amenities and Accessibility

As of 2024, Milton Transit owns and maintains 395 bus stops across the town. Of these stops, 259 (66%) had an accessible landing pad, and of these stops, 52 (13%) had a shelter. The Accessibility for Ontarians with Disabilities Act (AODA) mandates that all new and renovated stops have a level surface, which is accomplished by providing a concrete landing pad.[6] However, this means that one-third of Milton Transit's stops are not accessible.

The AODA allows for the transit system to have stops which are not accessible, under the condition that "persons with disabilities are able to board or deboard a transportation vehicle at the closest available safe location, as determined by the operator, that is not an official stop…" While this allows transit systems to continue to operate grandfathered-in stops which are not accessible, it is desirable to upgrade these stops to meet AODA standards to provide a more safe and comfortable transit experience for both riders living with and without disabilities.

Another benefit of improved passenger amenities is a reduction in perceived waiting time. Research has shown that riders often over-estimate their perceived time spent waiting for transit, and the provision of amenities such as benches and shelters allows the rider to feel more comfortable and safer, and reduces the perceived waiting time. This effect was shown to be particularly effective for female riders, tying into broader gender-based equity objectives.[7]

Milton Transit's bus shelters are installed and maintained by Pattison, who has a contract with the Town to provide this service in exchange for the advertising space on shelters.

[6] https://aoda.ca/public-transportation-for-everyone-in-ontario/

[7] https://nacto.org/wp-content/uploads/2016/02/1_Fan-et-al-Perception-of-Waiting-Time-at-Transit-Stops-and-Stations_2015.pdf

7.4.2 Bus Stop Additions, Removals, and Spacing

New bus stops will need to be installed to support the new routes contained in the 2029 Proposed Network, along with corresponding removals of bus stops no longer serviced by conventional routes or OnDemand service. At the same time, the network changes create an opportunity to re-balance bus stop spacing. Fewer stops along a route mean faster travel times and more reliable service, but longer walks to the bus stop, which can have a disproportionate impact on riders with mobility challenges. Stop spacing between 300-400 metres is generally deemed to be appropriate, while many existing Milton Transit stops are closer together and/or see minimal ridership.

7.4.3 Terminals/Transfer Hubs

Milton Transit operates a single terminal, at the Milton GO station (seen below in Exhibit 7.3). The terminal consists of bus-only lanes along Drew Centre, concrete pads, and shelters, with a combination of bays at the station and on-street stops along the public roadway. Milton Transit also uses the bus bays at Milton GO Station under a service arrangement with Metrolinx.

Exhibit 7.2: Milton GO Station

Source: Google Maps (2024)

Given the radial network design and low frequencies, it is not feasible to transfer at other locations within the existing network. The 2029 Proposed Network supports the development of two new transfer points within the Milton Transit network in the next five years:

- **Milton Education Village:** A terminal is planned to be situated adjacent to the parking lot of the existing Mattamy Homes Cycling Centre, which will be in the centre of the future MEV site. As an off-street terminal with sawtooth bus bays, this terminal will provide a high-quality transfer experience for Routes 6, 7, and 8.
- **Kennedy Circle:** A smaller transfer point is identified in this area to connect Routes 3, 4, and 5. The terminal would likely be located on-street on either Kennedy Circle, Thompson Road, or Louis St Laurent Avenue. The terminal would include several shelters and include possibility for bus-only lane to ensure reliability. The design would be similar to the existing on-street portion of the Milton GO terminal, as well as Kingston's Downtown Transfer Point shown in Exhibit 7.4.

Exhibit 7.3: Kingston's Downtown Transfer Point

Source: Google Maps (2024)

In addition to the two new terminals identified within the five-year span of the Plan, a third terminal was identified within the 10-Year Capital Forecast to serve the emerging Britannia and Trafalgar areas and support future connections to neighbouring municipalities. This terminal would be located at the intersection of James Snow Parkway & Britannia Road, which is planned to be a major node within the future neighbourhood.

7.4.4 Key Takeaways

- High-quality bus stop amenities support **accessibility, comfort, and safety** objectives, and reduce the rider's perceived wait time for their bus.
- **Bus stops will be added, removed, and relocated**, to support the 2029 Proposed Transit Network.
- **Additional terminals** will allow for more convenient travel throughout the town and enhance integration with OnDemand transit service.

7.5 Recommendations

7.5.1 Town-Owned Garage

- Advance **planning, funding design, and construction** of the Town-Owned Garage to enable the service increases outlined in this Plan and achieve garage opening within the Service Plan horizon.

7.5.2 Fleet Plan

A fleet plan was established, based on the needs identified above and the Fleet Transition Plan. A driver of fleet growth beyond the Fleet Transition Plan is the need to service urban expansion areas by 2029, at an industry-standard spare ratio of 20%[8]. The fleet plan, provided in Exhibit 7.5 below, provides the procurement year and quantity required for each fleet type. The table includes both growth and replacement fleet:

Exhibit 7.4: Recommended Fleet Plan

	Diesel – 12m	BEB – 12m	Diesel – 8m	Diesel – 6m	BEB – 6m
2025	+3	+3	-	+1	-
2026	+7	+3	-	+4	-

[8] https://www.transit.dot.gov/funding/procurement/third-party-procurement/spare-ratio

	Diesel – 12m	BEB – 12m	Diesel – 8m	Diesel – 6m	BEB – 6m
2027	+1	+1	+2	+2	+2
2028	+2	+1	-	-	-
2029	-	+4	+4	-	+2
2030	-	+6	-	-	-
2031	-	+4	-	-	+2
2032	-	+2	-	-	-
2033	-	+2	-	-	+6
2034	-	-	-	-	+6

7.5.3 Electrification

- Milton Transit should **continue to advance the Fleet Transition Plan** to ensure alignment with available fleet options on the market as well as broader industry trends
- **Explore updating the Fleet Transition Plan** to build on and confirm Arcadis's initial analysis of electrification feasibility of the 2029 Proposed Network, and determine strategies to provide the service levels outlined in this Plan while meeting electrification targets

7.5.4 Passenger Amenities

- **Conduct a "blitz" to install concrete pads** where possible and move closer towards AODA objectives – establish goal of concrete pads at 100% of fixed-route stops by 2034.
- **Explore arrangements to acquire new bus shelters** with a goal of shelters at 33% of fixed-route stops by 2034. These additional shelters should be purchased by the Town and/or by Pattison through existing or re-negotiated arrangements. The Town should explore future opportunities to partner with Pattison or an external vendor for the maintenance of these new shelters.
- **Construct MEV and Kennedy Circle Terminals** in preparation for Phase 3 implementation of the 2029 Proposed Network
- Explore the feasibility of **reserving land for a future terminal** at James Snow Parkway & Britannia Road

8 Fare Policy and Payment

This section provides an overview of the fare policy and payment methods used by Milton Transit. This includes a review of the existing fare structure, a peer review of fare policies employed by comparable municipalities, a review of existing fare payment technology, and recommendations for both fare programs and policies as well as fare technology.

8.1 Existing Fare Structure

The table below (Exhibit 8.1) highlights Milton Transit's existing fare structure, with concession fares available for youth, senior, and children. Percentage discounts relative to the adult fare for concession fares are provided in brackets within the table.

Exhibit 8.1: Milton Transit's Existing Fare Structure (2024)

Fare Type	Availability on Token Transit	Adult (20-64) Fare	Youth (13-19) Fare	Senior (65+) Fare	Child (0-12) Fare
Cash Fare	No	$4.25	$4.25	$4.25	Free
10-Ride Ticket Book	Yes	$34.00	$25.00 (26%)	$23.00 (32%)	N/A
Monthly Pass	Yes	$91.00	$68.00 (25%)	$57.00 (37%)	N/A

In addition to the fare table above, riders with vision loss who present proper identification (CNIB) can ride transit for free. As of 2024, a Conestoga College Term Pass was added for post-secondary students, which provides unlimited transit for a semester (4 months) for $273.

8.2 Fare Structure Benchmarking

Milton Transit's fare structure was benchmarked against four peer transit systems: Barrie Transit, Brantford Transit, Burlington Transit, and Guelph Transit. Each peer transit system is within the Greater Golden Horseshoe, with similar population sizes to Milton. Every peer transit system uses an electronic fare payment platform ("E-Fare"), with Burlington Transit being the only peer using the Province's PRESTO system. The benchmarking is provided below in Exhibit 8.2, for the purpose of comparing fare products and policies. Percentage discounts relative to the adult cash fare are provided in brackets within the table.

Exhibit 8.2: Peer Fare Structure Benchmarking

	Milton	Barrie	Brantford	Burlington	Guelph
Service Area Population (2022)	127,471	155,137	104,688	181,950	143,740
Ridership (2022)	325,795	2,526,764	1,074,479	2,223,173	3,716,101
"E-Fare" Platform	Token Transit (App)	HotSpot (App)	B-Card (Card)	PRESTO (Card)	OnTheWay (Card)
Adult Fare					
Cash Fare	$4.25	$3.50	$3.00	$3.50	$3.25
Single-Use E-Fare	N/A	$3.50 (0%)	$2.90 (3%)	$2.75 (21%)	$2.80 (14%)
Ticket Book (Quantity) 1 Ticket	$34 (10) $3.40 (20%)	$30.00 (10) $3.00 (14%)	$24.50 (10) $2.45 (18%)	N/A	N/A
Monthly Pass (Breakeven)	$91.00 (22 trips)	$91.00 (26 trips)	$73.50 (25 trips)	Free after 40 trips	Free after 32 trips
Day Pass (Breakeven)	N/A	$8.50 (3 trips)	$9.50 (4 trips)	N/A	$8.40 (3 trips)
Youth Fare					
Cash Fare	N/A	N/A	N/A	Free – weekdays after 6pm, weekends (100%)	N/A
Single-Use E-Fare	N/A	N/A	$1.70 (43%)	$1.90 – weekdays before 6pm (46%)	$2.25 (31%)
Ticket Book (Quantity) 1 Ticket	$25 (10) $2.50 (41%)	$26.00 (10) $2.60 (26%)	$17.50 (10) $1.75 (42%)	N/A	N/A
Monthly Pass (Breakeven)	$68.00 (16 trips)	$69.75 (20 trips)	$55.50 (19 trips)	Free after 40 trips	Free after 32 trips
Senior Fare					
Cash Fare	N/A	$3.00 – Mon, Wed, Fri-Sun (14%) Free – Tues, Thurs (100%)	N/A	N/A	N/A
Single-Use E-Fare	N/A	$3.00 (14%)	N/A	Free (100%)	$2.25 (31%)
Ticket Book (Quantity) 1 Ticket	$23 (10) $2.30 (46%)	$21.00 (10) $2.10 (40%)	N/A	N/A	N/A
Monthly Pass (Breakeven)	$57.00 (14 trips)	$53.00 (16 trips)	$55.50 (19 trips)	N/A	Free after 32 trips
Other Fare Types					
Child Cash Fare	Free (100%)	Free (100%)	Free (100%)	Free (100%)	Free (100%)
CNIB Cash Fare	Free (100%)	Free (100%)	$1.75 (50%)	N/A	Free (100%)

Post-Secondary Pass	$273/semester	U-Pass	U-Pass	$30/month	U-Pass
Low Income Fare	Yes	N/A	N/A	N/A	Yes
War Veteran Pass	N/A	N/A	Free	N/A	Free
Fare Availability					
Physical	Cash Fare, Ticket Book, Monthly Pass	Cash Fare, Ticket Book, Monthly Pass, Day Pass, Post-Secondary Pass	Cash Fare, Day Pass	Cash Fare	Cash Fare, Day Pass
E-Fare	Ticket Book, Monthly Pass, Post-Secondary Pass	Single-Use Fare, Ticket Book, Monthly Pass, Day Pass	Single-Use Fare, Ticket Book, Monthly Pass	Single-Use Fare, Post-Secondary Pass	Single-Use Fare, Post-Secondary Pass

Overall, Milton Transit uses a strategy of higher cash/single-use fare costs offset by more affordable monthly pass (relative to the cash fare). The cash fare of $4.25 is among the highest in Ontario, while the monthly pass cost is comparable to peers. Milton Transit's breakeven point for the adult monthly pass is only 22 trips, versus an average of 32 trips for peers. A lower breakeven point provides a degree of post-pandemic resiliency as the monthly pass remains the most affordable option for any workers making 11 monthly round-trips, maintaining popularity of the monthly pass. 2022 fare sale data shows that ridership paid using a monthly pass was nearly 10x greater than ridership paid using cash.

A noted trend from the benchmarking is the move towards a consolidated fare table. Guelph and Brantford have both aligned fares into two general categories: Adult, and Concession (youth, seniors, etc.). A streamlined fare table helps reduce complexity and lower barriers to understanding how to rider transit and reflects a push towards equity-based fares in lieu of age-based ones (see Section 8.3.3).

Two notable omissions in the Milton Transit fare table are day passes and single-use electronic fares. Three of the four peers sell day passes, which are designed to provide unlimited travel for one day and typically are priced to a breakeven of approximately three trips. Another notable omission is the lack of single-use fares within the Token Transit app, the only transit system of the peer group to not provide this option.

8.2.1 Key Takeaways

- Milton Transit currently uses a fare structure that varies based on age and fare type.
- Milton's cash fare is among the highest in Ontario, while the monthly pass cost is comparable to peers. This reflects a strategy of using higher cash/single-use fare costs that are offset by relatively more affordable monthly passes.
- Many peers are consolidating fares into two general categories: Adult and Concession (youth, seniors, etc.).
- Current gaps in Milton Transit's fare structure include day passes, single-use electronic fare, and single-use fares within the Token Transit app.

8.3 Fare Programs and Policies

The following section provides an overview of Milton Transit's existing fare programs and policies.

8.3.1 Transfer Policy

Milton Transit's transfer policy allows for two (2) hours of unrestricted travel upon payment of fare. This includes rounds trips and stopovers. Valid transfers include a paper transfer or Token Transit activated fare. This policy is consistent with many of the transit systems in the GTHA.

For inter-municipal transfers, such as connections to MiWay or Brampton Transit, a Milton Transit transfer is accepted on the outbound trip, and on the inbound trip, a PRESTO card or proof of PRESTO contactless payment can be shown to a Milton Transit operator to board and obtain a Milton Transit paper transfer.

For regional (GO) transfers, a GO ticket, PRESTO card or proof of PRESTO contactless payment can be shown to a Milton Transit operator to board. This policy only applies at Milton GO and the Hwy 401/RR 25 Park & Ride, meaning a valid Milton Transit fare would be required to connect at other locations (i.e. along Derry Road). There are further exemptions for certain fare products such as GO e-tickets and group/employee passes.

Milton Transit's inter-municipal and GO transfer policies allow for the rider to transfer at no additional cost in most circumstances. However, as Milton Transit does not use PRESTO, inter-agency and GO transfers are significantly more complicated for both the rider and operator and open up the possibility of significant fare evasion.

For peer transit systems using PRESTO, all that is required for inter-municipal and GO transfers is tapping a valid PRESTO fare (card or contactless payment). Validation and payment transaction occur on the back-end of the PRESTO system, improving ease of use for riders and operators.

8.3.2 U-Pass

U-Passes are fare products which are provided to post-secondary students, allowing for free unlimited use of the transit system, with a fixed per-student levy included as part of their tuition fees. U-Passes are typically ratified with participating student unions. They are a highly successful program as they promote transit use amongst a demographic which is less likely to own a personal vehicle, while providing a stable revenue base to the transit system to enhance services.

Milton did not have any post-secondary institutions until January 2024 when Conestoga College opened its first of three Milton campuses. Laurier is expected to soon follow. Milton Transit does not yet have a U-Pass agreement with either institution, with Term Passes (at $273 per semester) being provided as an interim measure.

Peer transit systems Brantford Transit, Kingston Transit, Barrie Transit, Guelph Transit, Thunder Bay Transit all offer U-Passes to participating post-secondary institutions. Sault Ste Marie Transit provides a semester pass, similar to Milton Transit. Neighbouring transit system Burlington Transit offers a $30 monthly “U-Pass add-on” for students in Burlington who take transit to study in neighbouring municipalities, and Oakville Transit does not offer a U-Pass despite being home to Sheridan College’s Trafalgar campus.

8.3.3 Equity and Inclusivity

As transit systems seek to improve the equity and inclusivity of their services, the popularity of equity-based fare products has grown significantly. While past concession fares were typically based on the rider’s identity (i.e. age-based), equity-based fare products rely on income measures to ensure discounts are provided to residents most in need.

Milton Transit is a member of Halton Region’s Subsidized Passes for Low Income Transit (SPLIT) program. The SPLIT program provides discounted monthly passes and tickets to riders who meet the eligibility criteria (see Exhibit 8.3).

Exhibit 8.3: Equity-Based Fare Products and Eligibility Requirements

	Milton	Kingston	Burlington	Thunder Bay	Sault Ste. Marie	Guelph
Discount	50%	75%	100%	50%	50%	58%-96%
Fare Products						
Monthly Passes	Yes	Yes	Yes	Yes	Yes	Yes*
Tickets	Yes	No	No	No	No	Yes*
Fare Product Types						
Paper	Yes	Yes	Yes	Yes	Yes	No
Electronic Farecard	No	Yes	No	No	No	Yes
Eligibility						
Low Income	Yes	Yes	Yes	Yes	No	Yes
Enrollment in Social Services	Yes	No	Yes	No	Yes	No
Refugee Status	Yes	No	Yes	No	No	No

*Guelph Transit uses a "pay-as-you-go" fare capping system. Their affordable pass program operates on a sliding-scale basis by income, providing flat-rate monthly travel for the registrants in most need, and a per-trip subsidy for other tiers of registrants.

While Milton Transit provides an industry-standard 50% discount on transit fare through the SPLIT program, peer transit systems have begun to exceed this standard, with neighbouring Burlington Transit providing fully-discounted (free) transit through the same SPLIT program. Meanwhile, other peer municipalities such as Barrie and Brantford do not provide any equity-based fare products.

In addition to low-income fare products, municipalities have begun to explore free transit for various user groups. As a result of recent initiatives, Oakville Transit provides free trips to youth riders under 20 years old or seniors 65+ years old. Burlington Transit has also been explored free transit strategies, and offers free trips for riders aged 12 and under, youth aged 13-19 after 6PM and on weekends, and seniors 65+ years old.

8.3.4 Employer Pass

Employer pass programs provide discounts to employers when they coordinate the bulk purchase of monthly passes for employees. The cost of these discounted passes can then be charged to employees, or further subsidized by the employer at their discretion. Milton Transit does not currently offer an employer pass program.

Kingston Transit is the only peer transit system with an employer pass program, with these programs often being more common in larger municipalities. However, Kingston's "Employer Transpass" program has been extremely successful, with nearly 100 active employers participating in the program. Kingston is a city with limited parking availability downtown and a frequent network of express bus routes, both contributing to the attractiveness of the program to employers. The program offers the following structure (see Exhibit 8.4):

Exhibit 8.4: Kingston Employer Transpass Discounts

Number of Participants	Discount
0-10	14%
11-25	17%
26-100	21%
101-250	27%
251+	31%

As the employment base in Milton grows, particularly in industrial/manufacturing sectors, Milton Transit may be able to translate this into ridership growth via an employer pass program. As learned from Kingston, the value of the program can be maximized by ensuring a high level of service to employment areas.

8.3.5 Fare Capping

To reward customer loyalty and enhance equitability of fares, ‘fare capping’ has emerged as a rapidly-growing fare program. Fare capping work as an alternative to monthly passes, where the rider pays the single-trip fare until they reach a “cap” (typically equivalent to the monthly pass cost), after which point all transit trips are free for the remainder of the month. Some fare capping programs layer on progressive discounts to incentivize additional travel prior to reaching the cap. This benefits the rider as they do not need to pay for a full monthly pass upfront, which is financially prohibitive to some, and saves riders money during months where they ride less (monthly pass cost is fixed regardless of utilization).

The growth in use of electronic fare payment systems has led to the ability to easily track the number of trips taken per month and administer these programs efficiently. The downside to the municipality is a less-predictable revenue stream, as monthly pass use is fairly consistent and predictable compared to single-use fares. Research on revenue and ridership impacts of fare capping is limited, but initial results do not demonstrate significant ridership or revenue impacts, while enhancing the equitability of the fare structure[9].

Of the peer transit systems, Guelph Transit and Burlington Transit both offer fare capping. Guelph’s “pay-as-you-go program” caps fares at 32 trips (at $2.80 per trip, or $89.60/month for adults), while Burlington’s “loyalty program” allows free travel after 40 trips (at $2.75 per trip, or $88/month for adults).

Milton Transit uses the Token Transit fare payment app, which has fare capping capabilities. However further study would be required to determine how the system would mitigate fare evasion due to existing inter-municipal and GO transfer policies. In addition, discussions with peers such as Guelph and Burlington should be held to better understand the impacts of fare capping on revenue and ridership.

[9] Abubakr Ziedan, Ashley Hightower, Luiz Lima, Candace Brakewood, The app or the cap? Which fare innovation affects bus ridership?, Transport Policy, Volume 145, 2024, Pages 247-258, ISSN 0967-070X, https://doi.org/10.1016/j.tranpol.2023.10.014. (https://www.sciencedirect.com/science/article/pii/S0967070X23002822)

8.3.6 Key Takeaways

- Milton's transfer policy for internal trips is consistent with peer municipalities, however there is a significant gap for inter-municipal travel as Milton Transit currently does not use PRESTO.
- While Milton Transit currently provides Term Passes for post-secondary students, there is a major opportunity to develop and implement U-Pass agreements with post-secondary institutions like Conestoga College and Wilfrid Laurier University.
- Milton Transit currently provides a 50% discount on transit fare for equity-deserving groups, many peer municipalities are exceeding this standard and even providing a 100% discount.
- Fare capping is a growing trend among peer agencies, however additional study would be required to determine the feasibility of this program in Milton.

8.4 Fare Payment Technology

This section provides an overview of existing fare payment technology used by Milton Transit.

8.4.1 Token Transit

Riders can pay fares through their smartphone using the Token Transit app. This app allows riders to purchase a single ride, 10 rides, or a monthly pass. Riders activate the ticket/pass in the app and show the digital ticket to the Milton Transit operator before boarding a bus. An internet connection is required to purchase and activate a mobile ticket/pass.

8.4.2 Onboard Fare Payment

Milton Transit buses are equipped with Cents-a-Bill onboard fareboxes supplied by Genfare. These fareboxes serve multiple functions:

- **Fare Collection:** Milton Transit riders can pay for their fares using any combination of accepted physical fare media, including coins, bills, and physical tickets. The fareboxes are equipped with a keypad that enable drivers to record visual monthly pass inspections, including paper monthly passes, all transfers, and all digital tickets.
- **Ridership Data Collection:** The farebox system records total ridership on individual buses, broken down by fare category and time of day. Location-specific boarding and alighting information is recorded and reported as well through the Automatic Passenger Counter system.
- **Geographic Information:** The fareboxes are integrated with Milton's Consat CAD/AVL system to provide single sign on and logon information through a J1708 interface. This interface also provides GPS information to the fareboxes for reporting.

Farebox data is retrieved manually from buses at the end of each day through a probing and cashbox emptying process.

Customers may request a physical paper transfer to demonstrate proof of payment. Paper transfers are provided by bus operators with a manual cutter to define the two-hour transfer window.

These fareboxes are uniformly installed across the fleet and reaching their end-of-life state (approximately 15 years), causing issues with revenue collection. Consultation with Town staff and PWTransit identified that farebox issues can result in Milton Transit buses being unable to collect revenue (operating in "farebox bypass" mode) or not being able to be deployed for service, leading to broader impacts to service reliability.

8.4.3 Fare Payment Technology Needs

The following key needs were identified based on a review of existing fare payment technology:

- **Farebox Upgrade/Replacement:** Existing fareboxes are nearing their end of life and experience mechanical and hardware issues. Replacement parts can also be difficult to acquire.
- **Mobile Ticketing Upgrade/Replacement:** The current mobile ticket activation process is confusing for customers. Monthly passes apply to calendar months and not 30-day periods, leading to riders not getting full value out of their passes. In addition, activation of an e-ticket too early before boarding will reduce the amount of time available in the 2-hour transfer window- this is particularly problematic as internet connection is required to activate e-tickets, so riders without phone data must do so at home before boarding. Mobile tickets are not electronically validated and can be vulnerable to fraud.
- **PRESTO Implementation:** There is increasing regional travel to neighbouring municipalities which utilize PRESTO as their electronic fare payment system. As the official regional fare system for the GTHA, there is an increasing expectation that riders travelling in the region are able to pay using PRESTO. PRESTO fares/transfers are validated visually by operators and not electronically, which is a common gap resulting in fare evasion.
- **On-Board and in-Terminal Wi-Fi/Activating Digital Tickets Offline:** The lack of on-board or in-terminal Wi-Fi can limit the use of mobile tickets for customers who are unable to access the internet.
- **Improved Data Tools and Resources:** The current fare collection system requires bus operators to manually enter a significant amount of rider information. This can lead to inaccuracies, particularly when there is a significant volume of boardings.

8.5 Recommendations

The recommendations below pertain to all aspects of the fare strategy.

8.5.1 Fare Programs and Policies

Ongoing Consideration

The following measures are recommended to modernize the fare structure and encourage new ridership across the transit service **throughout the full 5-year plan**:

- Implement modest increases to monthly pass price, tied to service increases, to fund improved transit service levels.

Short-term Consideration

The following measures are recommended to modernize the fare structure and encourage new ridership across the transit service in the short-term (1-2 years):

- Freeze the cash fare over short-term to reduce barriers for Milton's many new residents to try out Milton Transit without the commitment of a pass or 10-ticket book.
- Add a single-use e-fare product to Token Transit, priced below the cash fare but above the ticket book per-ticket fare.
- Extend the SPLIT fare discount to 100%, matching Burlington Transit, to target fare discounts to riders with the highest social equity need.

Medium-term Consideration

The following measures are recommended to modernize the fare structure and encourage new ridership across the transit service in the medium term (3-4 years):

- Explore implementing an Employer Pass program, tied to implementation of industrial tripper routes (potential use of excess fleet capacity tied to School Extras).
- Introduce "pay-as-you-go" monthly fare capping, simplifying the fare table and enhancing social equity. Implementation would be alongside implementation of PRESTO.
- Explore the possibility of distributing SPLIT fare products via the Token Transit app or PRESTO instead of solely through physical passes.

Long-term Consideration

The following measures are recommended to modernize the fare structure and encourage new ridership across the transit service in the long-term (5 years):

- Consider long-term harmonization of Youth and Senior concession fare categories to reflect changing socio-economic trends.

8.5.2 Fare Payment Technology

The fare payment technology recommendations listed below are intended to address the needs identified above in Section 8.4.3. Implementation timeframes are also included for each recommendation.

- **Replace and Upgrade Fareboxes (Short-Term Consideration, 1-2 years):** Existing fareboxes nearing their end of life should be replaced with new registering fareboxes. Many new validating farebox models are easy to install and maintain, can improve transit data reporting, and replacement parts are widely available.
- **Implement PRESTO (Medium-Term Consideration, 3-4 years):** It is recommended that the Town collaborate with Metrolinx to implement the PRESTO smart card system on Milton Transit buses. While the new fareboxes (described above) would be retained for cash fares, the PRESTO system would be used to validate electronic fare payments (PRESTO smart cards, credit and debit cards, mobile tickets). Implementing this system will provide seamless fare payment and transfers for riders, improve financial reconciliation for inter-municipal and Provincial fare integration reimbursement, reduce fare evasion and fraudulent activity, and improve transit reporting and ridership estimates. This may also reduce the administrative burden on Milton Transit customer service staff as PRESTO has its own website and customer service portal. This is recommended for medium-/long-term consideration to align with planned improvements and upgrades by Metrolinx to the PRESTO system (Next Gen PRESTO).

9 Marketing and Communications

Marketing and communications are key functions for any transit system. A variety of platforms, channels, and tools are used to provide information to both existing and prospective transit riders. This can involve marketing to attract new riders to transit as well as communicate information to provide existing transit riders with updates and increase trip convenience. The following section provides an overview of Milton Transit's existing marketing and communications platforms as well as recommendations to help grow ridership and enhance the customer experience.

9.1 Existing Communications Platforms

Milton Transit currently engages with their riders through a variety of online platforms. These are briefly summarized below:

- **Website:** The Town of Milton website (Milton.ca) includes a section that is dedicated to transit. Transit information is organized into four sections: Schedules and Maps, Fares and Passes, Services, and About Transit. The website includes links to transit maps and related mobile applications. There is also the ability to reach subscribed riders through website email alerts.
- **Social Media:** Milton Transit is currently active on X (formerly known as Twitter) and Facebook. Customer service staff provide service updates and engage with customers on these platforms.
- **Mobile Transit Applications:** Milton Transit customers use a variety of website and mobile applications to access transit information and plan transit trips. This includes general trip planning applications that contain Milton Transit information (like Google Maps, Triplinx, and the Transit App) as well as third-party applications that have partnered with the Town to provide Milton Transit-specific information and functionalities (like Milton OnDemand and Token Transit).

In addition to online platforms, Milton Transit engages with riders through in-person mediums:

- **Bus Stop Markers and Signage:** These stop amenities provide information to customers about Milton Transit services.
- **Electronic Vehicle Signs:** Milton Transit buses display route numbers and destinations on electronic signs.
- **Onboard variable message signs:** The current Intelligent Transportation System (ITS) used has the capability to display announcements.
- **Front Line Employees:** This includes bus operators as well as customer service staff.
- **Print publications:** Ride Guides, service cards.

9.2 Assessment of Milton Transit Communications Platforms

Section 9.1 above describes Milton's existing communications platforms. We assessed these platforms to identify gaps and issues with current practices. Findings were as follows:

- There is consistent application of graphic standards, and most materials consider accessibility best practices.
- User interfaces of the website and the transit applications could be improved. In particular, the Milton Transit route map, developed internally in an interactive GIS environment, can be difficult to navigate for new users and is not graphically appealing.
- Trip planning apps lack sufficient information which limits their effectiveness (i.e. instructions on how OnDemand zones function, how to book trips).
- The Triplinx app requires knowledge of the address for both the trip origin and destination – this information may not be known by new residents. This is opposed to Transit App which allows the rider to see bus routes serving their exact location regardless of desired destination. Communication may be difficult when there are multiple sources of system information on differing platforms.
- Some audiences may lack the devices or familiarity to access online/in-app services. An over-reliance on digital platforms misses the potential to reach customers and new riders.

Recommendations to address these needs and gaps are described below in Section 9.5.

9.3 Target Market Segments

The results from public and stakeholder engagement (Section 11) were used to identify Milton Transit's key target market segments. These market segments group Milton Transit riders into categories based on commonalities among demographics and transportation behaviours.[10] This process helps to determine how transit needs and wants vary among different groups. Targeted strategies and recommendations can then be developed for different segments to increase overall marketing engagement and ridership.

The following key Milton Transit market segments were identified:

[10] It is acknowledged that not all Milton Transit riders may fall into one of these categories, and that attributes described within each category may not apply to all Milton Transit riders within a category. This process is intended to broadly identify commonalities and trends to inform the development of strategies and actions.

- **Youth:** This group lives in both urban and suburban contexts and rely heavily on public transportation, active transportation, and car rides as passengers. Youth are often students who have limited funds and desire social spaces/activities that are accessible by transit.
- **Skilled Labour:** This group involves skilled labour workers who often use a mix of private automobile and public transit as their primary modes of transportation. Shift work is common, and the start and end times may not align well with transit options. Rising costs of living and the unpredictability of job contracts means that affordable transportation is key for this group.
- **Post-Secondary:** Both Conestoga College and Wilfrid Laurier University have opened/are soon opening major campus facilities in Milton, and the post-secondary population is anticipated to increase significantly. Post-secondary students often do not own cars and rely on transit. Varying class schedules and part-time work means that many trips occur outside of peak hours, and transit schedules may not align with class/work start and end times.
- **Office-Retail-Medical:** This group represents a significant percent of Milton's overall population, as 45% of residents are between the ages of 25 and 54 and 62% of the labour force works in knowledge-based jobs. This group uses a variety of sustainable transportation modes, however busy work and personal schedules means that transit reliability and frequency are key.
- **GO Commuter:** This group involves people who rely on regional GO Transit to access workplaces and destinations outside of Milton. These are longer transit trips, and first/last mile connections to Milton GO and the 401 Park & Ride are key. Outside of work, cars are commonly used to local errands and trips in Milton.
- **Specialized:** This group represents persons with disabilities who use Milton access+ specialized transit trips. Specialized trips are needed for both internal Milton trips and occasionally regional travel outside of Milton. However, the frequency and availability of specialized transit services does not always align with when this group needs to travel. Accessibility is also key for this group. This includes accessibility of physical infrastructure, like sidewalks and public places, as well as online platforms (including digital transit trip planning platforms).
- **Seniors:** This group may not have a car, or the ability to drive, and relies on transit for their needs – this includes both conventional and specialized transit trips. Some people in this group do not have access to technology, and those that do may face challenges in using technology to plan and pay for transit trips.

9.3.1 Key Takeaways

- Transit-dependence is prevalent among many of Milton Transit's key market segments including Youth, Post-Secondary, and Seniors.
- Varying class schedules, part-time work, and shift work among the Post-Secondary and Skilled Labour groups drives a need for transit service outside of peak hours.
- Many potential transit customers among the Office-Retail-Medical group have busy schedules and transit must be reliable and frequent to be appealing.
- There is a need to improve frequency and availability for specialized transit trips to effectively meet the needs of the Specialized market segment.

9.4 Customer Service Platforms Review

9.4.1 Customer Service Technologies

Milton Transit's customer service functions currently leverage various technologies to assist in handling customer inquiries. These technologies include the following:

- **Social Media** (managed by internal staff): This includes X (formerly known as Twitter) and Facebook. Staff use these platforms to provide service updates and engage with customers.
- **Internally Built Call Tracking System** (managed by contracted service provider staff): A tracking system was developed internally and is used to record customer call inquiries that are not related to booking trips. This system tracks the date and time of the call, phone numbers, customer names (if available), the call subject and actions taken.

9.4.2 Customer Inquiries

Inquiries by Milton Transit customers generally fall within one of the following categories:

- **Schedule and Service Information Requests:** This includes trip planning and lost and found requests.
- **access+ or OnDemand Reservation Requests:** Call volumes for these requests have increased significantly as access+ and OnDemand ridership has increased.
- **Payment and Fare Media Information:** This includes inquiries about different fare payment methods and amounts.
- **Website or Application Issues:** This includes growing call volumes for issues related to the use of the access+/OnDemand platform and associated systems.
- **Technology/Technical Issues:** Other issues in addition to the ones described above.

9.4.3 Customer Service Needs

The following key needs were identified based on the review of existing customer service platforms and technologies:

- **Automated Call and Response Tracking:** Existing customer service operations are manual, which results in less efficiency and capacity for tracking calls and customer inquiries.
- **Reduced Call Volumes for Customer Service Agents:** Customer service agents face challenges when dealing with significant call volumes.
- **Improved OnDemand System Reliability:** Customers often experience technical issues when using the OnDemand system, which results in large call volumes.

9.5 Recommendations

The following sections outline recommendations based on the review of the existing communications platforms and target market segments, described above, as well as findings from public and stakeholder engagement (Section 12). Implementation timeframes are also included for each recommendation – these timeframes are described by year and by quarter.

9.5.1 Customer Information

The following recommendations are intended to increase awareness and familiarity with Milton Transit's services. This is particularly important given the significant network change proposed in 2025 and to educate riders about how OnDemand services work.

- **Continue publishing a Ride Guide (as needed):** This guide would include a route map, instructions on how to take transit, fare information, and contact information. This should be available in both a physical paper and online PDF format.
- **Publish an Updated OnDemand Information Pamphlet (Q3, 2024):** This would focus specifically on OnDemand services including service information, and education on the impacts of no-shows and cancellations. This pamphlet should always be available onboard OnDemand vehicles.
- **Translate Customer-Facing Content (Q4, 2024):** Transit information, including online web pages, digital platforms, and paper materials should be provided in commonly spoken languages in Milton (i.e. Urdu, Arabic, Spanish).
- **Standardize Process for Marketing Service Changes (Q2/Q3, 2024):** This includes notification via email, social media, transit apps, phone systems and fare purchase locations. All Town of Milton and contractor front-line staff should also be informed of service changes.

9.5.2 Promotions

The following recommendations are intended to highlight the appeal of Milton Transit's services and provide incentives to take transit.

- **Build Excitement around the New Network (Q2, 2025)**: This promotion will include a campaign to educate riders on the benefits of the new network and how their transit journeys may change.
- **Continue the Read and Ride Program (Q3, Annually):** This partnership with the Milton Public Library has been operating successfully since 2008 and should be continued.
- **Continue to Conduct a Seniors Month Initiative (Q2, Annually):** Provide free transit rides to seniors on Wednesdays in the month of June.
- **Increase Milton Transit Presence at Community Events (Q3/Q4, Annually):** This includes community events like SummerFest, Milton Fall Fair and Canada Day.

9.5.3 Market Research

The following recommendations are intended to collect increased feedback from Milton's population that can be used to inform future transit improvements.

- **Conduct Annual Customer Satisfaction Surveys (Q3, Annually):** These surveys can be administered through the Let's Talk Milton platform and in-person at Milton GO and/or onboard transit vehicles.
- **Conduct Non-Rider Surveys (Q1, Annually):** These surveys will help to identify the needs of non-transit riders to identify ways to attract Miltonians to transit. These surveys should be conducted every few years and can be administered through a variety of means (i.e. intercept survey, research panel).

In addition to the above, secondary data sources (including from other Town studies and plans) should be leveraged where available to gain further insights on how transit can be improved in the future.

9.5.4 Partnerships

The following recommendations speak to groups that Milton Transit can partner with directly to increase transit ridership.

- **Conduct Annual Visits to Schools (Q1/Q2, Annually from 2025):** This can include bringing a transit vehicle on-site to educate students on how to ride transit and will help to build a youth transit culture.

- **Reach out to the Growing Newcomer Community (Q2/Q3, Annually):** Milton is expected to welcome up to 50,000 new residents over the life of the Transit Service Plan. Milton Transit can build relationships with local cultural, religious, and community organizations to educate and attract newcomers to transit.
- **Attend Post-Secondary Orientations (Q3, Annually):** This will introduce new students to Milton Transit, and the U-Pass program, and inform them of how their campus is served by transit. This is a key partnership given significant anticipated growth in post-secondary students.

9.5.5 Customer Experience

The following recommendations are intended to enhance the customer experience for Milton Transit riders.

- **Consider Developing a Customer Charter (Q1, 2025):** Consult with riders to develop a charter that outlines rider expectations when they use Milton Transit. Milton Transit can track their performance against the charter commitment to Council as part of annual reporting.
- **De-brand access+ and OnDemand Services into One Public-Facing Brand (Q4, 2025):** The existence of two branded products, access+ and OnDemand, creates a mindset that customers of one are disadvantaged by customers of the other. A single re-branded service will better manage expectations of on-demand transit services. This is a critical part of a "Family of Services" approach that will simplify customer understanding of Milton Transit's non-fixed route services.

9.5.6 Customer Service Technology

The customer service technology recommendations listed below are intended to address the needs identified above (10.4.3). Implementation timeframes are also included for each recommendation.

Short-term Consideration

The following is recommended for short-term consideration (1-2 years):

- **Improve OnDemand Service Reliability and User Experience:** There is an opportunity to work with the OnDemand software provider to address issues and glitches in the system. This will help to reduce the number of issues that customers experience and therefore reduce customer call volume. A ticketing system or additional software updates may also allow customer service staff to manage and respond to customer issues more efficiently.

Long-term Consideration

The following is recommended for long-term consideration (5+ years):

- **Consider Procuring a Customer Relationship Management (CRM) System:** Procuring a CRM system would allow Milton Transit customer service staff to efficiently track and manage customer data and interactions and reduce the customer service agent burden. This increase in data would help customer service staff streamline processes, respond to respond to customer inquiries faster, personalize customer interactions, access historical inquiries, and identify trends and insights that can be used to improve the transit system.
- **Consider Procuring an Interactive Voice Response (IVR) System:** An IVR system is an automated telephone technology system that interacts with customers through voice prompts and touch-tone keypad entries. Procuring this automated system would allow customers to quickly access transit system information without needing to speak to customer service staff. This also increases accessibility as customers can access information 24/7, and some IVR systems offer multilingual options. This system can be scaled up to support more customer inquiries in a manner that reduces the need for additional Milton Transit customer service staff.

Both recommendations for long-term consideration should be subject to further analysis to validate required functionality. Additionally, it is possible that it may be more efficient for the contractor to procure these systems, as they are largely responsible for customer service. This requirement could be included within a future operations contract. Thus, they are not included within the Capital Budget.

9.6 Distribution and Performance Measures

Exhibit 9.1 below outlines the distribution channels and performance measures for each of the marketing and communications recommendations.

Exhibit 9.1: Distribution and Performance Measures for Marketing and Communications Recommendations

Program	Audience	Rationale	Channels	Resource Requirement	Performance Measures
Customer Information					
Ride Guide	All	- Accessible, comprehensive customer information is vital to attracting new customers - Timely information improves the customer experience	6 panel; website, print on demand, printed	-Milton StratComs for development of materials	-Customer satisfaction scores for quality of information
Customer Information Enhancements	All	-Increase ease of use of customer information for new and existing customers	Website enhancements, Apps, Translation, Communications calendar, Scripts, Contract with PWTransit	-Milton Transit for creation of calendar, script development and contract details with PWTransit -Milton StratComs for development of materials - Dedicated MarCom FTE	-Customer Satisfaction ratings for information channels

Program	Audience	Rationale	Channels	Resource Requirement	Performance Measures
Low cost channels	All	-Leverage use of low cost channels to push transit information	Website, X, Facebook, Milton OnDemand, Transit Tracker, Token Transit, CSR on hold system, onboard advertising spaces, vehicles, posters	-Milton StratComs for development of materials - Dedicated MarCom FTE to manage updates	- Track and report use of low-cost channels - Number of posts, app updates, CSR messages
Promotions					
Network Redesign	All	-The launch of the new network will be a transformational change for transit service in Milton - It is essential to provide timely and comprehensive information about the change - A stepped campaign will ensure customers and potential new riders are well informed in advance of the new network implementation	Sign boards installed at transfer hubs at Milton GO, MEV, Kennedy Circle, Household mailer, street teams, swag, website, apps, social, posters, video	-Milton Transit for service details and scripts -Milton StratComs for development of materials - Sign shop for sign boards and installation -Dedicated MarCom FTE -Street teams -Video Production services	- Adherence to Implementation Plan - Customer Satisfaction Scores with quality of information - Awareness of New Network

Program	Audience	Rationale	Channels	Resource Requirement	Performance Measures
Service Alerts/Changes	All	-In order to minimize customer inconvenience and support ridership uptake for new service options it is critical to adopt a standardized cadence for distribution of service change information -Information should be provided on a variety of platforms to ensure timely customer awareness -Distribution channels should consider where and when customers are most likely to see information	Website, social, apps, poster	-Milton Transit for service details and scripts -Milton StratComs for development of materials - Dedicated MarCom FTE	-Customer satisfaction scores for quality of information
Read & Ride	Youth	-Well regarded partnership program with Milton Public Library -Reaches youth demographic while promoting transit and literacy	Website, apps, social, poster	-Milton StratComs for development of materials	-Program details communicated 30 days prior to promotion start date - Number of transit validation stickers issued
Seniors Month	Seniors	-Well received program for Seniors Audience -Demonstrates community support	Website, poster	-Milton StratComs for development of materials	-Program details communicated 30 days prior to promotion start date - Awareness levels amongst senior community

Program	Audience	Rationale	Channels	Resource Requirement	Performance Measures
Community Events	All	-Community events attract a large cross-section of attendees -Opportunity to increase awareness of new and existing services - Increase awareness amongst newcomers and non-riders	Website, social, signs, pop up booth	-Milton StratComs for development of materials -Sign shop for signs -Dedicated MarCom FTE -Staffing for events	-Number of events supported -Awareness of Milton Transit event participation
Market Research					
Customer Research	All	-The annual customer satisfaction survey is a vital source of performance measures including usage, attitude, and awareness metrics	Website, intercepts	-Milton Transit for questionnaire design -Milton StratComs for development of materials -Dedicated MarCom FTE -Intercept team	-Number of completed surveys -Survey representative of all audiences
Non-rider Research	Non-riders	-The non-rider surveys will provide insights into services and/or motivators which might convert them to transit or increase taxpayer support for transit services	Mailer insert	-Milton Transit for questionnaire design -Milton StratComs for development of materials -Dedicated MarCom FTE -Intercept team	-Number of completed surveys -Survey representative of all audiences
Partnerships					

Program	Audience	Rationale	Channels	Resource Requirement	Performance Measures
Schools and Post-Secondary Visits	Youth	-Youth and Post-Secondary are important ridership segments - Schools program familiarizes new students with transit -Excellent venue to emphasize Transit Safety and Etiquette	4 panel Youth Guide, colouring pages (Schools), bookmark	-Milton StratComs for development of materials -Dedicated MarCom FTE -Staffing for visits	-Number of schools program visits completed -Feedback from schools program participants
Newcomers	All	-50,000 new residents anticipated over life of 5 year plan - Many will be new to transit - A strong potential source of new riders -Opportunity to leverage community associations and faith community	Posters, bookmark, Ride Guide - translations	-Milton Transit to sign up community partners/confirm translation requirements -Milton StratComs for development of materials -Dedicated MarCom FTE	-Number of community partners - Newcomer awareness levels
Customer Experience					
Customer Charter	All	-Customer charters are an excellent foundation for a customer centric service -Outlines Milton Transit commitments -Includes Passenger Code of Conduct (Safety and Etiquette) -Build community engagement through co-creation of charter - Establishes meaningful performance measures	Website, apps, social, car cards, decals	-Milton Transit to design and lead community working group -Milton StratComs for development of materials -Dedicated MarCom FTE	-Creation of community panel to develop charter -Regular publication of Milton Transit performance vs charter commitments

Program	Audience	Rationale	Channels	Resource Requirement	Performance Measures
OnDemand	All	-OnDemand Services an important, ongoing element of service delivery - Building support for comingled services will encourage inclusion - Service information clearly explains the two service protocols and clarifies eligibility - Support for OnDemand will ready neighbourhoods for changes to established services expected with move to multi-focal system	4 panel; website, printed, car cards, decals, video	-Milton StratComs for development of materials -Dedicated MarCom FTE - Video production services	-Customer satisfaction scores for OnDemand service -Customer satisfaction scores for quality of information - Awareness of comingled service

10 Capital and Operating Budgets

Assumptions for the budgets and forecasts below are as follows:

- All costs are in current dollars.
- These cover all recommendations contained in this report, unless otherwise noted.
- Costs are provided by the Town where possible, and where Town estimates could not be provided, high-level estimates were based on the consultant's best judgement and peer comparables.
- Annual spending is tied to phasing of recommendations identified throughout the Plan.
- Gas Tax revenue is an estimate based on the MTO's funding allocation formula, but overall funding pool is tied to province-wide fuel consumption and therefore cannot be predicted with full accuracy.
- All service changes (Phase 1-3 implementation) are assumed to begin in September of their respective years.
- U-Pass agreement with Conestoga College and Laurier University is assumed to be active by September 2026. Until this point, the stopgap contribution from the post-secondary institutions is assumed to be maintained.
- Service to urban expansion areas is assumed to begin in September 2027
- Town-Owned Garage is budgeted under a different Town department and therefore is not included within the Capital Budget.
- Town-Owned Garage is assumed to be able to provide storage capacity by July 2027 and be fully operational by January 2028.
- PRESTO is assumed to be implemented by January 2028. PRESTO fee is assumed to be 9% but in practice will be subject to negotiations.
- Fare capping, and the suspension of monthly passes and tickets is assumed to occur upon PRESTO implementation in January 2028.

10.1 Capital Budgets and 10-Year Forecast

The 5-year Capital Budget and 10-year Capital Forecast for Conventional Transit is provided below in Exhibit 10.1, and for Specialized Transit in Exhibit 10.2.

Exhibit 10.1: 5-Year Capital Budget and 10-Year Capital Forecast for Conventional Transit (Dollars in Thousands)

	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Diesel Buses – Growth	$2,745	$2,745	$915	$915	$0	$0	$0	$0	$0	$0
Diesel Buses – Urban Expansion	$0	$3,660	$0	$915	$0	$0	$0	$0	$0	$0
Diesel Bus Refurbishment	$240	$120	$0	$0	$0	$0	$480	$360	$840	$120
BEBs – Growth	$5,729	$5,729	$1,910	$1,910	$3,819	$1,910	$3,819	$1,910	$3,819	$0
BEBs – Replacement	$0	$0	$0	$0	$3,819	$9,548	$3,819	$1,910	$0	$0
BEB Charging Equipment	$251	$251	$186	$32	$283	$501	$437	$64	$218	$0
BEB Refurbishment	$0	$0	$0	$0	$0	$7	$21	$0	$21	$21
Support Vehicles – Growth	$0	$220	$0	$0	$0	$0	$110	$0	$0	$0
Support Vehicles – Replacement	$0	$0	$0	$0	$0	$0	$330	$0	$0	$0
Bus Signposts	$24	$0	$54	$9	$30	$0	$0	$0	$0	$0
Bus Concrete Pads	$152	$19	$143	$67	$143	$10	$10	$10	$10	$10
Bus Shelters	$0	$270	$720	$0	$270	$0	$270	$0	$270	$0
MEV Terminal	$0	$0	$2,451	$0	$0	$0	$0	$0	$0	$0
Kennedy Circle Terminal	$0	$0	$0	$500	$0	$0	$0	$0	$0	$0
Britannia Terminal	$0	$0	$0	$0	$0	$0	$0	$0	$0	$2,451
PRESTO Fare Card	$0	$0	$765	$60	$80	$120	$80	$40	$40	$0
Farebox Replacement	$0	$0	$1,384	$0	$0	$0	$0	$0	$0	$0
Total	**$9,141**	**$13,014**	**$8,528**	**$4,408**	**$8,444**	**$12,096**	**$9,376**	**$4,294**	**$5,218**	**$2,602**

Exhibit 10.2: 5-Year Capital Budget and 10-Year Capital Forecast for Specialized Transit (Dollars in Thousands)

	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Diesel Buses (8m) – Replacement	$0	$0	$518	$0	$1,036	$0	$0	$0	$0	$0
Diesel Buses (6m) – Growth	$218	$0	$0	$0	$0	$0	$0	$0	$0	$0
Diesel Buses (6m) – Replacement	$0	$874	$437	$0	$0	$0	$0	$0	$0	$0
BEBs (6m) – Growth	$0	$0	$787	$0	$787	$0	$787	$0	$787	$0
BEBs (6m) – Replacement	$0	$0	$0	$0	$0	$0	$0	$0	$1,573	$2,360
BEB Charging Equipment	$0	$0	$218	$0	$218	$0	$64	$0	$501	$501
PRESTO Fare Card	$0	$0	$320	$0	$120	$0	$40	$0	$120	$120
Farebox Replacement	$0	$0	$732	$0	$0	$0	$0	$0	$0	$0
Total	**$218**	**$874**	**$3,012**	**$0**	**$2,161**	**$0**	**$891**	**$0**	**$2,981**	**$2,981**

10.2 Operating Budgets

Exhibit 10.3 below provides the Operating Budget for Conventional and Specialized Transit (including OnDemand):

Exhibit 10.3: Operating Budget for Conventional/Specialized Transit (Dollars in Thousands)

	2024 (Baseline)	2025	2026	2027	2028	2029
Population	143,897	147,529	159,597	166,845	173,223	180,886
Post-Secondary Enrollment	700	3,000	3,100	3,200	3,200	5,700
Conventional Service Hours	67,900	83,400	91,200	108,500	131,000	143,700
Specialized Service Hours	10,000	10,000	10,500	11,000	11,500	12,000
Total Ridership Forecast (000s)	1,095	1,295	1,787	1,880	2,090	2,271
Transit Division Staff (FTEs)	4	5	6	6	6	6
Total Conventional Fleet / BEBs	20 / 1	24 / 3	27 / 6	34 / 7	38 / 8	41 / 12
Total Specialized Fleet / BEBs	14 / 0	15 / 0	16 / 0	16 / 2	16 / 2	18 / 4
Operating Revenues						
Fare Revenue	$2,468	$3,353	$3,798	$4,037	$4,468	$5,006
U-Pass/Post-Secondary Contribution	$250	$250	$868	$896	$896	$1,596
Reserve Contributions (including Provincial Gas Tax)	$1,083	$1,670	$1,851	$2,107	$2,197	$2,345
Other Municipality Subsidies	$555	$709	$709	$750	$750	$750
Other	$173	$173	$173	$173	$173	$173
Total	**$4,529**	**$6,155**	**$7,399**	**$7,963**	**$8,484**	**$9,870**
Operating Expenditures						
General/Administration	$749	$940	$1,092	$1,092	$1,092	$1,092
Transportation Operations	$6,579	$7,228	$7,676	$8,639	$9,882	$10,594
Fuel for Vehicles	$1,467	$1,511	$1,497	$1,761	$2,088	$2,080
Electricity for Vehicles (BEBs)	$7	$63	$123	$143	$176	$264
Vehicle Maintenance	$1,080	$1,269	$1,383	$1,627	$1,944	$2,125
BEB Charging Equipment Maintenance	$6	$18	$36	$54	$60	$96
Transfer to Reserve	$2,156	$2,951	$4,083	$4,587	$4,941	$5,428
Total	**$12,044**	**$13,980**	**$15,890**	**$17,903**	**$20,183**	**$21,679**

	2024 (Baseline)	2025	2026	2027	2028	2029
Net Operating Spending						
Net Municipal Spend	$7,515	$7,825	$8,491	$9,930	$11,699	$11,809
Per Capita	$52.22	$53.04	$53.20	$59.58	$67.54	$65.28
Cost Recovery Ratio	38%	44%	47%	44%	42%	46%

11 Public and Stakeholder Engagement

The Milton Transit Service Review and Master Plan Update was developed with input from the public and stakeholders throughout the study process. Engagement is essential to developing a transit plan and network that meaningfully responds to community needs and priorities and reflects the residents' and stakeholders' vision for the future of Milton.

11.1 Engagement Activities

Engagement activities held throughout the study involved a range of stakeholders including members of the public, Town representatives, and agency stakeholders. Consultation was conducted over two rounds of engagement, each corresponding to specific milestones in the development of the Transit Service Review and Master Plan Update.

Phase One Engagement (June-August 2023) focused on initial outreach and exploratory engagement. This focused on collecting feedback on the existing transit service to identify key needs and to provide input into the major priorities and themes of the Transit Master Plan. Round one engagement consisted of the following activities:

- A **Public Information Centre (PIC)** was hosted in-person at the Sherwood Community Centre from 5:30PM-8:00PM on June 22nd, 2023. This was a joint PIC with the Transportation Master Plan Update. Engagement materials were also posted on the Let's Talk Milton engagement website.
- An **online survey** was conducted to understand priorities and travel patterns of Milton residents, both existing Milton Transit riders and non-riders. The survey was hosted on the Let's Talk Milton engagement website from June 26th-Sept 4th, 2023, and participation included 205 survey responses.
- **Stakeholder group meetings** were hosted both in-person and virtually from August 8th-17th, 2023. Meetings included participation from business groups, community groups, Town staff, Milton Accessibility Advisory Committee (MAAC), Halton Region, neighbouring transit systems, Metrolinx, Ontario Ministry of Transportation (MTO), and the transit service operator (PWTransit).
- A **dedicated presentation** was given to the MAAC on June 21st, 2023, to discuss the 5-Year Plan.

Phase Two Engagement (April-May 2024) focused on collecting feedback on the draft study recommendations, including the recommended transit network. Round two engagement consisted of the following activities:

- A follow-up **online survey** was shared with residents to obtain feedback, particularly on the 2029 proposed fixed-route transit network and overall student recommendations. The survey was hosted on the Let's Talk Milton engagement website and participation included 134 survey responses. The survey was open from May 1st-May 31st, 2024.
- **Stakeholder group meetings** were hosted virtually from April 29th-May 2nd, 2024. Meetings included participation from business groups, community groups, Town staff, MAAC, Halton Region, neighbouring transit systems, Metrolinx, MTO, and PWTransit.

11.2 Key Findings

The PIC, surveys, and stakeholder meetings provided valuable opportunities to engage directly with residents, business owners, advocates and more, learning about their experience, concerns, and priorities for Milton Transit. General themes and priorities heard throughout the study process are described below. These were used to inform the recommendations developed for the Transit Master Plan.

11.2.1 Phase One Engagement

Phase one engagement focused on the existing transit service and key needs. Key findings include the following:

- **Many Miltonians are not familiar with Milton Transit services:** Less than a quarter of survey respondents aged 25-64 reported being familiar with Milton Transit services. Further, less than 4% of survey respondents aged 65+ reported being familiar with Milton Transit services. There is an opportunity to apply marketing and communication strategies to increase awareness and utilization of Milton Transit services.
- **Transit affordability is key:** Miltonians across all ages reported that saving money and a lack of an available car/inability to drive were among the top reasons for taking transit. Milton has a diverse population that includes many youth, students, and seniors with fixed or limited incomes. Transit can play a critical role in providing access to essential needs and services. This includes community centres and recreational spaces that enable social connections.
- **Milton Transit excels in customer experience:** Customers reported having a positive experience when riding Milton Transit vehicles. This included clean vehicles that are in good condition, available comfortable seating areas, and transit staff who were courteous and helpful. Milton Transit's operator, PWTransit, reported that Milton Transit has a reputation as a good place to work and labour retention is positive.

- **There is a need for more frequent service and better coverage:** Faster transit and shorter wait times for transit were among the top improvements that would encourage Miltonians to use transit. Automobile use is dominant in Milton, and competitive travel times on transit will help to attract and retain ridership. Miltonians also expressed a desire for increased transit coverage. Many destinations are not currently served by transit, particularly industrial and rural areas.
- **Miltonians rely on transit during off-peak hours:** Work and school are among the top destinations for transit use in Milton. However, much of this travel occurs outside of peak hours. There is a desire for increased transit service on the weekdays, evenings, and on weekends to accommodate travel for student class times, shift work, and part-time jobs. This demand will likely increase in the future due to new educational campuses, like Conestoga College and Wilfrid Laurier University, and a growing post-secondary population.
- **There is a strong desire for PRESTO integration:** Currently, Milton Transit is one of the few transit agencies where fareboxes on buses do not accept PRESTO cards. There is a strong desire for PRESTO integration to simplify fare payments and enable seamless connections to regional transit. This is particularly relevant for Milton given the large volume of commuters who use Milton Transit to connect to GO Transit services.
- **Transit is part of a thriving natural environment:** Environmental friendliness was reported as one of the top reasons why Miltonians use transit. Over half of the survey respondents believed that Milton Transit is good for the environment, and there was support for more electric buses in Milton Transit's fleet.
- **Milton Transit facilitates both inter- and intra-municipal trips:** Many residents used Milton Transit to connect other regional transportation services, particularly GO Transit via the Milton GO station. Transit trips within Milton also occurred for a variety of purposes including work and school, shopping/errands, and medical appointments/care.
- **OnDemand and access+ should be seamlessly integrated:** OnDemand service and access+ operations conflict under the current comingled model. access+ riders experienced increased trip times and trip detours due to comingling, while OnDemand riders reported missing transfers with conventional service and arriving late to destinations. Additional areas of concern include long wait times on Saturdays and a high trip cancellation rate. There is a need to improve OnDemand and access+ integration under a Family of Services model to efficiently serve the needs of both groups.

11.2.2 Phase Two Engagement

Phase two engagement focused on the recommended future transit network and draft study recommendations. Key findings include the following:

- **Frequent transit service is a key component of an effective transit network:** Similar to phase one engagement results, Miltonians indicated that more frequent (15-20 minute) weekday transit service was very important to them. This critical for serving existing customers and helping to attract new customers to transit.
- **Increased transit coverage will help serve a growing Milton:** Many survey respondents reacted very positively to the increased coverage of the future Milton transit network. This represents increased transit access to major destinations, like Milton GO, as well as growing areas in Milton like the Milton Education Village and the Brittania neighbourhood. However, residents in new communities identified some limited coverage gaps in the Plan.
- **Direct routes make transit more appealing:** The recommended future transit network streamlines routes to implement a service-based network. This helps to make the transit system more intuitive, improve the transfer experience and reduce overall travel time when using transit.
- **There is a desire for more weekend transit service:** While the recommended future transit network includes improved weekend service compared to the existing network, there are desires for even more weekend transit service in the future. This will help to enable Miltonians to access key destinations for social services and recreational/leisure opportunities.
- **There is strong support for PRESTO integration:** Similar to phase one engagement, Many survey respondents expressed a desire for integration of PRESTO fare payment service with Milton Transit. This will help to increase convenience for transit riders, particularly when connecting to and from regional GO transit.
- **The transit network can provide critical connections to schools and jobs:** Many Miltonians rely on transit to access schools and places of work. This includes secondary schools like Milton District High School, and industrial areas north of Highway 401. Both conventional fixed-route service and OnDemand service can help to provide essential transit connections to these areas.
- **Miltonians want to use transit to connect to regional transportation:** The recommended future transit network includes connections with GO Transit at Milton GO station and the Milton 401 Park & Ride. However, respondents indicated that they would like to see additional frequency and service coverage to these areas beyond what has been planned. There may be opportunities in the future to increase partnerships and transit connections with neighbouring municipalities like Mississauga, Oakville, and Burlington.

Appendix A

Appendix A – Zero Emission Bus Energy Modelling Methodology

Trip Energy Analysis

Energy modelling was developed for all trips in the context of battery electric bus (BEB) operations. To estimate the compatibility between the proposed service plan and BEB range constraints, a simple blocking plan was also developed to estimate how long buses could remain in service before requiring swap-out. The blocking plan assumed no interlining, with all buses serving one route exclusively. The theoretical blocking plan is presented in Exhibits A.1, A.2, and A.3.

Exhibit A.1: Weekday Blocking Plan

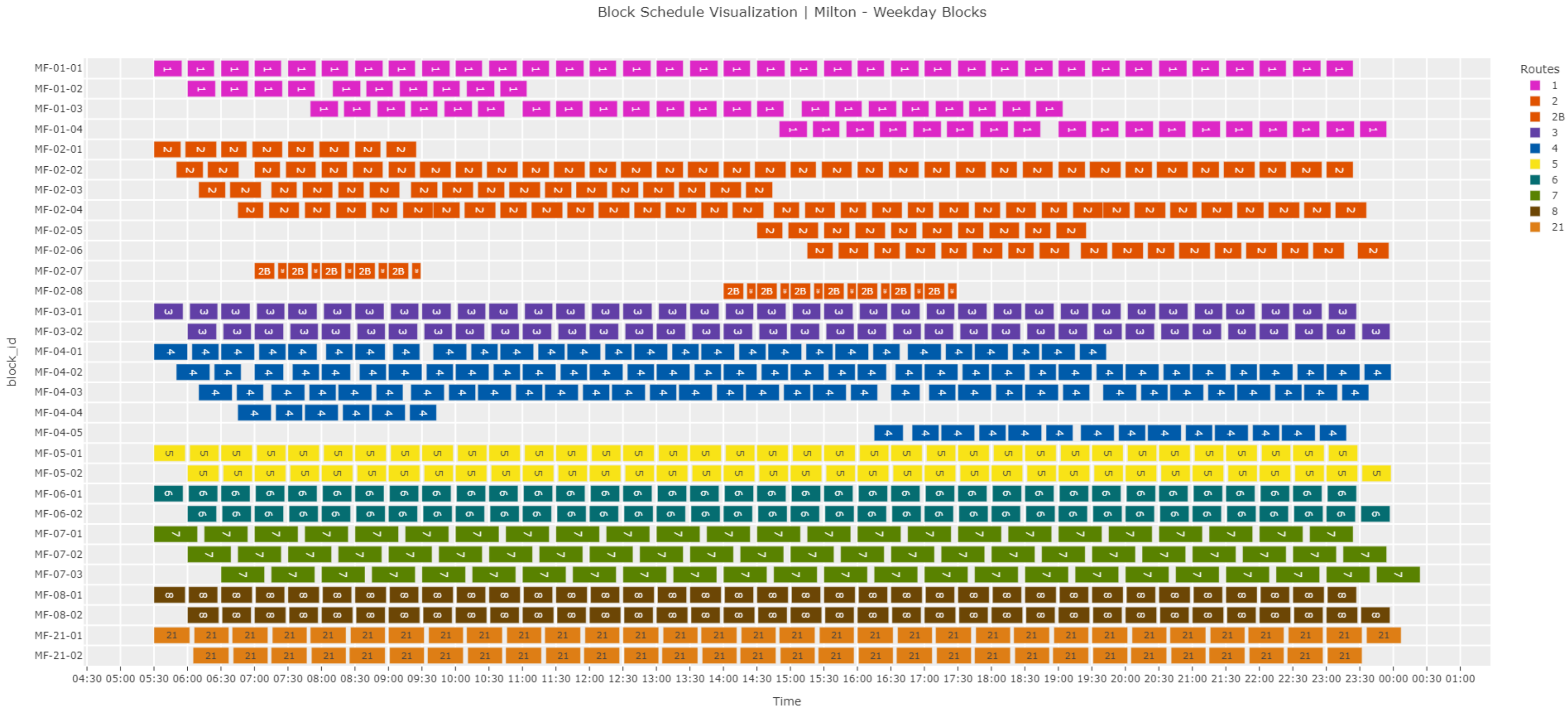
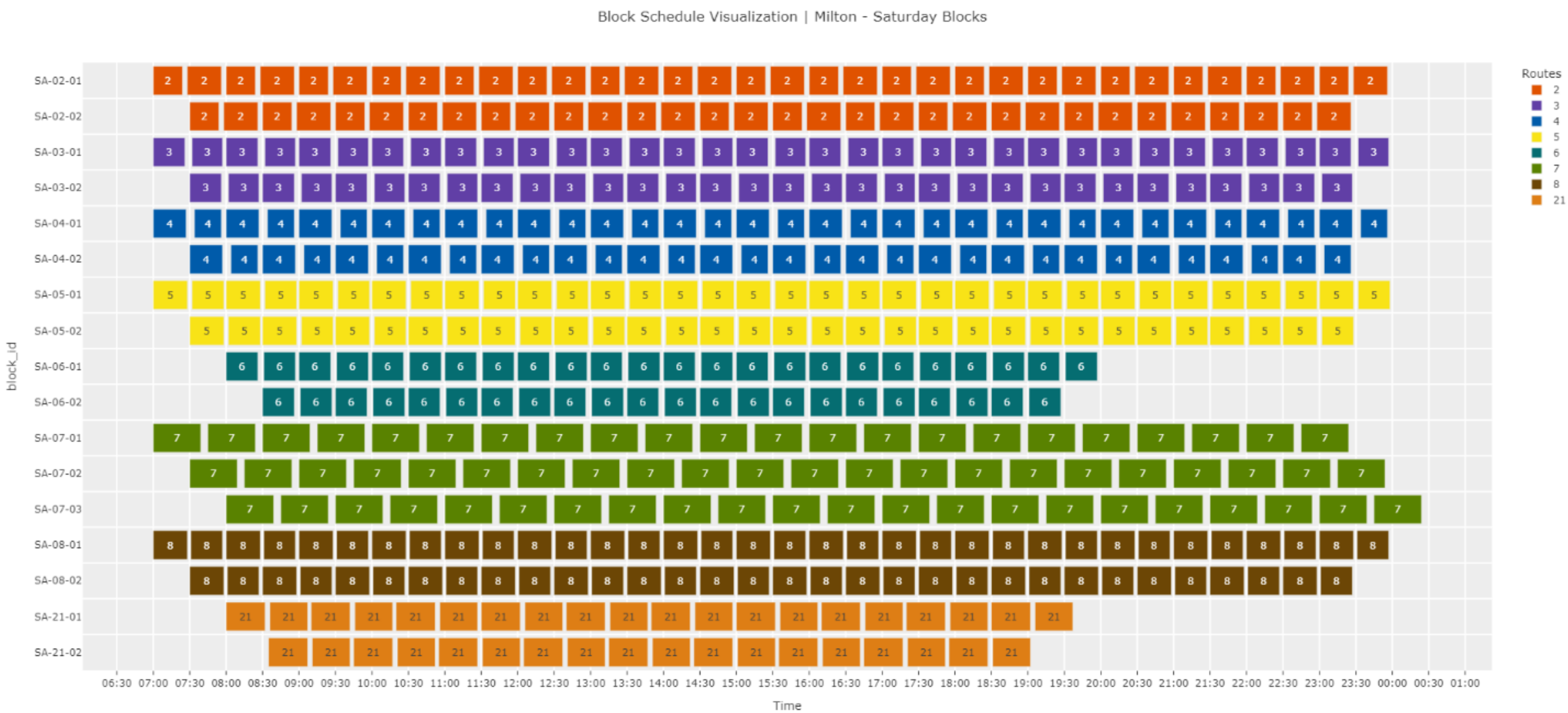


Exhibit A.2: Saturday Blocking Plan



MILTON

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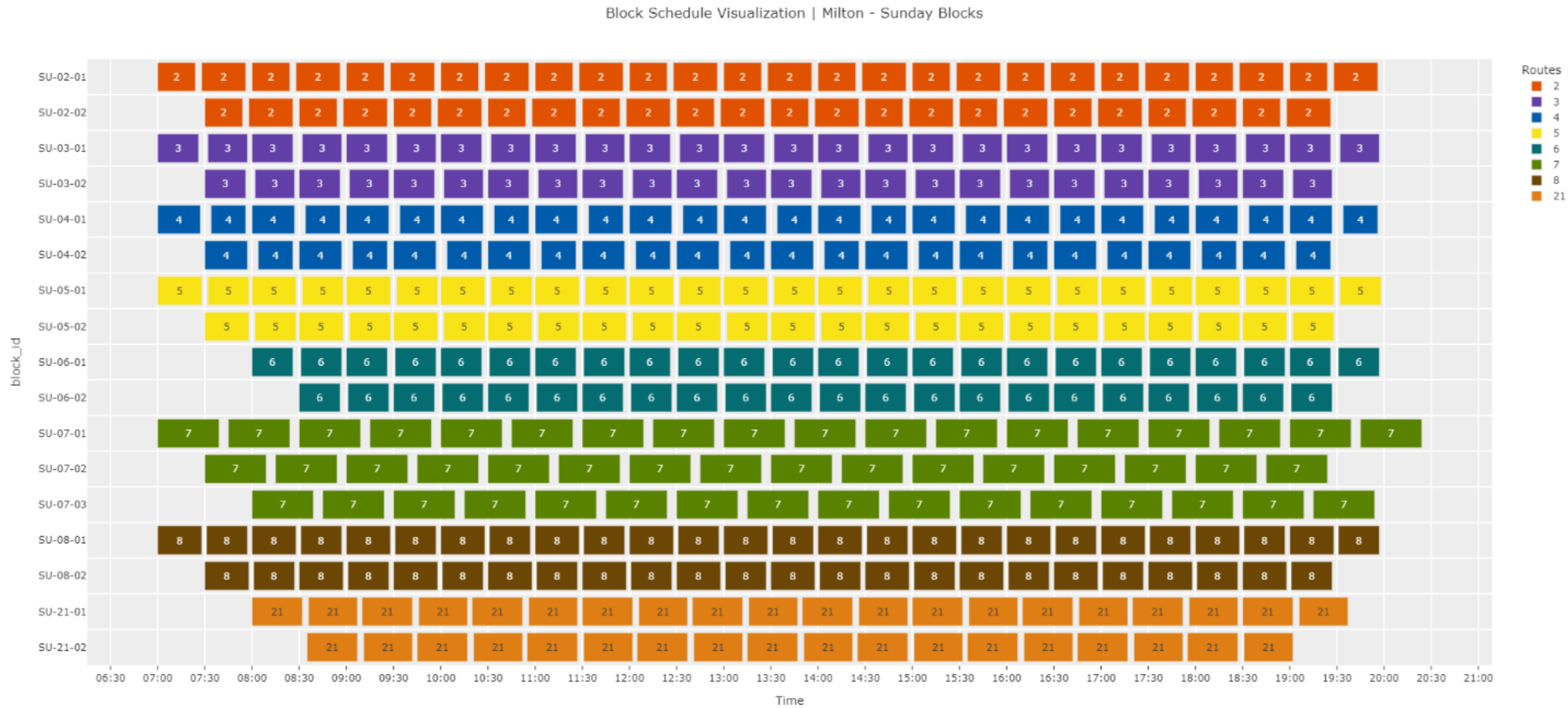
Exhibit A.3: Sunday Blocking Plan



Methodology

The energy consumption model considered the following key factors:

- Horizontal propulsion, based on vehicle mass and road design along run routings,
- Vertical propulsion, based on terrain elevation corresponding to run routings,
- Heating, ventilation, and air conditioning (HVAC), based on available weather data and vehicle properties,
- Passenger loading, using a range of occupancy from 0% to 100%.

Detailed discussion of each factor is found in the subsections below. The model used by Arcadis projects total energy consumption based on the interaction of these factors at the trip level.

The model used in this study calculates the kilowatt-hours (kWh) of energy consumed by 2 common 12-m (40-ft) models of BEB in the Canadian market:

- NovaBus LFSe+ (absolute capacity 564 kWh; 80% useable capacity 451 kWh)
- New Flyer Xcelsior CHARGE NG XE40 (absolute capacity 525 kWh; 80% useable capacity 420 kWh)

Our process uses annual maximum and minimum values for weather conditions to estimate realistic extreme-case scenarios. Given the temperate climate in the Milton region, cold winter weather was simulated. The model considers the energy consumed to accelerate forward including for uphill slopes, heat the interior of the vehicle (including escaped heat from opening and closing doors), and powering electrical devices onboard the vehicle. Environmental considerations are included in the model, such as from water films on roads and battery performance degradation from colder temperatures.

Horizontal Propulsion

Horizontal propulsion energy consumption is driven by the vehicle mass (including passengers), acceleration, rolling resistance, and air resistance. Propulsion power uses the kinetic energy formula throughout the course of a run.

$$E_{kinetic} = \frac{1}{2} m_{BEB} * v^2$$

m_{BEB} refers to the mass of the bus, v is the velocity (or speed) of the vehicle, and $E_{kinetic}$ is the kinetic energy consumed. The model incorporates the acceleration after every stop event. In addition, aerodynamic drag resistance is taken into account in the energy consumption model.

Vertical Propulsion

The impact of hill climbing on BEB energy consumption was included in the analysis. Energy consumed on vertical ascents is calculated as the cumulative difference in the gravitational potential energy, using the following equation:

$$E_{vert} = m_{BEB} \times g \times h_{climb}$$

m_{BEB} refers to the mass of the bus, g is the acceleration due to gravity (9.81 m/s^2), and h_{climb} is the cumulative positive vertical climb distance.

On descents, the effect of gravity on reducing propulsion energy is similarly subtracted, to a minimum of 0 kWh for downhill coasting. However, potential energy recovery through regenerative braking (converting a vehicle's kinetic energy back into electrical energy during deceleration, helping to recharge its batteries and improve overall efficiency) is not directly calculated, to produce a more conservative estimate. Our methodology takes this approach primarily due to the observed recovery of energy through regenerative braking being highly variable, being dependent on operator technique, traffic conditions, and road traction. Therefore, our methodology considers it unreliable at the feasibility planning stage when projecting future operational and infrastructure needs. Instead, driver behaviour has been built into the horizontal propulsion component, which is derived from observed field data.

Heating, Ventilation, and Air Conditioning (HVAC)

Energy consumption by HVAC depends on multiple factors including:

- Temperature gradient (difference between outside and inside temperature)
- Interior volume of the bus
- Air changes per hour (the number of times per hour that all air in the bus is replaced), which is affected by:
  - The baseline airtightness of a given vehicle
  - The cumulative amount of time that doors are open in an hour

These factors are then multiplied by the length of the run. Depending on the season and day-to-day weather, the resulting total energy consumption can vary significantly. In temperate regions such as the Greater Toronto Area, winter represents the period of highest total energy demand for heating; for vehicles with air conditioning, summer represents a secondary energy demand peak for cooling. Importantly for winter heating, BEBs can be designed to either draw all heating energy from the battery, or (depending on the manufacturer) to also carry a small diesel-powered heater to provide auxiliary heating below a threshold temperature setting.

Terrain

Our modeling tool queries publicly available terrain datasets from the Ontario GeoHub for the ground elevation of every point in the GTFS shapefile (example data visualization shown in Figure 5). Elevations are mapped to route paths to calculate vertical climb of buses. The elevation gain across a route is used to calculate the vertical propulsion energy consumed by the bus. Terrains with sharper changes in elevation will consume more energy than flat or steady terrains.

Findings

Results of the energy modelling effort indicated that nearly all blocks in the theoretical blocking plan were compatible with the battery capacity constraints of either the NovaBus LFSe+ or the New Flyer Xcelsior CHARGE NG XE40. The only exceptions were the two blocks operating on Route 21, which exceeded the recommended 80% maximum depth-of-discharge constraint. The projected energy consumption results are presented in Exhibit A.4.

Exhibit A.4: Energy Consumption Analysis Results

Service Day	Block ID	Block Start Time	Block End Time	Block Duration (h)	Block Distance (km)	Average Block Electric Energy Consumption (kWh) (Calculated at Battery Intake)
Weekday	MF-01-01	5:20:58	23:27:56	18.116	320.724	317.74
Weekday	MF-01-02	5:50:58	11:07:56	5.283	93.92	93.85
Weekday	MF-01-03	7:40:58	19:07:56	11.449	198.599	197.19
Weekday	MF-01-04	14:40:58	23:57:56	9.283	163.706	162.74
Weekday	MF-02-01	5:17:15	19:47:44	14.508	266.802	232.69
Weekday	MF-02-02	5:37:15	23:28:23	17.852	325.946	283.96
Weekday	MF-02-03	5:57:15	24:03:44	18.108	333.884	293.66
Weekday	MF-02-04	6:32:15	9:47:44	3.258	68.285	61.02
Weekday	MF-02-05	14:17:15	23:43:44	9.441	176.567	154.78
Weekday	MF-02-06	6:51:58	9:31:51	2.665	60.704	59.56
Weekday	MF-02-07	13:51:58	17:31:51	3.665	83.053	81.02
Weekday	MF-03-01	5:20:28	23:31:36	18.186	333.36	288.18
Weekday	MF-03-02	5:50:28	24:01:36	18.186	333.36	288.18
Weekday	MF-04-01	5:20:27	19:47:33	14.452	284.008	264.27
Weekday	MF-04-02	5:40:27	24:02:33	18.368	363.094	336.91
Weekday	MF-04-03	6:00:27	23:42:33	17.702	343.17	319.09
Weekday	MF-04-04	6:35:27	9:47:33	3.202	66.979	62.91
Weekday	MF-04-05	16:05:27	23:22:33	7.285	145.963	136.02
Weekday	MF-05-01	5:18:14	23:34:47	18.276	331.577	289.97
Weekday	MF-05-02	5:48:14	24:04:47	18.276	331.577	289.97
Weekday	MF-06-01	5:18:16	23:33:45	18.258	335.104	301.94
Weekday	MF-06-02	5:48:16	24:03:45	18.258	335.104	301.94
Weekday	MF-07-01	5:20:30	23:28:34	18.134	332.405	278.16
Weekday	MF-07-02	5:50:30	23:58:34	18.134	332.405	278.16

Weekday	MF-07-03	6:20:30	24:28:34	18.134	332.405	278.16
Weekday	MF-08-01	5:20:28	23:31:36	18.186	369.337	331.16
Weekday	MF-08-02	5:50:28	24:01:36	18.186	369.337	331.16
Weekday	MF-21-01	5:14:09	24:20:25	19.104	507.618	489.47
Weekday	MF-21-02	5:49:09	23:45:25	17.938	477.878	461.30
Saturday	SA-02-01	6:47:15	24:03:44	17.275	320.942	280.02
Saturday	SA-02-02	7:17:15	23:33:44	16.275	302.895	264.39
Saturday	SA-03-01	6:50:28	24:01:36	17.186	315.261	272.62
Saturday	SA-03-02	7:20:28	23:31:36	16.186	297.163	257.06
Saturday	SA-04-01	6:50:27	24:00:33	17.168	343.069	324.70
Saturday	SA-04-02	7:20:27	23:30:33	16.168	323.348	306.07
Saturday	SA-05-01	6:48:14	24:04:47	17.276	313.965	274.80
Saturday	SA-05-02	7:18:14	23:34:47	16.276	296.352	259.63
Saturday	SA-06-01	7:48:16	20:03:45	12.258	228.24	206.94
Saturday	SA-06-02	8:18:16	19:33:45	11.258	210.429	191.10
Saturday	SA-07-01	6:50:30	23:28:34	16.634	305.335	255.66
Saturday	SA-07-02	7:20:30	23:58:34	16.634	305.335	255.66
Saturday	SA-07-03	7:50:30	24:28:34	16.634	305.335	255.66
Saturday	SA-08-01	6:50:28	24:01:36	17.186	349.24	313.21
Saturday	SA-08-02	7:20:28	23:31:36	16.186	329.142	295.27
Saturday	SA-21-01	7:44:09	19:50:25	12.104	329.179	320.48
Saturday	SA-21-02	8:19:09	19:15:25	10.938	299.439	292.31
Sunday	SU-02-01	6:47:15	20:03:44	13.275	248.755	217.53
Sunday	SU-02-02	7:17:15	19:33:44	12.275	230.708	201.91
Sunday	SU-03-01	6:50:28	20:01:36	13.186	242.867	210.39
Sunday	SU-03-02	7:20:28	19:31:36	12.186	224.768	194.83
Sunday	SU-04-01	6:50:27	20:00:33	13.168	264.186	250.20
Sunday	SU-04-02	7:20:27	19:30:33	12.168	244.465	231.58
Sunday	SU-05-01	6:48:14	20:04:47	13.276	243.515	214.13

Sunday	SU-05-02	7:18:14	19:34:47	12.276	225.902	198.97
Sunday	SU-06-01	7:48:16	20:03:45	12.258	228.24	206.94
Sunday	SU-06-02	8:18:16	19:33:45	11.258	210.429	191.10
Sunday	SU-07-01	6:50:30	20:28:34	13.634	251.194	210.64
Sunday	SU-07-02	7:20:30	19:28:34	12.134	224.124	188.14
Sunday	SU-07-03	7:50:30	19:58:34	12.134	224.124	188.14
Sunday	SU-08-01	6:50:28	20:01:36	13.186	268.85	241.43
Sunday	SU-08-02	7:20:28	19:31:36	12.186	248.753	223.48
Sunday	SU-21-01	7:44:09	19:50:25	12.104	329.179	320.48
Sunday	SU-21-02	8:19:09	19:15:25	10.938	299.439	292.31

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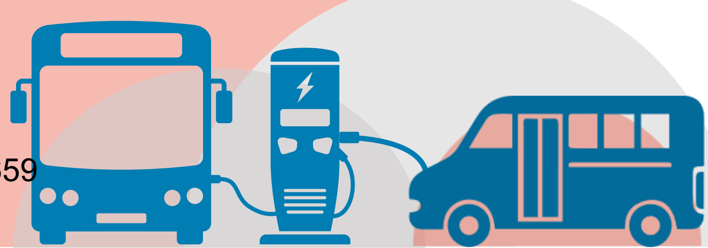
ZERO EMISSION BUS FEASIBILITY STRATEGY & FLEET TRANSITION PLAN

4/4/2024



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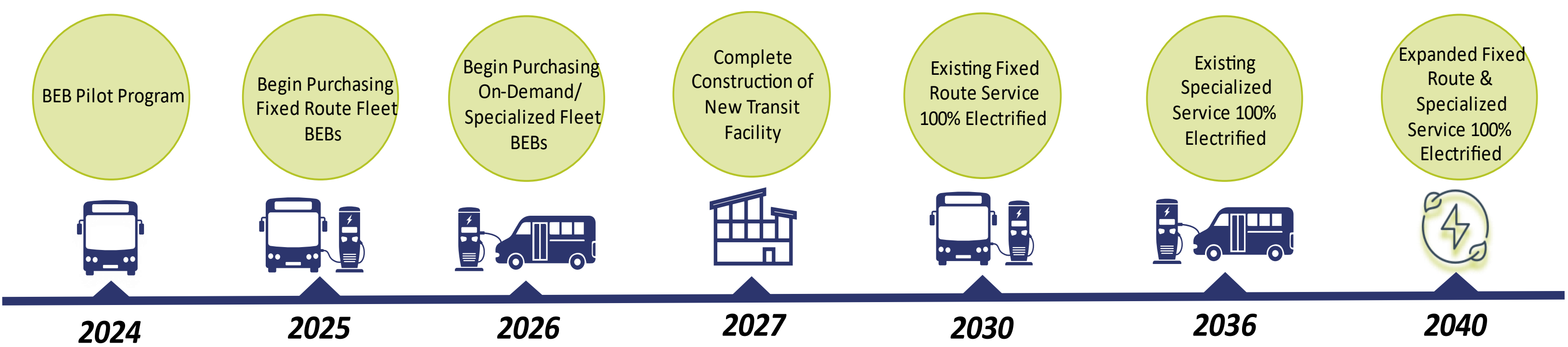
EXECUTIVE SUMMARY

Transitioning to a zero emission fleet involves more than simply buying vehicles and a fueling system; the transition introduces new technology and processes into day-to-day operations. Successful fleet transition plans take a comprehensive approach to consider operational requirements, market conditions, available power, infrastructure demands, and costs. This Zero Emission Fleet Transition Plan incorporates all of these elements and is intended to serve as a roadmap for Milton Transit to convert their transit fleets to zero emission by 2040.

Overall, the development of a comprehensive electrification plan for transitioning Milton Transit's fleet to electric vehicles was informed by several analyses conducted as part of this study. Key findings from these analyses performed during this study, including route modelling, schedule optimization, and the facilities assessment, are referred to in the step-by-step roadmap outlined in this Plan. Internal and external stakeholders were also engaged to understand the Town's needs and collaboratively develop the Transition Plan with input from other departments. Important elements of the Plan include recommended bus specifications, charging systems, and software solutions tailored to Milton Transit's operations, as well as maintenance and staff training considerations. The Transition Plan also includes timelines for fleet electrification, procurement coordination, service requirements, budgeting for capital and operating expenses, emission reduction projections, and an operational implementation plan addressing resource allocation and change management.

This study utilized energy modelling of battery electric buses (BEBs) using current route data to confirm operational feasibility and develop fleet charging strategies and recommendations for vehicle and charging infrastructure types. The comprehensive analysis summarized below provides Milton Transit with data to guide informed decisions involving capital programs and operations necessary to build key partnerships and support transition actions and phases.



As shown in the graphic above, this Transition Plan outlines a phased implementation approach that aligns with Milton Transit's goal of 100% electrified service by 20240. This gradual integration allows Milton Transit to gain experience with BEB technology while the market evolves. BEBs are impacted by limited range and the time to recharge may not be consistent with current fleet operations, depending on the fleet's operating profile. As technology advances, it's anticipated that batteries will become bigger and lighter, increasing vehicle range and overall market availability of BEB profiles will become more diverse. Anticipated advancements in battery and vehicle performance, as well as charging technology, will also enhance operational efficiency overtime.

The unit cost assumptions from the financial analysis are used to compare the operations of the baseline diesel bus fleet to the planned battery electric bus (BEB) fleet and provided in **Table 1** below. These costs reflect upfront capital costs for vehicles and electrical infrastructure, average annual cost of operations, maintenance, and diesel fuel and electricity costs. This table also includes the annual transfer to reserve needed to fund future vehicle and infrastructure replacements. All costs shown are in 2023 dollars and undiscounted. Overall, the capital costs of BEBs and related infrastructure are higher than diesel. However, maintenance cost and fuel cost savings associated with BEBs are significant relative to diesel.

Table 1. Capital Cost Comparison of 12-Metre Conventional Diesel Bus and Electric Bus (2023$)

Cost Components	Baseline Scenario - Diesel	BEB Transition Scenario Battery-Electric	Variance (Per Bus Unit)
Capital Expenditures			
Bus Acquisition – 12M	$915,024	$1,909,686	$994,662
Mid Life Refurbishment	$120,000	$7,000	-$113,000
Subtotal of Vehicle Costs	**$1,035,024**	**$1,916,686**	**$881,662**
Charging Equipment*			
Plug-In Depot Charger Cabinet (150 kW)	-	$154,097	$154,097
Plug-In Depot Charger Wall-Mounted Dispenser	-	$25,265	$25,265
Plug-In Depot Charger Overhead Reel Dispenser	-	$32,158	$32,158
Subtotal of Charging Equipment Costs	**-**	**$211,520**	**$211,520**
Capital Expenditures Total	**$1,035,024**	**$2,128,206**	**$1,093,182****

*- *Excludes major infrastructure and utility upgrades*
**-*106% increase in capital investment over baseline*

Table 2. Annual Operating Cost Comparison of 12-Metre Conventional Diesel Bus and Electric Bus (2023$)

Cost Components for Total Fleet	Diesel Bus	Battery-Electric Bus	Variance (Per Bus Unit)
Operating Expenditures (per year)			
Service Delivery and Administration, Training*	$326,794	$317,253	-$9,541
Vehicle Maintenance + Fuel (Diesel, Gasoline, Carbon Levy)	$99,843	$49,620	-$50,223
Electricity	-	$26,502	$26,502
Charger-Related Maintenance	-	$5,959	$5,959
Subtotal of Service Delivery + Charging Equipment	**$426,637**	**$399,334**	**-$27,303**
Contribution to Reserve for Asset Replacement			
Vehicles (12-year life)	$86,252	$159,724	$73,472
Charging Infrastructure (12-year life)	-	$17,627	$17,627
Subtotal Contribution to Reserve for Asset Replacement	**$86,252**	**$177,351**	**$91,099**
Total Annual Operating Cost (2023$)	**$512,889**	**$576,685**	**$63,796**

**-Based on average annual operating hours per vehicle, 2021 CUTA Statistics*

1 INTRODUCTION

As one of the fastest-growing municipalities in Canada, the town of Milton (the Town) is well-positioned to lead its community toward a cleaner future by recognizing the importance of its energy consumption and emissions. The Town has seized its opportunities to plan for a healthy future and engage as a leader in this growing field by developing a vision reflective of its key goals. To achieve the Town of Milton's vision as a strong and prosperous community, especially in the areas of economy, society, and the environment, the Milton Green Innovation Plan[1] has been launched as the flagship program for the Town's commitment to responsible energy management and development. As part of this program, the Town has created a baseline review of energy usage and emissions and developed an action plan to ensure responsible resource management.

To further build on its commitment to sustainability, the Town brings forth recommended key actions and initiatives for Council approval through its Climate Change Work Plan on an annual basis, allowing for expanded efforts on environmental stewardship. These initiatives focus on integrating sustainability principles into both daily practices and long-term plans. Among these efforts are the Community and Corporate Energy Plan, Diesel-to-Electric Bus Conversion Pilot, Milton Transit Master Plan, and the Transportation Master Plan. Within the Climate Change Work Plan, it is noted that the Town has a goal to reduce greenhouse gas emissions (GHGs) by 20%. To achieve the goal, the work plan outlines specific approaches such as developing an electrification strategy for town vehicles, including transit. Additionally, the town of Milton is committed to reducing emissions in line with the Ontario Community Climate Action Plan (OCCAP).[2]

[1] The Corporation of the Town of Milton Green Innovation Plan
[2] Ontario Community Climate Action Plan — March, 2023

2 TRANSIT FLEET ZERO EMISSION TRANSITION PLAN

The transition from conventional gasoline and diesel buses to battery electric buses is a significant undertaking that requires robust planning, as it will impact many aspects of the organization. Infrastructure Canada has created the Zero Emission Transit Fund[3] (ZETF) to support organizations in transitioning their fleets. In addition to funding planning projects, it has a capital stream that provides opportunities for transit agencies to receive funding for capital projects. To apply for capital funding there are five specific planning elements that applicants must satisfy, and this Fleet Transition Plan has been developed to address those elements:

1. **System Level Planning:** Description of system-level planning undertaken for the project, such as analysis of zero emission bus (ZEB) technologies, energy consumption analysis, and identification of charging/refueling and facility requirements.
2. **Operational Planning & Deployment Strategy:** Outlines a fleet and infrastructure implementation plan that supports innovative and effective ZEB deployments and future operations. This strategy is informed by optimal route selection, service design, and procurement needs.
3. **Financial Planning:** Provides preliminary capital and operating cost estimates, including the anticipated lifecycle cost comparison encompassing fuel and maintenance costs.
4. **Capacity to Implement the Technology:** Assesses the organization's current resources, skills and training required for the deployment and operation of a new ZEB fleet. It also provides an assessment of potential technological, operational, and system-wide risks associated with the transition and a risk management plan that details mitigation strategies.
5. **Environmental Benefits:** Includes a lifecycle assessment of environmental benefits associated with the transition, including estimates of greenhouse gas (GHG) emissions reduction, noise reduction, and non-GHG pollutant reduction.

This Transit Fleet Zero Emission Transition Plan (Fleet Transition Plan) addresses each of these topics in the following report and the accompanying appendices.

[3] Infrastructure Canada - Zero Emission Transit Fund Applicant Guide

3 SYSTEM LEVEL PLANNING

The foundation of this Fleet Transition Plan begins with the approach to system-level planning. An analysis of ZEB technologies was performed to further understand both BEB and fueling options on the market for Milton Transit to consider. An energy consumption analysis was developed for Milton Transit to create an accurate energy profile, which further works to identify charging, refueling and facility requirements specific to the agency's needs.

3.1 BATTERY ELECTRIC BUSES & FUELING OPTIONS

BEBs are currently the most popular zero emission bus because they utilize the electric grid as a source of fuel, which is universally available and relatively "easy" to connect to for drawing the required power. One shortfall is the limited range of BEBs compared to conventional diesel buses; for agencies with longer range requirements, BEBs may not be capable of directly replacing buses assigned to long duty cycles at a one-to-one replacement ratio. In some cases, it's not possible to adjust the service profile of these longer blocks to accommodate the range capabilities of today's available BEBs. For extended range requirements, either additional vehicles become necessary or en-route charging would need to be introduced at layover points along current routes.

En-route charging is an enhancement that can greatly improve the feasibility of BEBs in many situations; it can extend the range of a BEB and facilitate one-to-one replacement of diesel vehicles when the routes are conducive to this charging strategy. This is particularly helpful with circular routes where the same en-route charger can be used by a vehicle multiple times throughout the day. En-route charging infrastructure would ideally be located at places such as transit centers where buses operating on multiple routes all have scheduled layover time.

3.2 ENERGY CONSUMPTION ANALYSIS

Understanding energy consumption is a key component of fleet transition planning, as it informs the choice of vehicle technology, infrastructure requirements, finances, and fleet replacement strategies. The following sections outline the methodology, modelled scenarios, and key findings of Milton Transit's Energy Consumption Analysis.

3.2.1 METHODOLOGY

Milton Transit's zero emissions consultant, HDR, Inc. provided a comprehensive understanding of the potential impacts BEB technology may have on Milton Transit's existing service using their proprietary energy consumption model, Zero+. **Figure 1** shows the Zero+ Model inputs, outputs, and process.

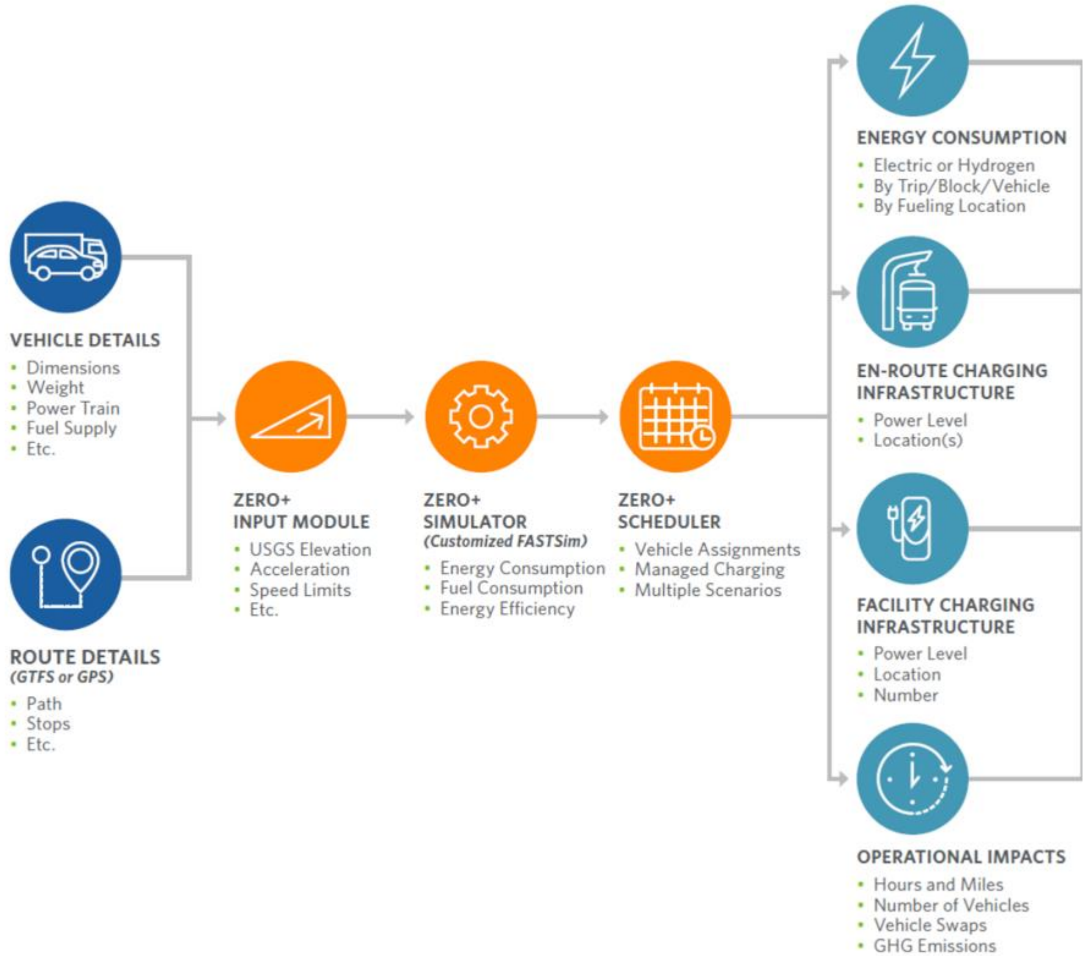


Figure 1. Zero+ Inputs, Outputs, and Modelling Process

Energy consumption is impacted by several factors including slope and grade of the bus routes, number of vehicle stops, anticipated roadway traffic, and ambient temperature. The Zero+ model also analyzes variables known to impact lifetime vehicle performance, like energy density, battery degradation, operating environment, HVAC and auxiliary power loads, as well as the lifecycle of bus batteries. The model is fed by GTFS data, GIS data, and vehicle profile assumptions to create an accurate energy consumption profile unique to Milton Transit's existing service. In sum, Zero+ results include many data variables, yielding the most accurate results possible to influence strong, effective decision making.

The Zero+ model results, combined with discussions with Town staff, provide the basis upon which the preferred vehicle technology and refueling strategy will be determined. This modelling evaluated whether the optimal charging strategy is depot charging only or a mix of depot and en-route charging, which nameplate battery capacity and auxiliary heater type is optimal and identifies potential strategies that best complement Milton Transit's service and fleet plans. Simulations were performed at the granular level to inform individual vehicles, routes, and blocks as well as the full Milton Transit fleet. Examining each vehicle individually drives decisions for the right technology at the system, depot, route, and block levels (e.g., how vehicles are scheduled to operate in revenue service during the day). This analysis balanced impacts to operations, overall fleet size, and infrastructure requirements and ultimately provides Milton Transit with the information to make a data-driven determination of the preferred BEB technologies to deploy and the pace at which to deploy them.

3.2.2 MODELLED SCENARIOS

The energy consumption modelling effort included the analysis of five scenarios for the conventional 12m transit bus fleet, inclusive of the supplementary school service; the On-Demand and Milton Access+ services were also modelled. This analysis only considers Milton Transit's existing service operated by the current fleet and does not model any planned future fleet expansions, but criteria for the transition to BEBs on these planned expanded services will be provided as a guideline for Milton Transit to use when planning for a full BEB fleet. Once the new, expanded service profile is established, Milton Transit will need to consider conducting an additional fleet modelling study as a supplement to this plan to provide exact recommendations for a fleet transition to BEBs.

3.2.2.1 FIXED-ROUTE TRANSIT FLEET

- Baseline (Diesel)
- Full BEB Fleet (525 kWh) with Depot Charging Only
- Full BEB Fleet (675 kWh) with Depot Charging Only
- Full BEB Fleet (525 kWh) with Depot and En-Route Charging

Based on the evaluation and collection of data described above, a baseline diesel scenario was simulated off current Milton Transit service to validate both the data provided and the functionality of the model by comparing simulation results to observed existing Milton Transit diesel operations. This validation provides confidence that the simulations of BEB scenarios are not missing critical data points that influence the transition.

Depot charging only was modelled first to establish a baseline feasibility. This scenario allows the Zero+ Model to identify which existing service blocks can be electrified without an increase in peak vehicle requirements, the need for en-route charging, or the need for schedule modifications to achieve the same level of service. In the depot charging only scenario, the model indicates how many additional vehicles would be required to maintain the same level of service without the use of en-route charging.

The model also included the analysis of a scenario where Milton Transit utilizes a combination of depot and en-route charging. Layover times in the existing schedule were used to identify the most ideal locations for en-route chargers; the Milton GO Station was identified as an ideal en-route charging location. It should be noted that although this location was modelled, the Town does not currently own this property which would be a contingency for installing and operating en-route chargers at this location. The Town should explore coordination with Metrolinx, the current property owner of the Milton GO Station, to install chargers that could be jointly operated by Milton Transit and GO Transit in anticipation of needing en-route charging capacity. Alternatively, Milton Transit could also consider delaying en-route charging plans until the planned service expansion is complete; through service expansion, additional candidate sites for en-route charging may be identified. Based on modelling of the existing fixed route service, the decision to implement en-route charging infrastructure at the Milton GO Station would need to be made at the beginning of Phase 2B with the purchase of the 12th BEB in 2029.

3.2.2.2 PARATRANSIT AND SPECIALIZED FLEET

Milton Transit's On-Demand and Access+ services were modelled separately from fixed route services due to the available data types. This modelling effort was based on operating data provided by the agency as well as the battery and charging specifications of equivalent BEBs. Existing paratransit and specialized fleet vehicles' average and maximum daily kilometres and hours in service, derived from Milton Transit's monthly vehicle data, were considered in the modelling. The total energy consumption of the BEB fleet is computed using the worst-case vehicles to forecast overall site energy and fleet size impacts.

If the daily amount of energy required exceeds the available energy for a vehicle, then the cases for an increase in fleet size or mid-day fast charging are considered. These additional cases facilitate protecting the vehicle's health while avoiding interruptions to normal operations. Three scenarios were considered: a base scenario, a scenario reflecting an expanded BEB fleet, and a scenario where the fleet is not expanded but mid-day recharging is supported.

3.2.3 KEY TAKEAWAYS

For conventional services, a 675kWh BEB fleet with depot only charging is operationally advantageous for Milton Transit as this scenario would require vehicle swaps (e.g. exchanging a BEB vehicle that has reached the daily operational limit for the battery capacity, with a BEB vehicle that is fully charged at the depot). These vehicle swaps would be required for four service blocks, while all other blocks are feasible without swaps. Under a 525kWh BEB fleet with depot only charging scenario, seven service blocks would require a vehicle swap. Fewer vehicle swaps are recommended for the following reasons:

- **Operational efficiency**
  - Fewer vehicle swaps result in lower non-revenue hours and miles to swap out vehicles during service, minimizing potential service disruptions.
  - Necessity for vehicle swaps may require additional drivers.
- **Cost savings**
  - More vehicle swaps result in a larger increase in fleet size requirements.
  - Increased fleet sizes also require additional charging equipment, depot space, and maintenance resources.
  - Swaps require vehicles to return to the garage midday for charging, incurring higher utility rates compared to overnight charging with lower utility rates, contributing to higher operational costs.

While a combination of depot and en-route charging would mean that all Milton Transit service blocks could be operated without vehicle swaps or changes to service, the complexities of infrastructure management, property ownership, and coordination at the identified feasible en-route charging location, the Milton GO Station, make Milton Transit's preferred scenario depot only charging with 675kWh BEBs.

Milton Transit's specialized fleet for on-demand services was modelled iteratively to determine the best alternative for the Town since vehicles cannot be transitioned at a one-to-one replacement ratio without some fleet and/or service modifications necessary. Milton Transit will elect to utilize mid-day recharging of the specialized fleet rather than expand the fleet. Nearly all existing vehicles can complete existing service on an average day without the need for service modifications, and all vehicles can complete service on both average and worst-case days with mid-day recharging. Since the worst-case operational profile is not regularly realized, the Town will operate BEBs on existing service with plans to utilize existing DCFCs installed at the depot for fixed route buses as a contingency if daily use is anticipated to exceed the operational range of the BEBs.

The detailed results of the route modelling analysis for Milton Transit's fixed route, On-Demand, and Access+ transit services can be found in **Appendix A: Energy Modelling Analysis.**

4 OPERATIONAL PLANNING & DEPLOYMENT

The following components highlight critical fleet and infrastructure implementation needs, including actions that will be taken to effectively deploy BEBs and ensure efficient future operations. The fleet deployment plan highlights each phase of the plan, offering a purchase schedule and insight into the phased deployment effort using the current transit fleet growth and replacement forecast provided by Town staff. The facility and infrastructure plan for the prospective depot facility is also provided, covering existing conditions and facility infrastructure implementation. The feasibility of en-route charging is also considered, with potential locations Milton Transit may consider to assessing in the future.

4.1 FLEET DEPLOYMENT PLAN

Milton Transit will be launching a BEB Pilot Program in early 2024 with one repowered bus (a diesel bus retrofitted with an electric drivetrain). The pilot will provide real-world experience with operating and managing an alternative-powered vehicle. Over time, and subject to Council approval of the Transit Fleet Zero Emission Transition Plan and associated budget, new BEBs are to be gradually introduced, with the first procurement anticipated in 2025 to be delivered and enter revenue service in 2027, two years from the purchase date. Initially, Milton Transit will integrate BEBs to the fixed route fleet with half of the buses purchased in each year to be BEBs and the other half to be diesel. Beginning in 2029, Milton Transit will cease purchasing diesel buses for fixed route service and all future procurement will be battery electric. The on-demand/specialized fleet transition will begin in 2026 with the purchase of three 6m buses. Similar to the fixed-route fleet, half of the buses purchased in each year will be battery electric until 2029; beginning in 2030, all future procurements will be battery electric.

4.1.1 FIXED ROUTE TRANSIT FLEET

The fixed route fleet will be electrified in three phases based upon infrastructure needs at the depot facility, available vehicle battery capacity, and future service expansion. The BEB in service through the Pilot Program will have a battery capacity of 400 kWh, while all future BEBs purchased from the OEM will be 675 kWh.

Phase 1: BEB Pilot Program (2024)
Milton Transit will pilot one repowered diesel BEB to test the technology and its impacts on ongoing service and operations. The Pilot BEB will rotate operating on all existing service routes to test how the bus performs on different route profiles.

Phase 2: Electrify Existing Fixed-Route Service (2025-2030)
Milton Transit currently operates seventeen (17) buses on existing active service. This phase will include the purchase of twenty-six (26) buses; sixteen (16) of these buses will be battery electric, completing the electrification of existing active fleet.

Phase 2A: 50% of procurements in each year will be BEB (2025-2028)
During this phase, Milton Transit will purchase sixteen (16) buses that will be a mix of diesel and battery electric buses; half of new procurements will be diesel (8 buses) and the other half will be BEB (8 buses).

Phase 2B: 100% of procurements in each year will be BEB (2029-2030)

Beginning in 2029, Milton Transit will cease purchasing diesel buses and all future procurements will be BEB. In this phase, ten (10) BEBs are purchased bringing the fleet total to forty (40) buses, including planned service expansion growth buses.

Phase 3: Electrify Expanded Fixed Route Service (2031-2040)

During this phase, Milton Transit will transition the remainder of the existing and planned expanded fleet to BEBs. BEB replacements of diesel buses purchased in phases 1 and 2A are also included in this phase, bringing the fixed-route transit fleet to a total of forty-five (45) buses in 2033 (delivery in 2035) with a full transition to BEBs occurring in 2038 (delivery in 2040).

Table 3 provides a breakdown of the number of fixed route BEBs purchased in each phase, with delivery of buses anticipated *two years after they are purchased*.

Table 3. Phased Fixed Route Fleet Deployment Plan

Phase	Purchased Replacement BEBs	Purchased Growth BEBs	Cumulative Purchased BEBs	Purchase Year
Phase 1	1	-	1	2024
Phase 2A	-	7	8	2025 – 2028
Phase 2B	6	3	17	2029 – 2030
Phase 3	23	5	45	2031 – 2040

Table 4 shows which purchases are replacement buses, where a diesel bus will be retired upon delivery, and expansion buses, where fleet size increases and a vehicle is not retired upon delivery. In many years, there are a mix of replacement and expansion buses. The breakdown aligns with the Town's expected 2023-2033 Transit Fleet Growth, Replacement, and Mid-Life Refurbishment Schedule.

Table 4. Bus Procurement Schedule, Replacement and Expansion Breakdown (2023 - 2040)

	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Diesel – Expansion Bus		4	4	3	1	1												
Diesel – Replacement Bus	5	2																
Electric – Expansion Bus			2	3	1	1	2	1	2	1	2							
Electric – Diesel Replacement Bus		1*					2	4	2	1			5	6	4	3	1	1
Electric – Electric Replacement Bus**								1							2	3	1	1

**Diesel conversion pilot BEB*

***BEB replacement of BEB purchased earlier in transition*

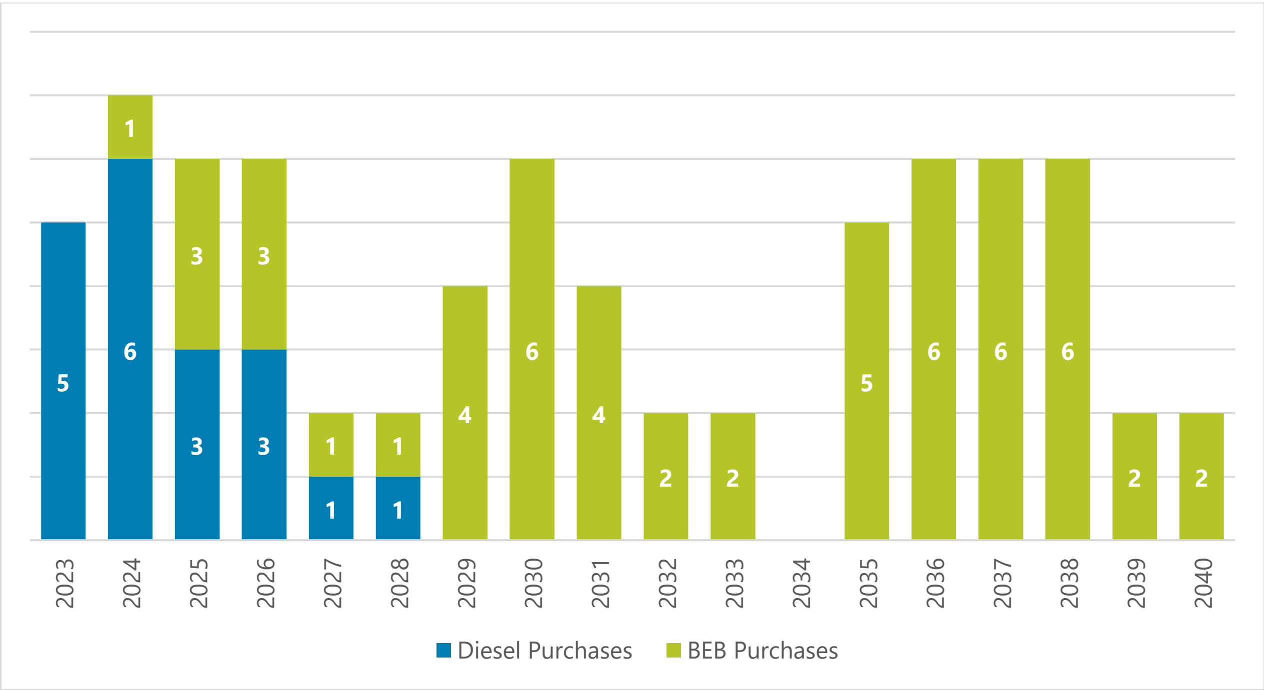


Figure 2 shows when new fixed route buses, both diesel and BEB, will be purchased through 2040, while

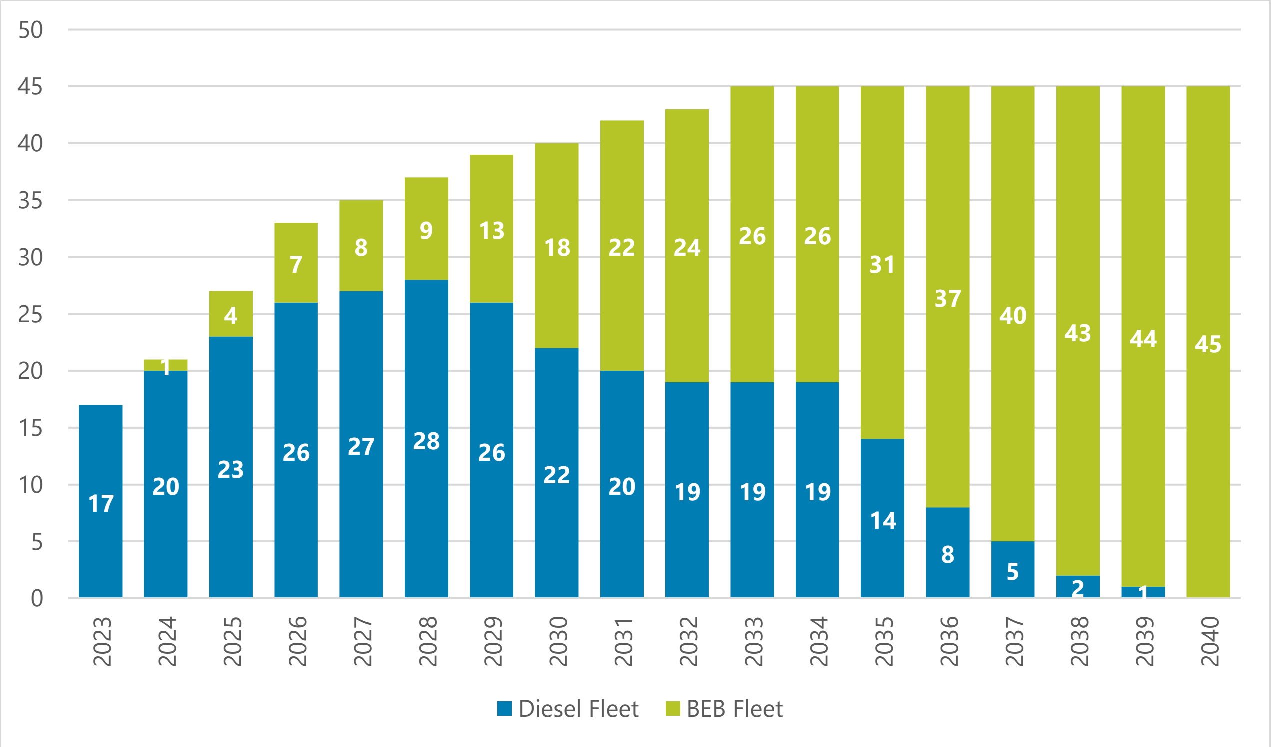


Figure 3 provides a visual representation of the fixed route fleet makeup throughout the planning period.

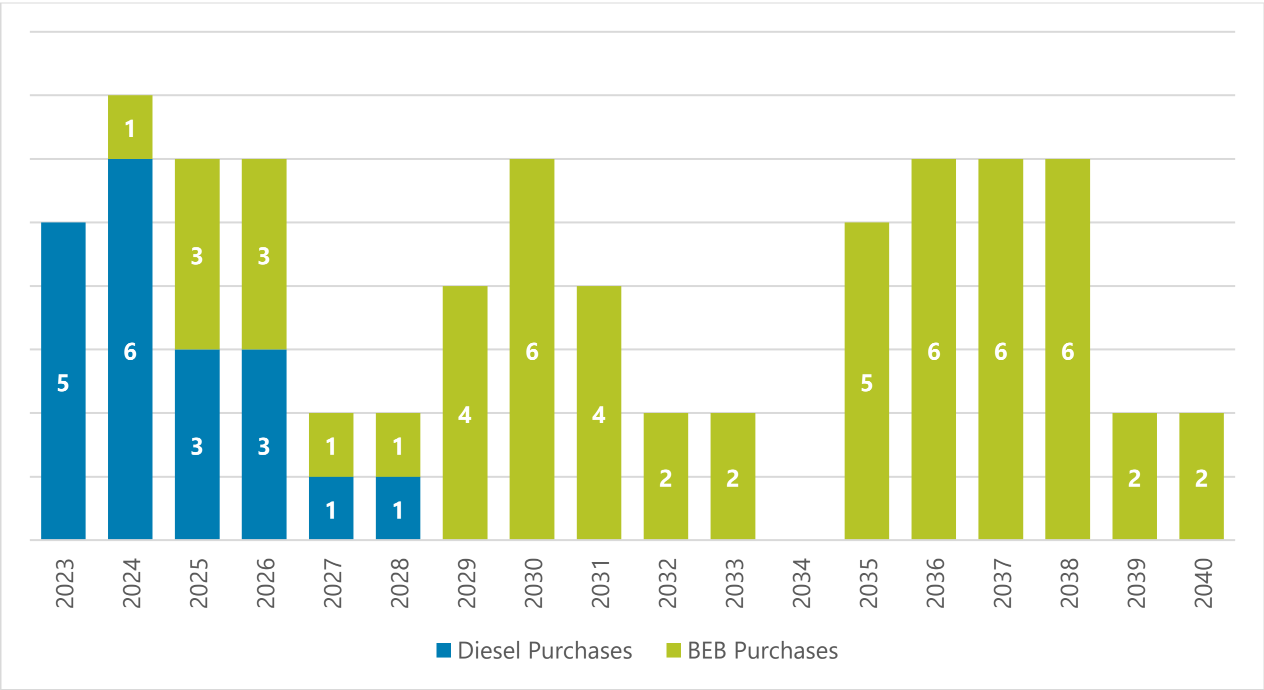


Figure 2. Fixed Route Transit Fleet Procurement Schedule (2023-2040)

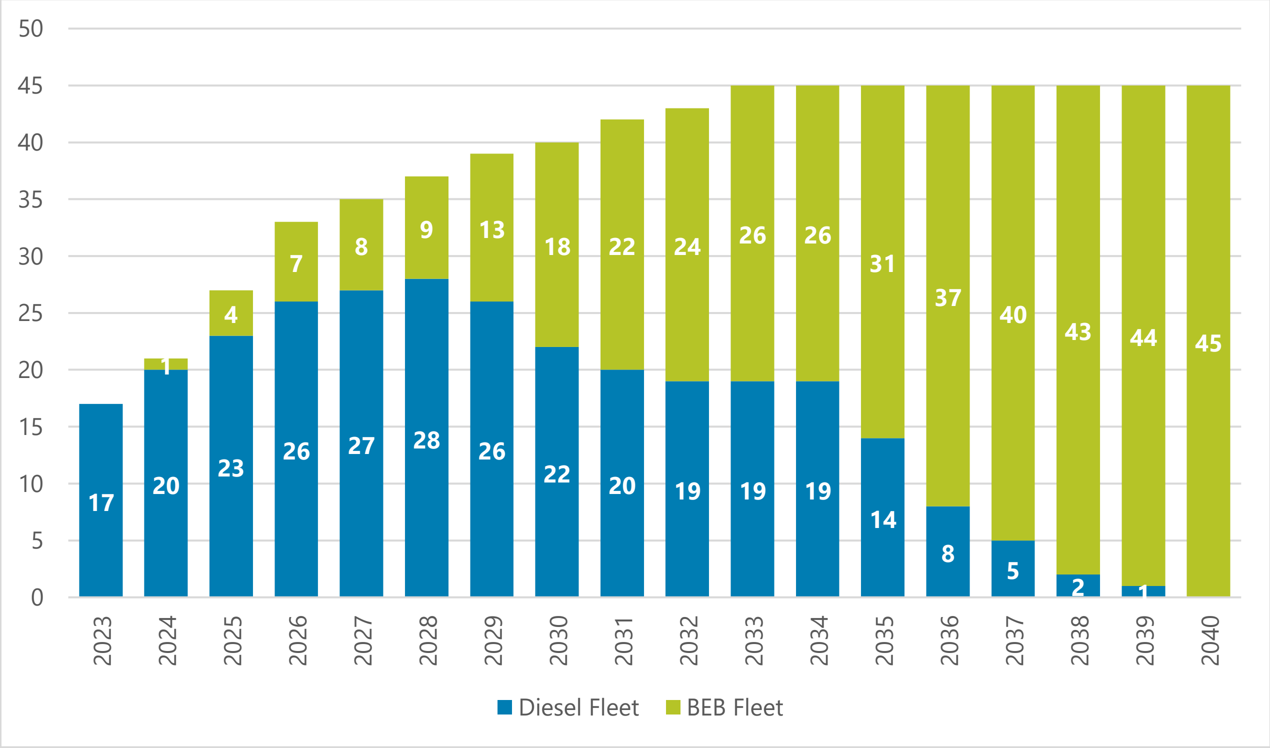


Figure 3. Fixed Route Transit Fleet Composition by Purchase Year (2023-2040)

4.1.1.1 FUTURE SERVICE CRITERIA

Milton Transit will begin by electrifying the fleet and operate service with depot charging only during Phases 1 and 2, where only one additional vehicle is required without the need for or en-route charging. In Phase 3, with the expanded service, either a fleet expansion or en-route charging infrastructure would likely be necessary to maintain the same level of service as diesel operations. Because the nature of the expanded service is unknown, the exact vehicle requirement to support this new service cannot be predicted. **Table 5** outlines the feasibility criteria for expanded service; the feasible distance for a 1:1 conversion is the maximum duty cycle distance a 675 kWh BEB can complete without the need for bus swaps or en-route charging.

Table 5. Expanded Service Feasibility Criteria

	Easiest Route	Average Route	Hardest Route
Average Vehicle Efficiency	1.3 kWh/km	1.60 kWh/km	1.97 kWh/km
Feasible Distance for 1:1 Conversion	Up to 330 km	Up to 270 km	Up to 220 km

The longest duty cycle in the Town's current service profile is 400 km, so in any case expanded service could be completed with at most one swap per duty cycle. "Easiest" refers to the most energy efficient route (i.e., least number of stops, flattest terrain, etc.), while "hardest" refers to the least energy efficient route (i.e., many stops, difficult/steeper terrain, etc.). If expanded service exceeds 330 km, either en-route charging or additional vehicles to facilitate bus swaps would be required.

4.1.2 ON-DEMAND/SPECIALIZED TRANSIT FLEET

The on-demand/specialized fleet will follow a similar phasing approach as the fixed route, but with different years of implementation. No specialized fleet vehicles will be replaced during Phase 1, but Phase 2A will include electrification of half the replacement vehicles between 2025 and 2028. Phase 2B will occur in 2029 and 2030 where all new vehicle purchases will be electric to maintain the existing fleet size. Phase 3 will increase the number of 6-metre vehicles to expand service and replace remaining gasoline vehicles.

Phase 1: Internal Combustion Only (2023-2025)
In Phase 1, Milton Transit will not purchase any battery electric on-demand/specialized fleet vehicles, all procurements will be gasoline.

Phase 2: Mixed Fleet (2026-2027)
During this phase, Milton Transit will purchase a mix of gasoline and battery electric vehicles. In each year, half of the procurements will be gasoline and the other half will be battery electric.

Phase 3: Full Fleet Electrification (2028 – 2034)
Beginning in 2028, Milton Transit will cease purchasing gasoline vehicles and all future procurements will be battery electric. The transition of both the 6- and 8-metre fleets will be complete in 2034 with a total fleet of seventeen (17) 6m buses and (6) 8m buses.

Table 6 provides a summary of the fleet composition by vehicle size and fuel type at the *end* of each phase.

Table 6. Phased Specialized Fleet Composition by Phase

Phase	6M Gas Fleet Count	6M BEB Fleet Count	8M Gas Fleet Count	8M BEB Fleet Count	Purchase Year
Phase 1	9	-	6	-	2023 - 2025
Phase 2	7	4	5	1	2026 - 2027
Phase 3	-	17	-	6	2028 - 2034

The fleet composition by year for 6-metre and 8-metre specialized vehicles are shown in **Figure 4** and **Figure 6**, respectively, through 2034.

4.1.2.1 6-METRE SPECIALIZED FLEET

The transition of the 6-metre specialized fleet will begin in 2026 with the purchase of 2 BEBs; the following years include the purchase of a mix of gasoline and electric buses, with the Town of Milton ceasing gasoline purchases after 2027 and reaching 100% BEB in 2034. A progression of the 8-metre fleet composition throughout the transition is shown below in **Figure 4**.

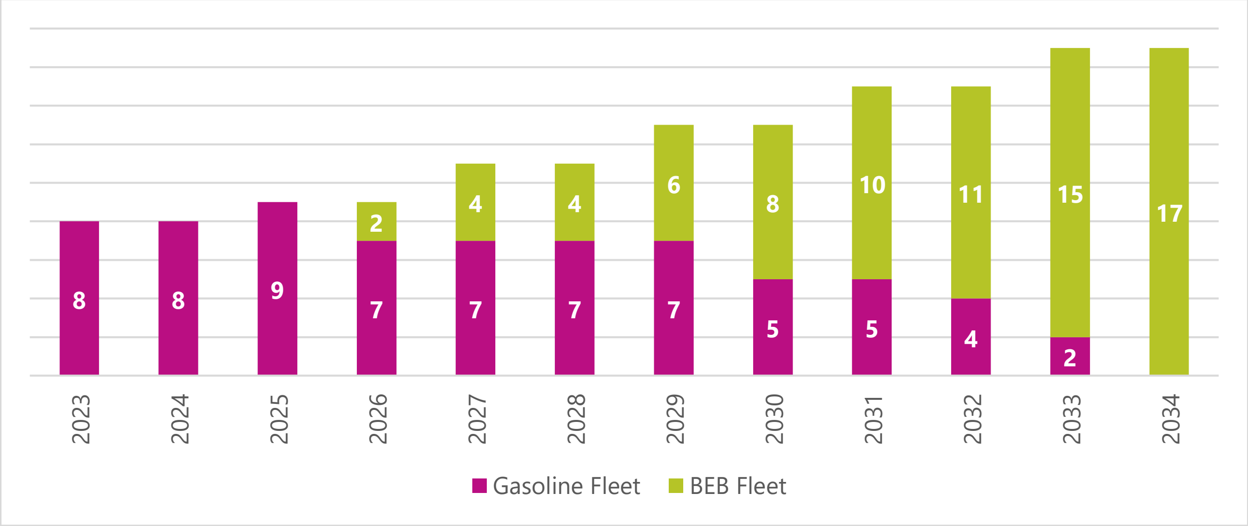


Figure 4. 6M Specialized Fleet Composition by Purchase Year (2023-2034)

Table 7 shows which purchases are replacement 6-metre buses, where a gas-powered bus will be retired upon delivery, and expansion buses, where fleet size increases and a vehicle is not retired upon delivery; in many years, there are a mix of replacement and expansion buses. Purchases of replacement BEBs are further broken down to differentiate between which are replacements of gasoline buses and which are replacements of BEBs purchased earlier in the transition. The breakdown aligns with the Town's expected 2023-2033 Transit Fleet Growth, Replacement, and Mid-Life Refurbishment Schedule.

Table 7. 6M Specialized Fleet Procurement Schedule, Replacement and Expansion Breakdown (2023 - 2040)

	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Gasoline - Growth Bus	2		1		1													
Gasoline - Replacement Bus				2	1													
BEB - Growth Bus					1		2		2		2							
BEB – Gas Replacement Bus				2	1			2		1		2						
BEB – Electric Replacement Bus											2	2	2		2	2	2	1

Figure 5 summarizes the information from the table above and shows the total number of 6-metre buses purchased in each year by fuel type through 2040.

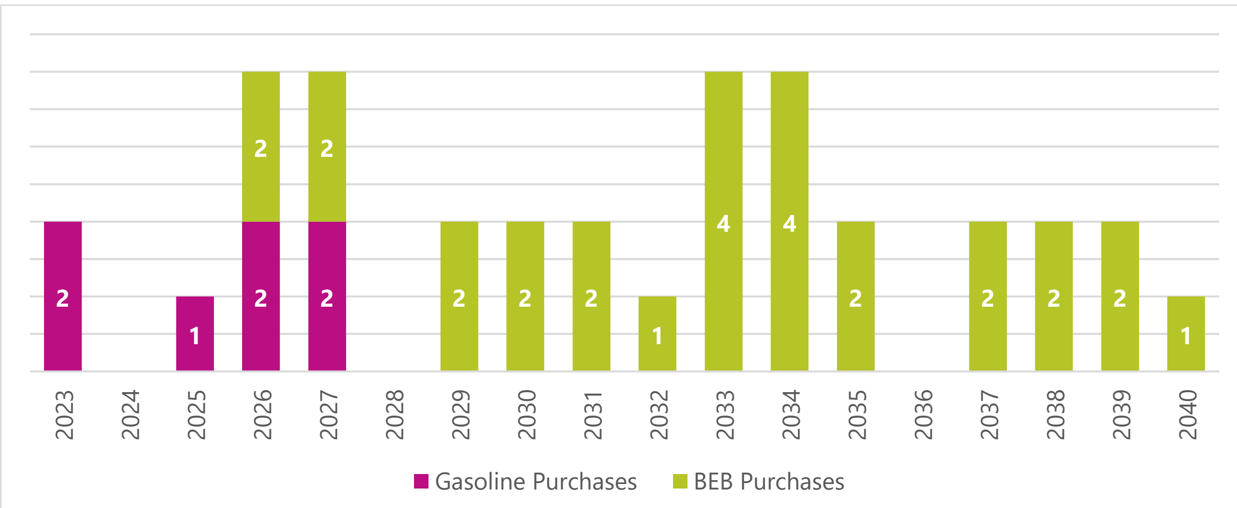


Figure 5. 6M Specialized Fleet Bus Procurement Schedule by Fuel Type (2023-2040)

4.1.2.2 8-METRE SPECIALIZED FLEET

The transition of the 8-metre specialized fleet will begin in 2027 with the purchase of 1 BEB; the following years include the purchase of a mix of gasoline and electric buses, with the Town of Milton ceasing gasoline purchases after 2027 and reaching 100% BEB in 2034. A progression of the 8-metre fleet composition throughout the transition is shown below in **Figure 6**.

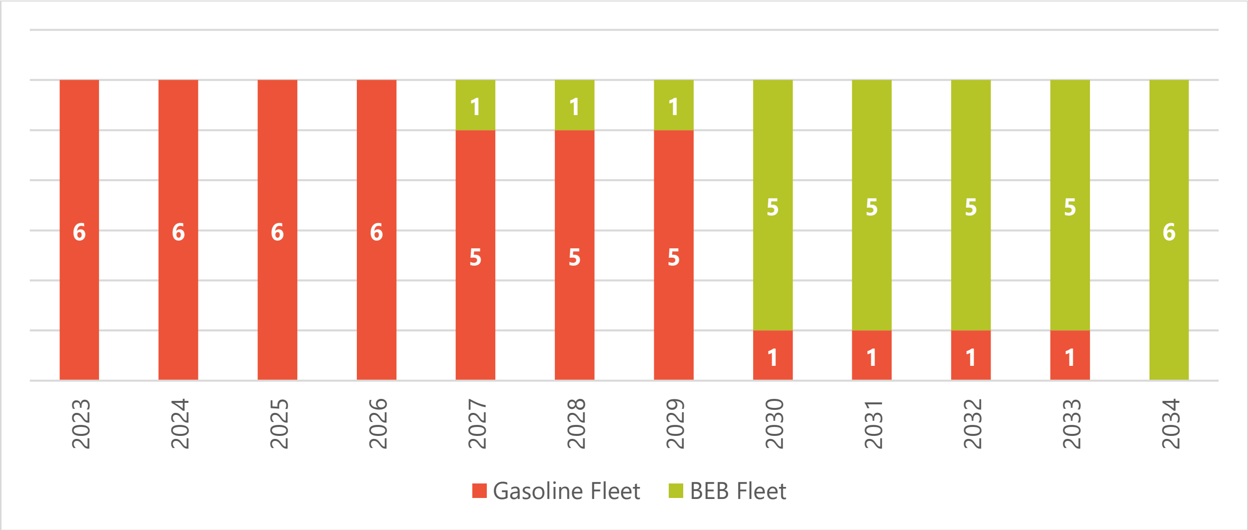


Figure 6. 8M Specialized Fleet Composition by Purchase Year (2023-2034)

Table 8 shows which purchases are replacement 8-metre buses, where a gas bus will be retired upon delivery, and expansion buses, where fleet size increases and a vehicle is not retired upon delivery. Purchases of replacement BEBs are further broken down to differentiate between which are replacements of gasoline buses and which are replacements of BEBs purchased earlier in the transition. The breakdown aligns with the Town's approved 2023-2033 Transit Fleet Growth, Replacement, and Mid-Life Refurbishment Schedule.

Table 8. 8M Specialized Fleet Procurement Schedule, Replacement and Expansion Breakdown (2023 - 2040)

	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Gasoline - Growth Bus	2																	
Gasoline - Replacement Bus	2				1													
BEB - Growth Bus																		
BEB – Gas Replacement Bus					1			4				1						
BEB – BEB Replacement Bus													1			4		

A summary of the total number of 8-metre buses purchased in each year by fuel type through 2040 is provided below in **Figure 7**.

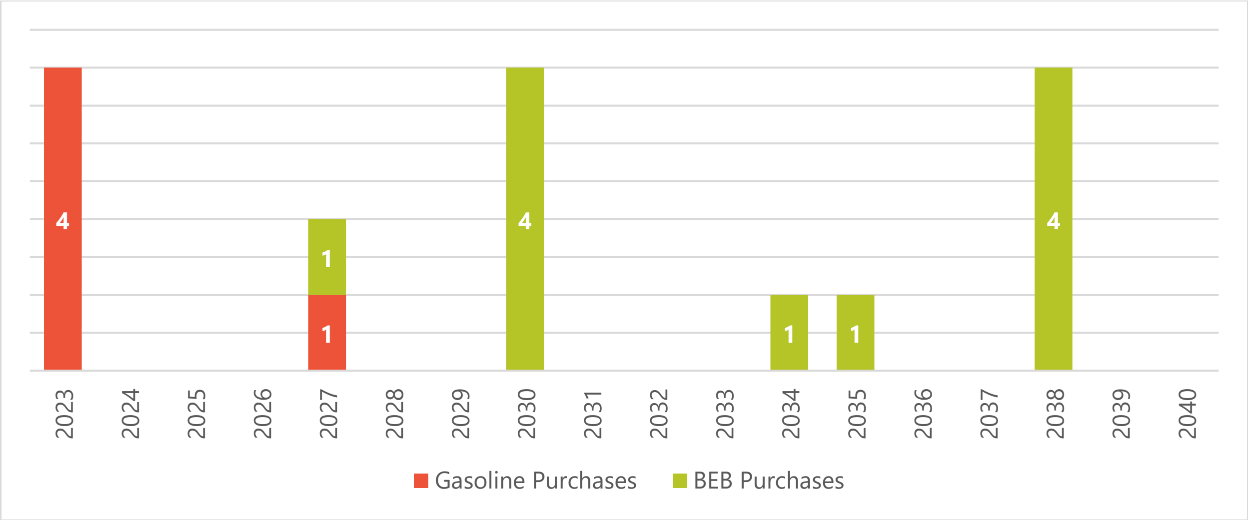


Figure 7. 8M Specialized Fleet Bus Procurement Schedule by Fuel Type (2023-2040)

4.1.3 SOFTWARE SYSTEMS

Introducing BEBs will introduce additional variables that Milton Transit plans to monitor, such as dynamic vehicle scheduling, vehicle battery health, charger health and energy management. There are several software packages available for transit agencies to monitor vehicles and chargers live and retroactively; some may be available from OEMs and others are third party software packages that Milton Transit would acquire independently from vehicle or charger procurements.

- **Vehicle Monitoring Systems –** Milton Transit will consider this software in order to provide constant monitoring and logging of all vehicle data transmitted by BEBs. This information can be critical to quickly identify mechanical component or hardware failures and expedite maintenance repairs. Some OEMs offer this software as part of the rolling stock procurement, but other third-party vendors may be preferred as they are typically manufacturer agnostic which would allow Milton Transit to view all vehicles in the same interface regardless of bus manufacturer. The interface should include vehicle telematics information including energy consumption, battery state of charge, and vehicle propulsion efficiency that can all be used to evaluate vehicle performance for future procurements.

- **Charging and Energy Management Systems –** Milton Transit will consider using this software schedule and manage charge sessions between different vehicles; this can provide a significant operational cost savings through demand peak shaving. This optimize costs where utility rates are priced in a time of use utility rate structure. Some providers offer options with additional functionality like management of other energy resources like battery energy storage and solar generation.

- **Digital Yard Management Systems –** Milton Transit will consider using this software to help staff know which buses are ready or not ready for service. Tools are now available that allow staff to know the real time location and status of vehicles in the yard. Some solutions can also help by providing parking information for the vehicle depending on the status and state of charge (SOC) of the vehicle. For example, a digital sign at the entrance of the facility could let drivers know based on vehicle information to park vehicles that are required to be held of scheduled maintenance in one area, vehicles with high SOC that can go back into service in another area and vehicles with low SOC that need more time to charge in a different area. This tool could also be shared with operations to let them know where vehicles are parked in the yard, whether a given vehicle is ready for service and/or if a substitution needs to be made.

- **Scheduling Software –** Milton Transit will consider procuring this software to help ensure BEB fleet vehicles assigned to routes are fully charged by the time they are due to pull out of the garage for revenue service. In many cases, this software can be tied into charge management and digital yard management system interfaces so that dispatchers can see the current vehicle state of charge when assigning vehicles to service blocks. In some cases, this can also provide an operational safeguard if a dispatcher attempts to assign a BEB to a block that exceeds the vehicle's capable range, reducing the probability of needing to do in-service bus swaps.

It is important to note that the Town is currently piloting a telematics software system as part of the diesel-to electric bus conversion pilot project through the Town's current Transit ITS/AVL vendor Consat Canada. Upon conclusion of the pilot, the Town may consider leveraging this software system to include BEB and charging infrastructure systems, subject to performance and meeting minimum requirements for vehicle monitoring, charging and energy management, yard management and scheduling systems.

4.2 FACILITY & INFRASTRUCTURE PLAN

Milton Transit does not currently operate out of an owned transit facility but is in the planning stages of designing a new facility for transit operations. This transition focuses on evaluating charging infrastructure to be implemented at this future new depot facility as well as the potential to install en-route charging infrastructure at the Milton GO Station.

4.2.1 MILTON CIVIC OPERATIONS CENTRE

The Town currently has a single ABB 150kW plug-in depot charger with one dispenser installed at the Milton Civic Operations Centre, a municipal facility owned by the Town. This charger will be used to support the BEB Pilot Program; this single BEB will transition to the future Milton Transit Depot Facility once constructed.

4.2.2 FUTURE MILTON TRANSIT DEPOT FACILITY

Milton Transit will electrify the future Milton Transit Depot facility for both the fixed route and on-demand/specialized fleets in three phases shown below in **Figure 8**; this conceptual layout is a representative plan of what a future transit facility could look like when factoring in the space requirements for different functions.

Most BEB charging typically occurs at transit depots while the buses are idle. Bus charging can take several hours depending on the state of charge, but not every bus will require a long charge period. Since charging will be implemented in phases, it is important that charging is planned to limit interruptions to service when installing future phases.

The site plan accommodates a large increase of buses through 2040 and must also accommodate a mixed fleet of BEB and ICE vehicles. **Figure 8** shows the buildout conditions for where the on-demand/specialized vehicles are housed in the south portion of the future Milton Transit Depot Facility and the fixed route buses are housed in the north portion.

The vehicles are largely separated by the indoor chargers and electrical equipment. Placing the chargers indoors will provide easier maintenance and longer life than if they were exposed to harsh outdoor winter conditions. One DC fast charger will be connected to up to three dispensers/fixed route buses. Since the on-demand/specialized buses have smaller batteries and travel less miles, these vehicles will utilize Level 2 charging, though they can still connect to DCFCs typically used for the fixed route buses if they need an occasional quick charge.

Phase 1 shall not require the installation of any additional chargers. The single 150 kW ABB charger installed at the Milton Civic Operations Centre will accommodate the single Pilot Program BEB to be delivered in 2024.

Phase 2 shall require the installation of (6) 150 kW plug-in chargers with 3 dispensers each at the future Milton Transit Depot Facility to support the Phase 1 Pilot BEB and additional (16) 675 kWh BEBs to be delivered by 2030. This phase will also include the installation of (13) 7.2 kW Level 2 AC chargers to support (8) 6-metre cutaways and (5) 8-metre cutaways. These chargers will all be powered by a new unit substation installed in 2025.

Phase 3 shall require the installation of (9) 150 kW plug-in DCFCs with 3 dispensers each at the future Milton Transit Depot Facility to support (28) additional 675 kWh to be delivered between 2031 and 2040. An additional (10) 7.2 kW Level 2 AC chargers will also be installed in this phase to support (1) additional 8m BEB and (9) additional 6m BEBs.

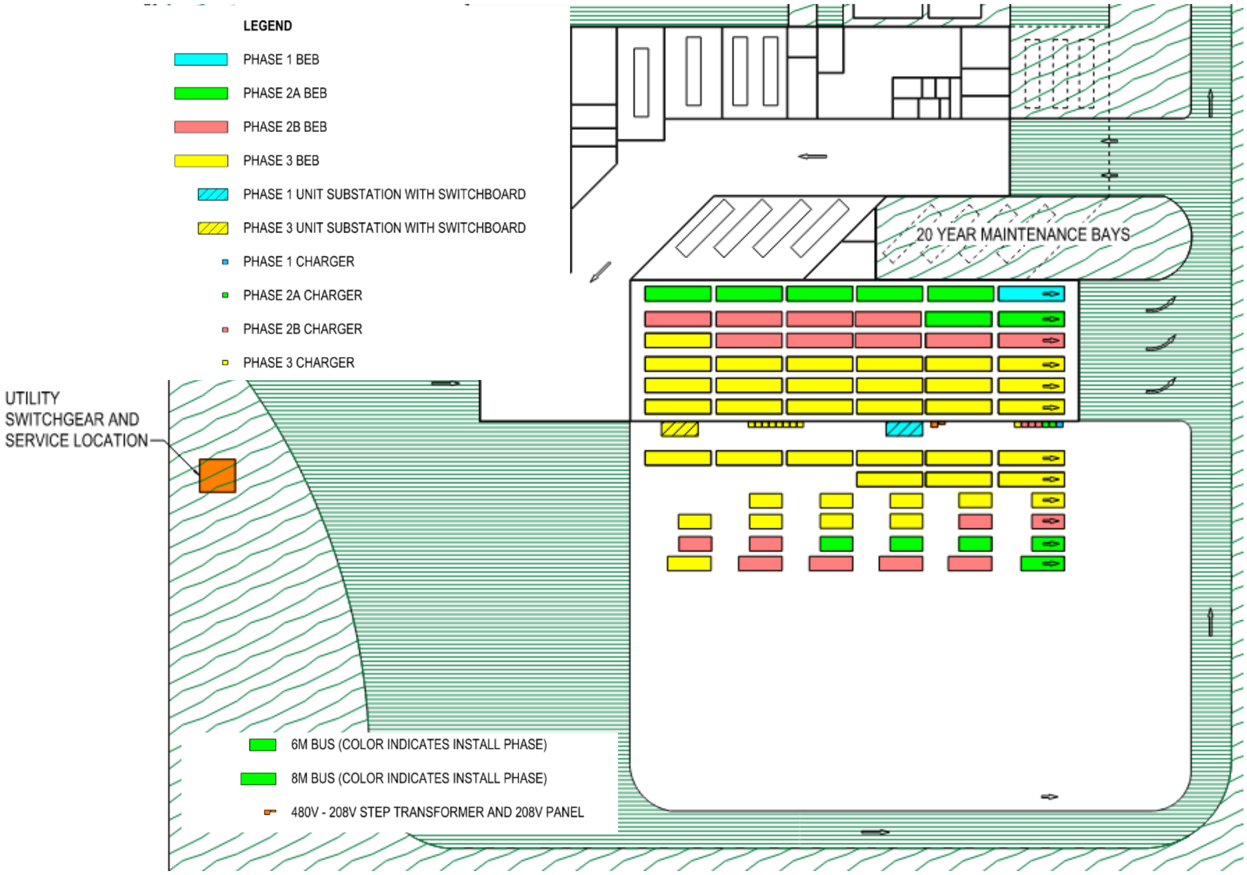


Figure 8. Milton Transit Facility Conceptual Site Plan

4.2.3 VEHICLE CHARGING AT FUTURE TRANSIT FACILITY

- Milton Transit will install one dispenser per bus be to allow for charging of vehicles without the need to hostel buses.
- Milton Transit will avoid ground mounting of the dispensers where possible due to the significant space required. The bus storage area is expected to be indoors so dispensers could be either ceiling mounted pantographs or retractable plug-ins depending on the agency's preference.
- If pantograph dispensers are specified, some plug-in dispensers should still be included. Locations closest to the wall are shown as wall-mounted plug-in dispensers.
- Phase 2 and Phase 3 include capacity for smaller electric cutaway buses that can only accept plug-in charging. Milton Transit will consider installing an island between the lanes for those locations in Phases 2 and 3 to site the smaller plug-in dispensers (Level 2) which may not be able to be ceiling mounted.
- With the current facility plan, the charging cabinets are located indoors and take up potential bus parking stalls. As this will be a new building, locating the charging and electrical infrastructure above the parking area is an option that Milton Transit will explore during design. A mezzanine level for charging infrastructure could shorten cable runs and keep charging infrastructure out of the way of bus traffic.

4.2.4 FUTURE EN-ROUTE CHARGING LOCATIONS

En-route charging is typically installed at terminus locations where vehicles layover between runs and already have time in the schedule to charge. Because transit agencies often locate stops on public streets or on properties that are owned by third parties, it can be difficult to find space to install charging infrastructure at those locations. Milton Transit will prioritize en-route charging locations where the agency already owns property or will engage with those property owners to understand if agreements can be reached to locate infrastructure at those sites.

The Town does not currently intend to proceed with en-route charging but will re-evaluate closer to 2030 based upon the vehicle battery technology available, en-route charger performance of other nearby agencies, and relationships with landowners of potential en-route charging locations.

4.2.4.1 MILTON GO STATION

The Milton GO Station has been identified as the primary location for en-route charging; this location is ideal for this use because all fixed route service begins and ends here. Located at 780 Main Street East, buses enter from Drew Centre Access Road and park in a sawtooth pattern depending on route assignment as shown in **Figure 9**. Milton Transit uses seven of the twelve bus bays closest to the rail line, including three landing pads on Drew Centre Access Road. GO Bus service occupies the remaining five bays. The right lane on SE-bound Drew Centre Access Road is designated as a bus only lane with signs and pavement markings.[4]

[4] 2019-2023 Milton Transit Services Review & Master Plan Update, page 32

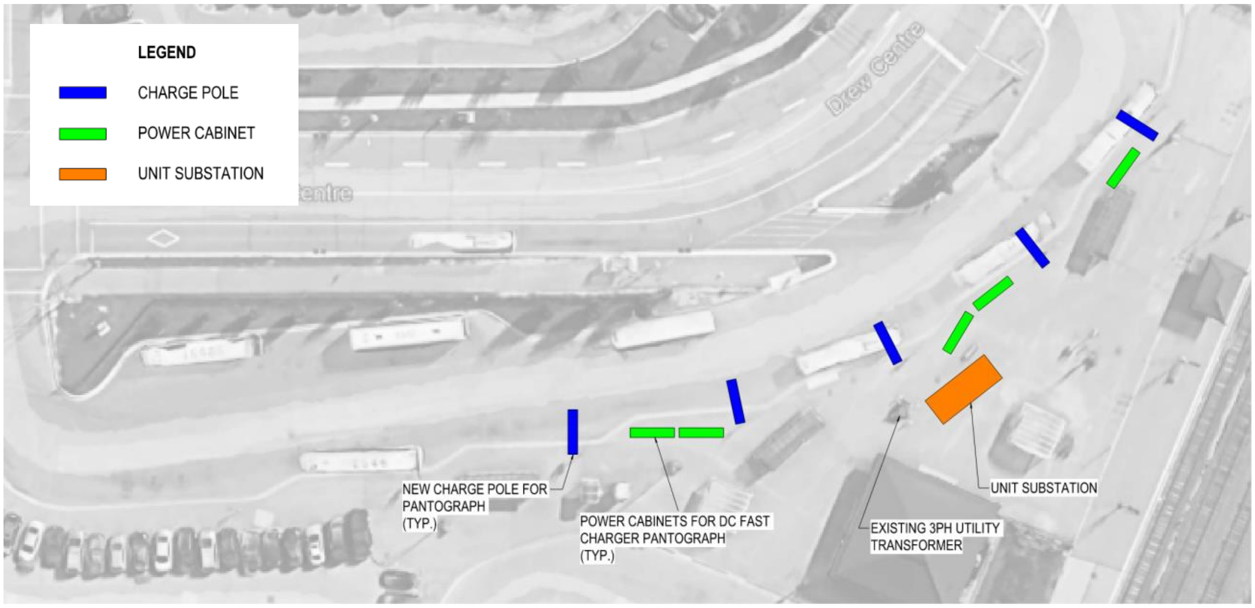


Figure 9. Milton GO Station Aerial View

Milton GO Station serves as Milton Transit's transfer hub, allowing passengers to transfer among bus routes as well as GO commuter rail and bus services. The facility's current layout is not large enough to accommodate all eight routes at the same time, the Town has tentative plans to redevelop this site layout which may significantly impact gate locations in the future necessary to serve Milton Transit's existing service and future service growth through 2031. If Milton Transit ultimately decides to proceed with en-route charging, all planning and construction activities will not commence until any site redevelopments are finalized.

5 CAPACITY TO IMPLEMENT THE TECHNOLOGY

In this section of the plan, Milton Transit's resources, skills and training required for the deployment and operation of a new ZEB fleet are evaluated to develop a staffing and training plan equipped to the agency's needs. An assessment of potential technological, operational, and system-wide risks associated with the transition and a risk management plan that details mitigation strategies is also provided.

5.1 STAFFING & TRAINING PLAN

With the introduction of battery electric technology to the Town's transit fleet, proper training on bus systems and subcomponents unique to BEBs is critical to ensure safe, efficient operation and maintenance of the transitioned fleet. As Milton Transit begins to bring vehicle maintenance in-house with the completion of the future Milton Transit Depot facility, the agency will work with the current contract operator and other external training programs while in close coordination with OEMs and neighboring transit agencies to acclimate the existing workforce to the new technology, avoiding any displacement of the existing workforce.

This section will address the necessary steps to evaluate the skills of the existing workforce, identify skill gaps on an individual basis, and develop a plan to build and implement an effective training program for bus operators and bus maintenance personnel. In addition to the further development of the existing workforce, this chapter will also convey a workforce growth strategy for attracting new employees, retaining new and current employees, and funding opportunities to sponsor the required growth.

If the Town elects to continue outsourcing maintenance services for the fixed route and/or on-demand/specialized fleets, this section could be utilized to create technical specifications and establish minimum training standards and requirements. These standards and requirements can then be considered for inclusion in any subsequent RFPs for contracted services.

5.1.1 SAFE WORKPLACE POLICY AND STANDARDS

In Ontario, employers have a legal obligation, through the Occupational Health and Safety Act, R.S.O. 1990 (OHSA) to develop and implement a workplace safety program that ensures the health and safety of their workers. This includes a written policy, hazard identification and control, worker training, worker involvement in program development, procedures for accidents and illness, and regular review and updates. Failure to comply with the OHSA can result in harm to workers and penalties for the employer.

The Canadian Standards Association (CSA) developed CSA Z462:21, an electrical safety standard for Canadian workplaces to prevent electrical injuries and fatalities. It provides guidelines and requirements for identifying and assessing electrical hazards, selecting, and using personal protective equipment (PPE), establishing safe work procedures, and training workers. CSA Z462:21 is updated periodically to reflect changes in technology, regulations, and best practices. The standard is widely adopted in Canada by a variety of industries where electrical hazards exist, including manufacturing, construction, and utilities.

CSA Z462:21 is largely based on its American counterpart, developed by the National Fire Protection Association (NFPA), called NFPA 70E. Both standards are focused on fixed electrical infrastructure (such as charging infrastructure) and do not directly address "mobile" high-voltage systems such as the battery drivetrains in battery electric vehicles. Transit agencies are identifying principles from these standards to apply to battery electric workplaces, and it is possible that updated versions of the standards will include consideration of battery electric vehicles.

5.1.1.1 PERSONAL PROTECTIVE EQUIPMENT (PPE)

Personal Protective Equipment (PPE) is designed to protect users from health and safety hazards. PPE must be implemented when elimination, substitution, engineering and administrative controls fail to reduce or remove hazards.[5]

Under Canadian and Ontarian law, PPE is required to be provided by the employer and worn by the employees to maintain safe working conditions. The following policies and standards related to PPE are applicable:

Canada Labour Code (R.S.C., 1995, c. L-2)

- Section 122.2 states that "Preventive measures should consist first of the elimination of hazards, then the reduction of hazards and finally, the provision of personal protective equipment, clothing, devices, or materials, all with the goal of ensuring the health and safety of the employees."
- Section 125 (l) requires the employer to provide the prescribed safety materials, equipment, devices, and clothing and Section 126 (1) requires employees to use safety materials, equipment, devices, and clothing intended for their protection.

Occupational Health and Safety Act, R. S. O. 1990

- Section 25 of the Act outlines the duties of the employer requiring them to provide equipment, materials and protective devices in good condition ensuring safety measures and procedures are enforced in the workplace.
- Section 27 of the Act outlines the duties of the supervisor to ensure that protective devices, measures and procedures are conducted and that they wear equipment, protective devices or clothing required by the employer.
- Section 28 outlines the duties of the worker to work within the provisions of the Act and use or wear equipment, protective devices or clothing required by the employer.

Battery electric buses are classified as high voltage systems, and as such, require specialized tools and personal protective equipment (PPE) that may not be necessary when working on the typical 12/24 V systems found in diesel buses. Examples of additional PPE that may be required for working on high voltage systems are offered by the Transportation Learning Center. The Transportation Learning Center[6] provides a list of typical tools and PPE that are expected to be needed to work on BEBs which are shown in **Table 9** and **Table 10**.

[5] https://www.ccohs.ca/oshanswers/hsprograms/hazard/hierarchy_controls.pdf
[6] ITLC_ZEB_Report_Final_2-11-2022.pdf (transportcenter.org)

Table 9. Recommended Insulated Tools

Tool	Recommended Quantity
CAT III rated digital multimeter(s) (rated up to 1000 VDC)	1 for each BEB technician
Insulated hand tools that follow ASTM F1505-01 and IEC 900 standards and compliance with OSHA 1910.333 (c)(2) and NFPA 70E standards (as recommended by the OEM)	1 set for each BEB technician that could be working on a BEB at any given time

Table 10. Recommended PPE for BEB Maintenance

Tool	Recommended Quantity	Notes
ASTM Class 0 insulated gloves with red label	1 pair, properly sized for each technician	Insulated gloves need to be tested and replaced at specified intervals.
Leather gloves to be worn over ASTM insulated gloves	1 pair, properly sized for each technician	
Insulated EH Rated Safety Shoes	1 pair, properly sized for each technician	
NRR 33 rated ear plugs	Ample supply for each technician that could be working on a BEB at any given time	
NRR 331 rated (overhead) earmuffs	Ample supply for each technician that could be working on a BEB at any given time	Combining NRR 33 rated ear plugs with NRR 31 ear muffs can provide a NRR protection level of 36.
Arc flash suits	Ample supply for each technician that could be working on a BEB at any given time	
Combination arc flash shield and hardhat	Ample supply for each technician that could be working on a BEB at any given time	
Arc flash hoods	Ample supply for each BEB technician that could be working on a BEB at any given time	Arc flash shield, hardhat and hood may be procured as one integrated item depending on manufacturer and agency preference.
Insulated electrical rescue hook(s) (Sheppard's Hook) sized for use on BEBs	1 set for each BEB technician that could be working on a BEB at any given time (certain HV operations require a second worker to be available to extricate primary worker in an emergency)	

5.1.2 TRAINING PROGRAM DEVELOPMENT

Milton Transit does not currently have any in-house maintenance or training functions, but with completion of the future Milton Transit Depot Facility, Milton Transit may choose to bring these functions in-house. The town may explore providing bus operators with commercial licensing (B,C,D, and Z) as needed as well as providing in-house Corporate Health & Safety Training consisting of customer service, Accessibility for Ontarians with Disabilities Act, and health and safety topics.

Milton Transit will also consider using operations and maintenance training curriculum as established by The Ontario Public Transit Authority's (OTPA's) Zero Emission Bus (ZEB) Committee. In early 2021, OPTA recommended the establishment of the ZEB Committee in response to the need expressed by members for the ability to learn from and share with one another as revenue and non-revenue fleets are transitioned to zero emission technology. The OPTA ZEB Committee's mandate is to establish and maintain a forum for OPTA members to develop and share best practices, lessons learned, standard documentation, and key metrics for the implementation of zero emission vehicle technology. This forum is defined by three Workstreams:

- **WS1 - Operations and Maintenance Work Plan**
  - WS1A – ZEB Planning, Scheduling, and Operations
  - WS1B – ZEB Safety, Training, and Maintenance
  - WS1C – ZEB Performance, Monitoring, and Reporting
- **WS2 - Engineering Work Plan**
  - WS2A – ZEB Light & Heavy Duty Vehicle Requirements
  - WS2B – ZEB Infrastructure Requirements
  - WS2C – NA Technical Working Group
- **WS3 - Procurement and Vendor Engagement Work Plan**
  - WS3A – Engage Vendor Community
  - WS3B – Commercial Bus Management
  - WS3C – Paratransit EV Commercial Management
  - WS3D – Non-Revenue Vehicle Commercial Management

5.1.3 TRAINING CURRICULUM

BEBs contain high voltage batteries, requiring all maintenance technicians to be certified to work on high voltage (HV) systems. Milton Transit is aware of the development of zero-emissions maintenance training curriculum developed by the OPTA ZEB Committee in conjunction with other transit agencies in Ontario and anticipates implementing these training resources for Milton Transit staff when available. The OPTA ZEB Committee's training curriculum development program aims to establish and maintain safe work conditions for bus operations and maintenance personnel serving Ontario's fleet of BEBs.

5.1.3.1 OEM TRAINING CURRICULUM

Milton Transit currently contracts with an external maintenance training provider. The Town anticipates extending the use of this program in future work plans and plans to purchase additional OEM training modules with the addition of BEBs to its fleet where the cost of training is rolled into the cost of the bus. As a part of the initial OEM training, the Town's selected BEB OEM can be anticipated to provide training modules such as Operator Orientation, Maintenance Mechanic Training, and Towing and Emergency Responder Training.

5.1.3.2 OPTA WORKSTREAM TRAINING CURRICULUM

Milton Transit will explore in-house implementation of the following courses for ZEB Safety, Training, and Maintenance as developed by OPTA's WS1B Workplan; the detailed objectives of each course are summarized below.

WS1B-1: ZEB Safety

- EV Systems Electrical: Arc Flash & High Voltage Work (LOTO, SOPs, etc.)
- BEB Thermal Events: Theory, Risk, and Mitigation (in collaboration with WS2 – Engineering)
- BEB EMI: Theory, Risk, and Mitigation (in collaboration with WS2 – Engineering)

WS1B-2: ZEB Training

- Operator BEB Training Considerations & Guidelines
- Maintenance BEB Training Considerations & Guidelines
- ZEB Academia & Certifications/Endorsements (OPTA Maintenance Committee; eMobility Training Subcommittee reporting in; STO)

WS1B-3: ZEB Maintenance

- BEB PM Program Elements
- BEB Maintenance-Specific KPIs and Comparative Analysis (Feeds WS1C: ZEB Performance Monitoring & Reporting
- HV System Inspection Requirements (MTO NSCS11B)

5.1.4 SKILLS ASSESSMENT, CATEGORIZATION, AND GAP IDENTIFICATION

This section outlines workplace hierarchy, authorized responsibilities based on qualifications, skill level requirements, and training guidelines. Generally speaking, operational staff can be grouped into the following four categories:

- **Operations Support**: Staff in this category would include those who are critical to bus operations but do not directly interact with the buses.
- **Bus Operations**: Staff in this category would include operational staff who directly interact with the buses but do not perform any vehicle maintenance.
- **Bus Maintenance Support**: Staff in this category include operational staff who directly interact with the buses and are responsible for the assignment and oversight of maintenance functions.
- **Bus Maintenance**: Staff in this category include operational staff who directly interact with the buses and perform routine and unplanned maintenance functions.

Operations support staff will require minimal training that typically covers a high-level overview of the technology and its capabilities. For example, it's important for dispatchers to understand the operational range of the vehicles to avoid assigning vehicles to unsuitable routes.

Those categorized under bus operations will require more training than operations support staff given their direct interaction with the vehicles. For example, bus operators must be familiar with all dash indicator lights, the operation of doors and wheelchair access, and safety procedures.

Bus maintenance support staff include key personnel responsible for the assignment and oversight of maintenance work, both preventative and corrective, and are responsible for troubleshooting and dispatching vehicle road calls. Milton Transit does not currently have any bus maintenance support personnel on staff. If Milton Transit determines they will bring bus maintenance activities in-house in conjunction with the zero emission fleet transition and construction of the Milton Transit Depot Facility, staff in this category will receive the same training as bus maintenance personnel as their roles include making “game time” decisions that require full familiarity with all vehicle systems and mechanical components.

Bus maintenance personnel require the most training as they have the most frequent and in-depth interaction with the vehicles. Milton Transit does not currently have any bus maintenance personnel on staff. As Milton Transit brings bus maintenance activities in-house in conjunction with the zero emission fleet transition and completion of the Milton Transit Depot Facility, staff in this category will be individually assessed on current skills and assigned to training modules as necessary, ensuring that all bus maintenance personnel receive all training required without duplicating efforts. For example, maintenance personnel who can demonstrate proficient multiplexing skills will not be assigned to multiplexing courses.

5.1.5 TRAINING PROGRAM IMPLEMENTATION

Milton Transit’s current technical training approach will continuously evolve, including exploration of in-house training programs. Should Milton Transit determine maintaining an outside contracted training program is most appropriate for operational needs, the agency will determine if the existing training provider is specialized to provide up-to-date information on new and existing equipment, including modern electronic and mechanical bus systems, OEM changes that impact maintenance practices, and refresher training when necessary. If the existing training provider cannot provide the necessary training for evolving ZEB vehicles and technologies, Milton Transit will contract with a more suitable training provider.

Milton Transit will take a phased approach to implement ZEB-specific training. As the number of zero emission vehicles in the fleet increases, more mechanics will complete zero emission maintenance training. For instance, if Milton Transit expects delivery of six BEBs, transition training for three mechanics to become BEB-certified fleet specialists will begin at least three months before delivery. Milton Transit expects its first non-pilot program BEB deliveries in 2025, providing ample time to identify and enroll candidates in the transition training program. This will ensure that the staff is adequately prepared when new buses arrive and aligns with the fleet replacement schedule, with a complete transition to 100% zero emissions by 2040.

5.1.6 FLEET APPRENTICESHIP PROGRAM

Should Milton Transit decide to implement an in-house maintenance program, the agency will explore implementation of a maintenance apprenticeship program to help develop a qualified and knowledgeable zero emissions maintenance staff. Milton Transit would sponsor the apprenticeship program with the local branch of CUPE and the Ministry of Skilled Trades (Ontario) and Industry. Applicants would apply through the Town, have completed the academic standard prescribed by the regulations for the trade or must have an Ontario Secondary School Diploma or its educational equivalent, and must successfully pass the agency’s regular employment requirements including testing.

This apprenticeship program would be designed to provide practical training for apprentices, which complements their classroom instruction[7]. The program aims to provide on-the-job (OTJ) training and help individuals become Certified Journey Level Heavy Duty Diesel Mechanics. To achieve this, apprentices must complete 6,000 hours of reasonably continuous employment and 720 hours of in-class instruction, which is divided into three levels/semesters, namely Basic, Intermediate, and Advanced. One of the occupational objectives under this program is to train individuals to become Coach Heavy Duty Diesel Mechanics.

5.1.6.1 ACADEMIC TRAINING

Any future apprenticeship program participants would be required as a condition of apprenticeship to receive and attend classroom instruction at a technical, trade, or similar school. Credit for time spent in academic training would be given in the calculation of the hours of apprenticeship served and would be applied against the period total.

As hybrid and battery electric technology becomes more prevalent in the automotive industry, automotive programs will begin to expand course curriculum to include these new systems. If Milton Transit implements an apprenticeship program for a possible future in-house maintenance program, the agency would continue to promote classes offered by local technical and trade schools and would work to establish partnerships with these institutions to build a workforce that has the technical competency to service zero emission vehicles as they are phased into the fleet.

5.1.7 WORKFORCE RIGHTSIZING

Should Milton Transit decide to implement an in-house maintenance program, the agency would plan to conduct an annual evaluation of its bus maintenance staffing needs. This evaluation would be based on accomplishing day-to-day maintenance functions to continuously maintain reliability and duty-cycle standards. The evaluation would also consider training hours, vacation entitlement, and absenteeism rates based on historical data. As Milton Transit transitions to a zero emissions fleet, it will re-evaluate its staffing needs on a rolling basis, based on overall fleet growth. If necessary, the agency would approve additional Apprentice Mechanic and Mechanic positions to ensure the smooth functioning of the fleet.

Due to a shortage of qualified BEB OEM training resources, Milton Transit plans to collaborate with other regional transit agencies to optimize limited OEM training resources should the agency decide to bring maintenance activities in-house. This strategy would include partnering with other agencies to maximize class sizes and sending mechanics to participate in scheduled training sessions or reserving a centrally located training location or college to host an OEM session. This coordination has received overwhelming endorsement and is a key strategic initiative through OPTA’s ZEB Committee Workstreams surrounding Safety and Training. The Committee's other foundational goals include developing and sharing training programs and content, lobbying, and working with colleges to expand battery electric bus training program availability and certifications.

Milton Transit would post requisitions for open maintenance positions internally and externally at the same time with priority given to internal candidates. All Milton Transit employees would have the opportunity to apply to the Apprenticeship Program. Under an in-house maintenance program, if there are available

[7] Skilled Trades Ontario

mechanic vacancies, Milton Transit would first evaluate whether any apprentices are nearing program completion. If the position cannot be filled internally, Milton Transit would then post the vacancy externally in partnership with local trade schools.

Milton Transit offers various job positions, including Transit Supervisors and Bus Operators. As post-pandemic service levels have begun increasing, Milton is actively hiring Bus Operators. Applicants with a valid "G" driver's license, a clean driver's record, and at least one year of driving experience can apply for the job. It is not mandatory to possess a commercial driver's license for this job. Milton Transit provides training to all new bus operators through an external training provider.

Milton Transit does not have specific plans at this time to hire zero emissions-specific staff but acknowledges that specialty skills will be required to support the agency's transition to a zero emission fleet. Milton Transit will continue to monitor and assess the need for specific zero emissions staff as the fleet transition proceeds and will approve and post dedicated positions should the agency decide to bring these functions in-house.

Milton Transit currently posts job openings on the Town's website as well as on job search sites such as Indeed and in local newspapers. As the shortage of mechanics and bus operators continues, Milton Transit strives to develop more creative recruiting strategies that will address this issue. Proper marketing of the agency's Zero Emission Fleet Transition, including the potential opportunity for an advanced technical career, will be crucial to attracting, developing, and retaining the required workforce.

5.1.8 FUNDING OPPORTUNITIES

The expenses associated with workforce training are expected to vary, influenced by the widespread adoption of BEB's. Funding is projected to emanate from a number of sources, encompassing procurement, where training costs are incorporated into the allocated budget for vehicle or infrastructure procurement, as well as existing funding streams dedicated to training. Additionally, financial support is anticipated from federal, provincial, and local funding allocations.

While the cost of the training itself is one item to consider, the labor cost to train bus maintenance personnel is anticipated to be high. As highlighted by the International Transportation Learning Center, the following costs will be considered when budgeting for workforce training:

- Classroom training hours
- Instructor hours (instruction and prep)
- Instructor hourly wages and benefits
- Instructor costs per class
- Instructor cost per trainee
- OTJ training hours
- Mentor hours
- Mentor hourly cost
- Mentor cost per trainee
- Facilities costs
- Training materials/mock-ups/software/simulation cost

Milton Transit will continually work to identify funding sources for worker training and re-training and utilize the training funding offered through federal grants to support the agency's zero emission workforce training.

6 FINANCIAL PLANNING

When undertaking any major transit technology and infrastructure project, the cost to implement can be a major concern. Although capital costs are often estimated during the planning stage, the costs of operating and maintaining vehicles and infrastructure over time, as well as the costs associated with midlife rehabilitations or end of life replacements, are frequently left out of the decision-making process. These costs can become significant in the long-term and may influence future decisions.

Milton Transit's existing diesel bus fleet has been compared to proposed BEB alternatives to identify the best value alternative for the Town to reach 100 percent conversion to BEB technologies by 2040. A high-level summary is provided below and a comprehensive breakdown of the financial analysis assumptions and results can be found in Appendix C: Budget & Financial Plan.

6.1 FLEET TRANSITION SCENARIOS

The financial analysis considers two scenarios for Milton Transit's fleet transition. Each scenario evaluates the capital, operating, maintenance, and fuel/electricity costs over the 2023-2050 period. The assumptions used are detailed further below. The two scenarios evaluated reflect the following:

- **Baseline (Business as Usual) Scenario**: Reflects the scenario where no transition to BEBs occurs. All replacements of the current diesel fleet are with new diesel buses. Specialized 6m and 8m vehicles are replaced with new gas vehicles.
- **BEB Transition Scenario:** This scenario reflects the full transition of Milton Transit's fleet to 675 kWh BEBs, and in-depot charging only as part of a phased transition beginning in 2024. Specialized 6m and 8m fleet vehicles are replaced with BEV equivalents.

6.2 LIFECYCLE COST ANALYSIS

The lifecycle cost analysis compares the lifecycle cost of implementing each scenario described above. Cost estimates produced in support of the active procurement of the BEBs, and associated equipment are aligned with Milton Transit's current grant application for ICIP funding. The study period for the analysis was selected to be 27 years, from 2023-2050 as this aligns with the federal government's current guidance on reaching net-zero emission targets.[8] While Milton Transit's BEB purchase schedule ends in 2040, ending the study period in that year excludes operating cost savings for BEBs purchased in the later years of the fleet transition. For this reason, the study period is extended to 2050 to show long-term cost savings of BEBs.

A summary of the unit capital costs, annual operations and maintenance (O&M) costs, and fuel and electricity costs are shown in the table below. Annual O&M and fuel costs are based on the average diesel and BEB vehicles.

Table 11. Capital Cost Comparison of 12M Conventional Diesel Bus and Electric Bus (2023$)

[8] Net-zero emissions by 2050 - Canada.ca

Cost Components	Baseline Scenario - Diesel	BEB Transition Scenario Battery-Electric	Variance (Per Bus Unit)
Capital Expenditures			
Bus Acquisition – 12M	$915,024	$1,909,686	$994,662
Mid Life Refurbishment	$120,000	$7,000	-$113,000
Subtotal of Vehicle Costs	**$1,035,024**	**$1,916,686**	**$881,662**
Charging Equipment*			
Plug-In Depot Charger Cabinet (150 kW)	-	$154,097	$154,097
Plug-In Depot Charger Wall-Mounted Dispenser	-	$25,265	$25,265
Plug-In Depot Charger Overhead Reel Dispenser	-	$32,158	$32,158
Subtotal of Charging Equipment Costs	**-**	**$211,520**	**$211,520**
Capital Expenditures Total	**$1,035,024**	**$2,128,206**	**$1,093,182****

**- Excludes major infrastructure and utility upgrades*
***-106% increase in capital investment over baseline*

Table 12. Annual Operating Cost Comparison of 12M Conventional Diesel Bus and Electric Bus (2023$)

Cost Components for Total Fleet	Diesel Bus	Battery-Electric Bus	Variance (Per Bus Unit)
Operating Expenditures (per year)			
Service Delivery and Administration, Training*	$326,794	$317,253	-$9,541
Vehicle Maintenance + Fuel (Diesel, Gasoline, Carbon Levy)	$99,843	$49,620	-$50,223
Electricity	-	$26,502	$26,502
Charger-Related Maintenance	-	$5,959	$5,959
Subtotal of Service Delivery + Charging Equipment	**$426,637**	**$399,334**	**-$27,303**
Contribution to Reserve for Asset Replacement			
Vehicles (12-year life)	$86,252	$159,724	$73,472
Charging Infrastructure (12-year life)	-	$17,627	$17,627
Subtotal Contribution to Reserve for Asset Replacement	**$86,252**	**$177,351**	**$91,099**
Total Annual Operating Cost (2023$)	**$512,889**	**$576,685**	**$63,796**

*-Based on average annual operating hours per vehicle, 2021 CUTA Statistics

6.2.1 CAPITAL COST ASSUMPTIONS

Capital costs include bus unit costs, mid-life rehabilitation costs, and BEB charging equipment and required electric servicing upgrades.

6.2.2 VEHICLE CAPITAL COSTS

Cost estimates were based on recent experience with other transit agencies and include infrastructure required for the BEB scenarios modelled. **Table 13** contains the capital cost assumptions used in the lifecycle cost analysis.

Table 13. Capital Unit Cost Assumptions, 2023$

Capital Assumptions	
Diesel Bus Cost	$915,024
Battery Electric Bus Cost (675 kWh)	$1,909,686
Repowering Cost (Pilot Bus Conversion)	$600,000
6m Specialized Transit (ICE)	$218,473
6m Specialized Transit (BEB)	$393,319
8m Specialized Transit (ICE)	$258,888
8m Specialized Transit (BEB)	$462,843
Midlife Rehabilitation Cost – Diesel	$120,300
Midlife Rehabilitation Cost – BEB	$7,000
Plug-In Depot Charger Cabinet (150 kW)	$154,097
Plug-In Depot Charger Wall-Mounted Dispenser	$25,265
Plug-In Depot Charger Overhead Reel Dispenser	$32,158

6.2.3 INFRASTRUCTURE CAPITAL COSTS

In addition to the unit capital costs above, infrastructure phasing costs at the Milton Transit Depot Facility are shown in **Table 14**. Lump sum phasing costs include budgetary pricing provided by electrical infrastructure OEMs for unit substations, and typical unit costs for other civil and electrical work (conduits, grounding, patching), and other anticipated construction expenses. The per-phase costs also factor in a 4% engineering design and a 30% contingency based on concept plan details.

Table 14. Infrastructure Phasing Assumptions

Phase	Cost	Year	Key Equipment
Phase 1	$7,472,500	2025	Unit substation (#1), initial deployment of chargers as shown in the phasing plan and concept figures.
Phase 2A	$2,827,400	2026	Expansion of DCFC and Level 2 charging infrastructure.
Phase 2B	$3,748,000	2029	Expansion of DCFC and Level 2 charging infrastructure.
Phase 3	$17,785,500	2031	Unit substation (#2), ultimate deployment of chargers as shown in the phasing plan and concept figures.

Table 15 displays a comparison between the capital costs under each scenario. Implementing a full transition to BEBs will result in an additional $63.1 million in capital costs relative to the Baseline scenario. This is largely driven by the higher capital cost of 675 kWh buses, and the additional electrification infrastructure required.

Table 15. Capital Cost Comparison, Millions of 2023$, 2023-2050

	Baseline	BEB	Variance
Diesel – Replacement	$42.1	$6.4	-$35.7
Diesel Replacement Quantity	45	7	
Diesel – Growth	$65.9	$11.0	-$54.9
Diesel Growth Quantity	72	12	
BEB – Replacement	-	$72.6	$72.6
BEB Replacement Quantity	-	38	
BEB – Growth	-	$114.6	$114.6
BEB Growth Quantity	-	60	
8m Specialized ICE – Replacement	$6.2	$0.8	-$5.4
8m ICE Replacement Quantity	24	3	
8m Specialized BEB – Replacement	-	$9.7	$9.7
8m BEB Replacement Quantity	-	21	
6m Specialized ICE – Replacement	$11.6	$0.7	-$10.9
6m ICE Replacement Quantity	53	3	
6m Specialized BEB – Replacement	-	$19.7	$19.7
6m BEB Replacement Quantity	-	50	
6m Specialized ICE – Growth	$2.4	$0.9	-$1.5
6m ICE Growth Quantity	11	4	
6m Specialized BEB – Growth	-	$2.8	$2.8
6m BEB Replacement Quantity	-	7	
Total Fleet Purchases	**$128.2**	**$239.0**	**$110.8**
Diesel Midlife Rehabilitation	$81.4	$2.3	-$79.2
BEB Midlife Rehabilitation	-	$0.5	$0.5
Additional Infrastructure	-	$31.8	$31.8
Total Fleet Lifecycle Capital Costs	**$209.6**	**$273.6**	**$64.0**

6.3 OPERATING & MAINTENANCE COST ASSUMPTIONS

Ongoing fueling and maintenance costs for Milton Transit's existing transit vehicles and modelled BEB replacements are part of this analysis.

6.3.1 OPERATING COST ASSUMPTIONS

Operations and maintenance (O&M) costs associated with the transition to BEBs considered the regular expenses required to maintain the Milton Transit conventional diesel fleet, as well as any incremental maintenance costs for new BEB infrastructure. O&M costs for the buses were calculated using historical Milton Transit maintenance cost data. Annualized O&M costs for BEB charging equipment were estimated from a published service level agreement of representative in-depot chargers. **Table 16** contains the key O&M assumptions in the analysis; a more detailed discussion regarding these estimates is included in **Appendix C**: Budget & Financial Plan.

Table 16. Fixed Route Fleet O&M Unit Cost Assumptions, 2023$

Conventional Fleet Operating Assumptions	Diesel	BEB
Operating Costs ($/hr)	$98.59	$98.59
Fixed Route Bus Maintenance Cost ($/km)[9]	$0.64	$0.58
Specialized Bus Maintenance Cost ($/km)	$0.61	$0.55
BEB Maintenance Cost Efficiency Factor	-	10%
Charger Efficiency	-	95%
Charger Maintenance Cost ($/year)	-	$5,959
Average Useful Life of New Bus	12	12
Bus Fuel Efficiency (L/100 km)	46.1	-
Diesel Heater Efficiency (L/km)	-	0.034
Spare Bus Ratio (Peak Fleet/Total Fleet)	6%	6%
Fixed Route Transfer to Reserve ($/year)	$76,252	$159,140

Table 17 contains the unit costs and key operations assumptions of the specialized transit fleet. Based on industry standards of expected useful life for cutaway vehicles, 6m and 8m BEBs are expected to have a useful life of about 8 years, compared to 7 for conventional ICE buses.

Table 17. Specialized Fleet O&M Unit Cost Assumptions

Specialized Fleet Operating Assumptions	Diesel	BEB
Specialized Bus Maintenance Cost ($/km)	$0.61	$0.55
BEB Maintenance Cost Efficiency Factor	-	10%
Average Useful Life of New Bus	7	8
Bus Fuel Efficiency (L/100 km)	39.1	-
8m Specialized Transfer to Reserve ($/year)	$36,984	$57,855
6m Specialized Transfer to Reserve ($/year)	$31,210	$49,165
Daily Energy Usage per 6m Vehicles (kWh)		76.9
Daily Energy Usage per 8m Vehicles (kWh)		88.6
8m Average Daily Kilometres Driven	177	177
6m Average Daily Kilometres Driven	147	147
8m Average Daily Hours Utilized	10	10
6m Average Daily Hours Utilized	10	10

Table 18 displays the comparison of O&M lifecycle costs between the different scenarios. The costs are comparable under both scenarios for operations and maintenance costs. Notable differences include the incremental maintenance costs between the Baseline Scenario and BEB Scenario due to additional

[9] Note that while $/km maintenance costs are lower for BEBs, these are offset by the deadhead kilometres driven to facilitate bus swaps due to their shorter range relative to diesel equivalents.

infrastructure. In addition, annual transfers to reserve for lifecycle replacement costs are higher under the BEB scenario.

Table 18. O&M Cost Comparison, Millions of 2023$, 2023-2050

	Baseline	BEB	Variance
Diesel O&M	$414.2	$121.8	-$292.4
BEB O&M	-	$286.7	$286.7
Diesel Bus – Transfer to Reserve	$89.0	-	-$89.0
BEB – Transfer to Reserve	-	$153.7	$153.7
8m Specialized Gas Transfer to Reserve	$5.1	-	-$5.1
8m Specialized BEB Transfer to Reserve	-	$8.8	$8.8
6m Specialized Gas Transfer to Reserve	$11.3	-	-$11.3
6m Specialized BEB Transfer to Reserve	-	$20.3	$20.3
Electrical Infrastructure Transfer to Reserve	-	$8.3	$8.3
Related Infrastructure O&M Costs	-	$1.5	$1.5
Total Fleet Lifecycle O&M Costs	**$519.7**	**$601.2**	**$81.4**

6.3.2 FUEL & ELECTRICITY COSTS

Fuel and electricity costs associated with the transition include the propulsion of diesel and BEBs, and diesel fuel to operate electric heaters on board BEBs. Diesel fuel costs were estimated using wholesale diesel fuel prices per litre for Milton, and escalated to include federal and provincial HST, as well as the federal carbon tax. The average price of diesel fuel per litre was applied to total diesel consumption. Estimated electricity costs are based on Milton Hydro's average per kilowatt-hour and per kilowatt charges, combined with 2023 year to date Ontario electricity prices. These charges were applied to the total kilowatt-hours and kilowatts to be consumed, respectively. **Table 19** provides the assumptions used for the fuel and electricity cost comparison.

Table 19. Fuel and Electricity Cost Assumptions, 2023$

Fuel and Electricity Cost Assumptions	
Diesel Price (2023$/L)	$1.44
Gasoline Price (2023$/L)	$1.41
Carbon Levy on Diesel (2023$/L)	$0.17
Carbon Levy on Gasoline (2023$/L)	$0.14
Electricity Consumption Price (2023$/kWh)	$0.20
Electricity Demand Price (2023$/kW)	$11.67
Charger Efficiency	95%

In the Baseline Scenario fuel costs are more expensive due to the increasing price of diesel, driven in part by escalating carbon taxes, and costs $22.7 million more than the BEB Scenario. **Table 20** includes the fuel and electricity lifecycle cost comparison.

Table 20. Fuel and Electricity Lifecycle Cost Comparison, Millions of 2023$, 2023-2050

	Baseline	BEB	Variance
Diesel Costs	$49.5	$16.6	-$32.9
Electricity Costs	-	$23.8	$23.8
Carbon Levy Costs	$19.4	$5.7	-$13.6
Total Fleet Lifecycle Propulsion Costs	**$68.9**	**$46.2**	**-$22.7**

6.3.3 OVERALL LIFECYCLE COST COMPARISON

Table 21 below shows the overall lifecycle cost comparison between the Base and BEB Scenarios. It is anticipated that the cost of transitioning to BEBs will be $37.1 million over the Baseline, in 2023-dollar terms. Additionally, the analysis assumes that capital costs will not be offset by grant or incentive funding. Including additional funding sources, such as ICIP or ZETF, may affect the results of the analysis. However, since these funds have not been applied for or secured by Milton Transit, they are not included in this analysis. Please note that the transfer to reserve costs is not included in the totals for either scenario, as this would substantially overstate the projected costs.

Table 21. Overall Lifecycle Cost Comparison, Millions of 2023$, 2023-2050[10]

2023$	Baseline Scenario	BEB Transition Scenario	Variance
Buses	$108.0	$204.5	$96.6
Midlife Rehabilitation	$81.4	$2.8	-$78.7
Specialized Transit	$20.2	$34.4	$14.2
Related Infrastructure	-	$31.8	$31.8
Life Cycle Capital Costs, Total	**$209.6**	**$273.6**	**$64.0**
Operations & Maintenance	$398.4	$393.0	-$5.5
Propulsion	$55.7	$41.1	-$14.6
Related Infrastructure O&M	-	$1.5	$1.5
Life Cycle O&M, Fixed Route	**$454.1**	**$435.6**	**-$18.5**
Operations & Maintenance	$15.8	$15.5	-$0.2
Propulsion	$13.2	$5.1	-$8.1
Life Cycle O&M, Specialized Transit	**$29.0**	**$20.7**	**-$8.3**
Total Fleet Lifecycle Costs	**$692.7**	**$729.8**	**$37.1**

[10]Note that **Table 21** does not include lifecycle replacement transfers to reserve, as the capital costs are included. To determine lifecycle costs over the 2023-2050 study period, replacement transfers are not included, to avoid double counting. Over the study period, replacement transfers for the conventional fleet are expected to be $153.7 million, $8.3 million for the infrastructure, and $29.1 million for the specialized fleet.

6.4 FUNDING PLAN

There are several external financing opportunities Milton Transit will consider in order to secure funding for the zero emission fleet transition. The two primary external funding sources are the Investing in Canada Infrastructure Program (ICIP) and the Zero Emission Transit Fund (ZETF).

The ICIP program is administered by Infrastructure Canada and has invested $131 billion in over 85,000 projects. This program has already funded several other municipalities' transit fleet buses, including conventional transit and other mobility services. The federal government will invest up to 40% for most municipal public transit costs, though this may increase to 50% for rehabilitation projects. Funding provided by Infrastructure Canada is divided among the provinces who distribute funding by municipality. It is noted that the Town was successful in retaining approximately $7.2 million in ICIP funds for the development of a Transit Garage Facility.

The ZETF is administered by Infrastructure Canada, and targets projects that enable or implement transit fleet electrification. The ZETF offers flexible financing solutions, including grants and loans through the Canada Infrastructure Bank (CIB) to applicants. ZETF funding decisions are determined by project viability, estimated operational savings, and estimated GHG emission reduction. Approximately $2.75 billion in funding is earmarked for the ZETF program to support the numerous municipal transit agencies that may apply for that funding.

Funding from either program may be used to offset planning, capital, and operating costs associated with transitioning diesel fleets to BEBs or alternative fuel technologies. As this funding has not been secured by Milton Transit, it is not included in this analysis.

7 ENVIRONMENTAL BENEFITS

Greenhouse gas (GHG) emissions reduction is a significant benefit of transitioning from a diesel fleet to BEBs. This section helps quantify the impacts that Milton Transit's conversion to BEBs may have on GHG emissions relative to the baseline diesel scenario; results do not consider GHG emissions associated with fabrication and construction of new BEB infrastructure or with resource extraction for the vehicles, etc.

7.1 ASSUMPTIONS & METHODOLOGY

The analysis quantified GHG impacts based on estimates of diesel fuel and electricity usage by transit buses over the 2023-2050 period. The following assumptions were used to quantify emissions based on litres of fuel and kWh of electricity consumed. Milton Transit's current fleet consumes biodiesel fuel and the emission factor selected reflects this.

The emission rate for diesel fuel is 2.681 kilograms (kgs) of carbon dioxide (CO2) per litre of fuel. The emission rate for gasoline fuel is 2.28 kgs of CO_2 per litre of fuel. These values were obtained from the Canadian National Inventory Report, 2023. The emission rate was multiplied by the annual litres of fuel consumed to calculate the annual kgs of CO2 emitted. To quantify the impact of electricity usage on GHG emissions, the total kWh of electricity used per year was multiplied by the corresponding Electricity Emission Intensity factor for Ontario from 2023 to 2050. This factor represents the kg of CO2 per kWh based on the average electricity grid mix for the province. The intensity factor declines over time due to anticipated introduction of new renewable power generation sources. The Electricity Emission Intensity Factor was obtained from the Average Grid Electricity Emission Intensities table in the ZETF GHG+ Guidance Modules, Annex C.

7.2 GHG EMISSION REDUCTION IMPACTS

Based on the assumptions above, the GHG emissions from BEB operations of Milton Transit's fleet are summarized in **Table 22**. Over the study period, BEBs will reduce emissions by approximately 76,900 tonnes. This translates to approximately 185 tonnes of CO2 saved per year, per bus.

Table 22. Total GHG Emissions (CO_2 in Tonnes)

	2025	2030	2040	Total
Diesel	2,168	4,134	5,156	120,466
BEB	-	-	-	-
Total, Baseline Scenario	**2,168**	**4,134**	**5,156**	**120,466**
Diesel	2,168	3,144	487	40,374
BEB	-	40	174	3,131
Total, BEB Scenario	**2,168**	**3,184**	**662**	**43,505**

There is a substantial decline from approximately 2,200 tonnes of GHGs per year to just below 700 tonnes per year in the BEB Scenario (**Figure 10**). Emissions remaining after the complete transition of the fleet to BEBs is due to diesel auxiliary heating on board BEBs.

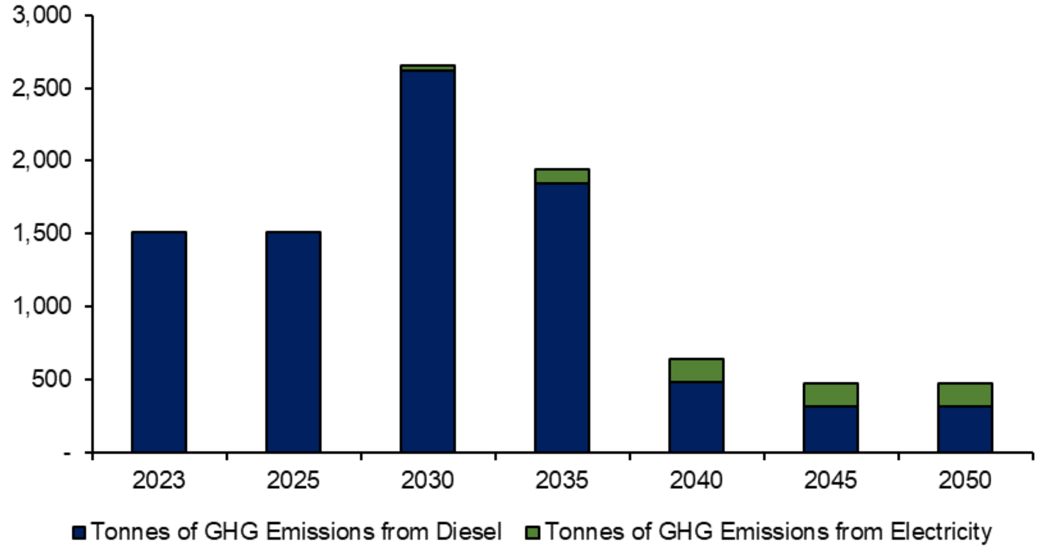


Figure 10. Annual GHG Emissions (CO_2 in Tonnes), BEB Scenario

The cumulative percent reduction in GHG emissions is shown in **Figure 11**. The annual emissions reduced grows substantially over time as the diesel fleet is converted to BEBs. By the end of the transition to BEBs, emissions are reduced by approximately 90%.

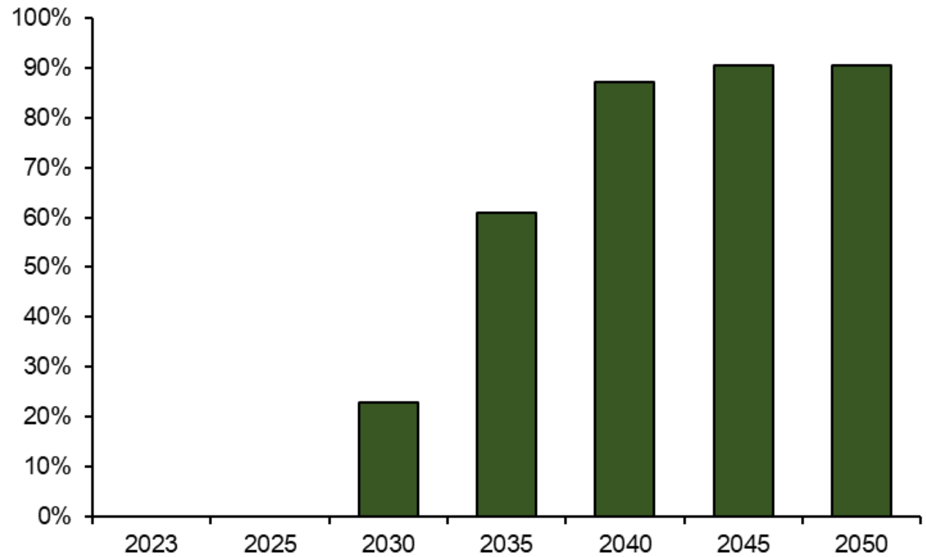


Figure 11. Percentage GHG Reductions from Baseline in BEB Scenario

8 PROJECT RISKS & MITIGATION

New technology introduces a host of potential risks associated with transitioning Milton Transit's fleet to a new fuel source. The table below highlights potential areas of risk associated with implementation and operation of BEBs into Milton Transit's fleet, accompanied by the response or countermeasure Milton Transit will take for each identified risk. It should be noted that risk exposure is subjective by nature and the plan's risk exposure will continuously evolve throughout the transition.

Risk	Risk Description	Risk Response
Infrastructure Transition	As BEBs are introduced to the fleet, it is essential that the necessary infrastructure is in place to enable their integration into the service. Coordination with third parties, such as local utilities and infrastructure manufacturers, can often result in lengthy timeframes and disruptions to current operations.	Initiate planning for infrastructure and ensure construction considerations are made while maintaining current operations. See that infrastructure upgrades are completed at least six months in advance of vehicles arriving. Following infrastructure installation, it is critical to conduct comprehensive testing and commissioning before placing vehicles and infrastructure into active service.
Internal Resource Availability to Support Implementation	The implementation of BEBs will require program management and operational support and may result in resource limitations, additional costs, and delays.	Identify key personnel for the management of procuring the vehicles and infrastructure upgrades as a coordinated program. See that existing resources are supplemented by hiring new roles to address gaps that are been identified. Engage consultants as necessary to offer support during project delivery to support the procurement process, construction, delivery and commissioning. Continue to leverage the Metrolinx TPI Group Purchasing program for procurement and contract administration for BEB and required charging infrastructure.
Service Planning and Scheduling	The BEB fleet will introduce new variables and processes into service planning and scheduling. Adjusting to these new requirements may take additional time and resources, which could result in an increased cost of service delivery and potential delays in implementation. It is important for service planning and scheduling to be flexible to the changes brought about by the new fleet to ensure smooth and efficient operations.	Initiate service planning adjustments at an early stage to gain insights into the attributes and operational limitations of BEBs using data from the Transition Plan. Ensure staff to identify necessary information and tools, assist them in acquiring additional capabilities, and support optimization of schedules with BEBs to maximize fleet utilization and minimize operating costs.

Risk	Risk Description	Risk Response
Revenue Operations Assumptions	The modelling forecasts the fleet size required to maintain current operations considering operator hours and associated operating costs. However, the underlying assumptions may not consider the full range of operations which may underestimate operational costs.	Initiate the adjustment of service planning practices to align with the characteristics and operational constraints of BEBs using insights from the Transition Plan. This approach aims to minimize the chance of adverse impacts. Additionally, start early and engage in a constructive dialogue with unions to mitigate the impact of any deviations from expected models. The use of on-board AVL / Electric Bus Telematics Software will be critical in creating critical alerts around battery state of charge and operating metrics.
Supply Chain Disruptions	The ongoing global shortage of electrical subcomponents, replacement parts, and heightened production demand due to the increased funding available for zero-emissions bus fleets may result in shortages of parts and tooling which would increase costs and delay procurement. Delays in vehicle procurement and delivery would also result in increased maintenance requirements for the current diesel fleets.	Consider supply chain disruptions, as they are applicable to both buses and fixed electrical infrastructure. Plan for adequate lead time to account for potential manufacturing and delivery delays. Ensure that enough local spare parts are maintained either through contracts or storage at the transit facility. Lists of types and quantities of critical spare parts should be provided by both vehicle and charging system suppliers. Strategies to address some of these challenges have been built into the Metrolinx TPI procurement contract (e.g. late delivery penalties, parts availability, etc.).
Resiliency	Utility blackouts, primary and secondary infrastructure failures, as well as natural disasters or extreme weather events, have the potential to significantly disrupt operations.	Assess the impact and frequency of power outages to evaluate mitigation options that will meet the organization's risk tolerance. Consider the options provided in the facilities report to determine what level of resiliency is required. Having a plan to replace major critical electrical components with long lead times, such as transformers, should be evaluated.

Risk	Risk Description	Risk Response
Insufficient Grid Capacity	The planned fleet will require significant power demand which may not be available with current infrastructure and could require additional costs to install new transmission lines or substations	Begin constructive engagement with local utilities to ensure necessary infrastructure upgrades are in place in time to support the charging equipment in the early stages. Engagement should be done with the utility as soon as a site is selected for the new bus garage to discuss capacity required and see if the utility will be able to provide the power required. Upgrades will also need to consider impacts from other facility related electrification such using electric heat pumps for HVAC.
Technology Interoperability	Potential incompatibility between buses and chargers from different manufacturers may be discovered during testing and commissioning which would result in additional costs and delays.	Thoroughly inquire and assess the compatibility of the equipment to be purchased during the procurement phase. Ensure contracts include testing and commissioning of vehicles with any equipment that is expected to be used. Plan would be to standardize on infrastructure provider and develop Service Level Agreement.
Technology Obsolescence	The technology for EVs is quickly evolving and older generation vehicles and chargers may not be compatible with newer ones. These changes can be driven by updates to charging standards, advancements in battery technology, or changes in design principles. As a result, retrofitting older models with the latest technology	Prior to the procurement of additional vehicles and infrastructure, regular and periodic market scans of the current state of the industry are recommended. Vehicle and charging manufacturers should be expected to maintain spare components for the expected lifespan of vehicles. Additionally, a sufficient supply of spare components should be purchased to ensure equipment is able to be kept serviceable. Leverage Metrolinx TPI Group Purchasing contracts to assist with contract administration as well as obsolescence and parts availability throughout the life of the contract. Evaluate alternative delivery options to lease / finance infrastructure through the utility or another 3rd party.

Risk	Risk Description	Risk Response
Software Issues	The smart charging software available in modern chargers is subject to bugs and disruptions which would negatively impact operations.	Ensure thorough testing and commissioning are carried out after installation of new infrastructure servicing BEBs and that timely support is available for software that is essential to operations. Leverage Metrolinx TPI Group Purchasing contracts to assist with contract administration and language surrounding obsolescence, reliability and parts availability throughout the life of the contract. Utilize charge-management software to pro-actively alert any charging faults, etc. Review option to have the utility manage charging infrastructure under a service contract.
Software Adoption	Delays or failure to adopt necessary software tools for electrification, such as smart charging, dispatch, and control, planning and scheduling, depot management, and fleet telematics, may cause implementation delays for electrification.	Before procuring new infrastructure for BEBs, conduct a comprehensive assessment of software and data needs. Once installed, thoroughly test and commission the new infrastructure. Leverage Metrolinx to share ideas and best practices around software deployment. This should also consider how it may apply to a broader fleet transition like Municipal Zero Emission Fleet Plans and Infrastructure Planning.
Known-Unknowns	The Town has identified a number of anticipated costs to be incurred as a result of the transition to BEBs, but the magnitude of these costs is unknown and/or unable to be predicted with any degree of accuracy. These costs include the cost of training for operations and maintenance staff, potential increases in facility insurance premiums to store BEBs indoors relative to storage of diesel and gasoline vehicles, and the incidental costs associated with implementation of en-route charging infrastructure (including land ownership, right-of-way, utility upgrades, etc.) The Town has also identified the potential labor constraints with maintenance contractors and service providers.	

APPENDIX A: ENERGY MODELLING ANALYSIS

FIXED-ROUTE SERVICE

The service data used was based on GTFS data for service in 2023, which is representative of current (post-COVID) service conditions. Five fixed-route service BEB scenarios were modelled: baseline, depot charging only with 525 kWh batteries, depot charging only with 675 kWh batteries, and depot and en-route charging with 525 kWh batteries. All scenarios are detailed below following a discussion of key assumptions.

KEY ASSUMPTIONS

To develop a model relevant for Milton Transit's fleet and operations, a set of assumptions and variables were identified and displayed in **Table 23**. It is noted that the assumptions regarding vehicle Original Equipment Manufacturer (OEM) attributes represent a typical, commercially available BEB model. Subsequent procurements following this analysis may result in vehicle OEM specifications which differ from these assumptions, which may impact the results of this analysis. Additional energy consumption modelling based on the selected OEM should be conducted to confirm any changes in energy and infrastructure requirements.

Table 23. BEB Simulation Assumptions

Variable	Input
Service Data	December 2022 – January 2023
Battery Capacity	525 kWh (Existing vehicle battery size) 675 kWh (Expected future vehicle battery size)
End-of-Life Battery State of Health	80% (max battery degradation)
Energy Reserve	20% state of charge (SOC)
Heating	Diesel Auxiliary Heat
Ambient Temperature	-22C (Cold weather, 10th percentile) +27C (Hot weather, 90th percentile)
Passenger Capacity	100% seated capacity
Depot Charger Power	150 kW @ 95% Efficiency
En-route Charger Power	450 kW (Vehicle Limited) @ 95% Efficiency

BASELINE SCENARIO

The first modelled scenario assumes depot charging is allowed all day with no modifications to block schedules. Buses are reused if a vehicle has a minimum state-of-charge (SOC) of 60% or higher. In this scenario, if a short block is completed and the bus has at least 60% SOC, then the vehicle is used again in the same day to start another block that it can complete. This gives an indication of how feasible the blocks will be based on how Milton currently operates. The results of the baseline scenario indicate that vehicles were not able to complete several of the blocks, so this scenario was discounted as it is not a viable option.

DEPOT CHARGING ONLY SCENARIOS

These scenarios evaluated a fleet of either 525kWh or 675kWh BEBs with on-board diesel auxiliary heaters that would utilize plug-in depot chargers. It was assumed that buses would be swapped out part way through the block with a fully charged vehicle when the first vehicle reaches 20% SOC. By swapping the buses, they would be scheduled to run shorter blocks that align with the capabilities of the BEBs.

The model also assumes that when swaps occur, the bus that would normally stay in service would return to the depot, and another bus and operator would drive from the depot to take its place. This has impacts both on fleet size required (peak vehicle requirement) as well as operational costs due to the increased amount of deadhead miles incurred (non-revenue hours and kilometres between the depot and the first/last stop).

MODEL RESULTS: 525 KWH BATTERY CAPACITY

A review is provided below that details the main components of the transit service and operations likely to change when transitioning to a 525kWh BEB fleet using only depot charging. **Figure 12** shows an estimate of the increase in non-revenue hours and kilometres as well as the estimated number of vehicles required to continue the current transit service.

- Revenue hours and kilometres remain the same
- Non-revenue hours: **29% increase**
- Non-revenue kilometres: **28% increase**
- Peak Vehicle Requirement: **31% increase**
- At least 3 depot chargers will be required:
  - (3) 150 kW plug-in chargers
- (9) 525kWh BEBs can be deployed before an increase in fleet size is required

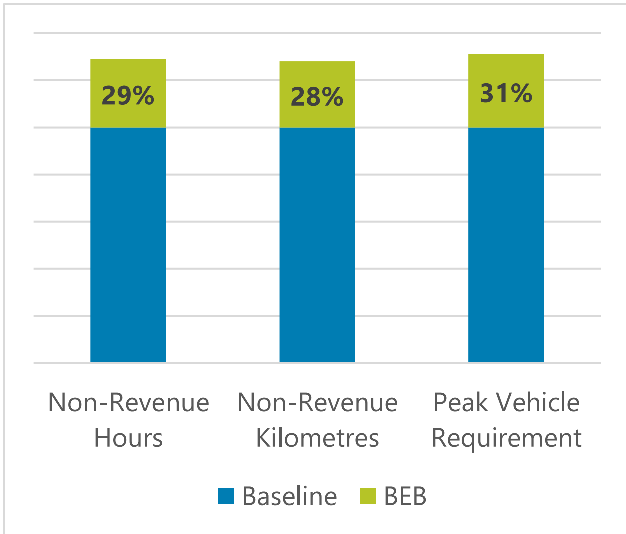


Figure 12. 525kWh BEB Depot Charging Only Model Outputs

The vehicle battery states of charge on each block during weekday service are shown in **Figure 13**. Weekend service was also modelled, but fleet and charging requirements are driven by weekday service which illustrates the most demanding operations for Milton Transit.

Each block is represented by a line on the chart with the color of the line corresponding to the state of charge of the vehicle. The color changes from green to yellow to red to black as the state of charge drops from 100 to 0 percent. Bus swaps (shown in blue) are introduced only between trips to minimize service impacts. Bus swaps are also inserted in locations shown in blue to guarantee the minimum SOC does not dip below the required 20 percent reserve capacity, including the energy needed to return the vehicle to the depot when a swap is needed. Whenever a vehicle is swapped out, it is replaced with a BEB that has a fully charged battery. Swapping buses is only helpful when the bus either stays near the depot all day or returns within a close distance to the depot at multiple points throughout the day. If a block is scheduled to travel a long distance away from the depot, then there is no convenient opportunity for a swap.

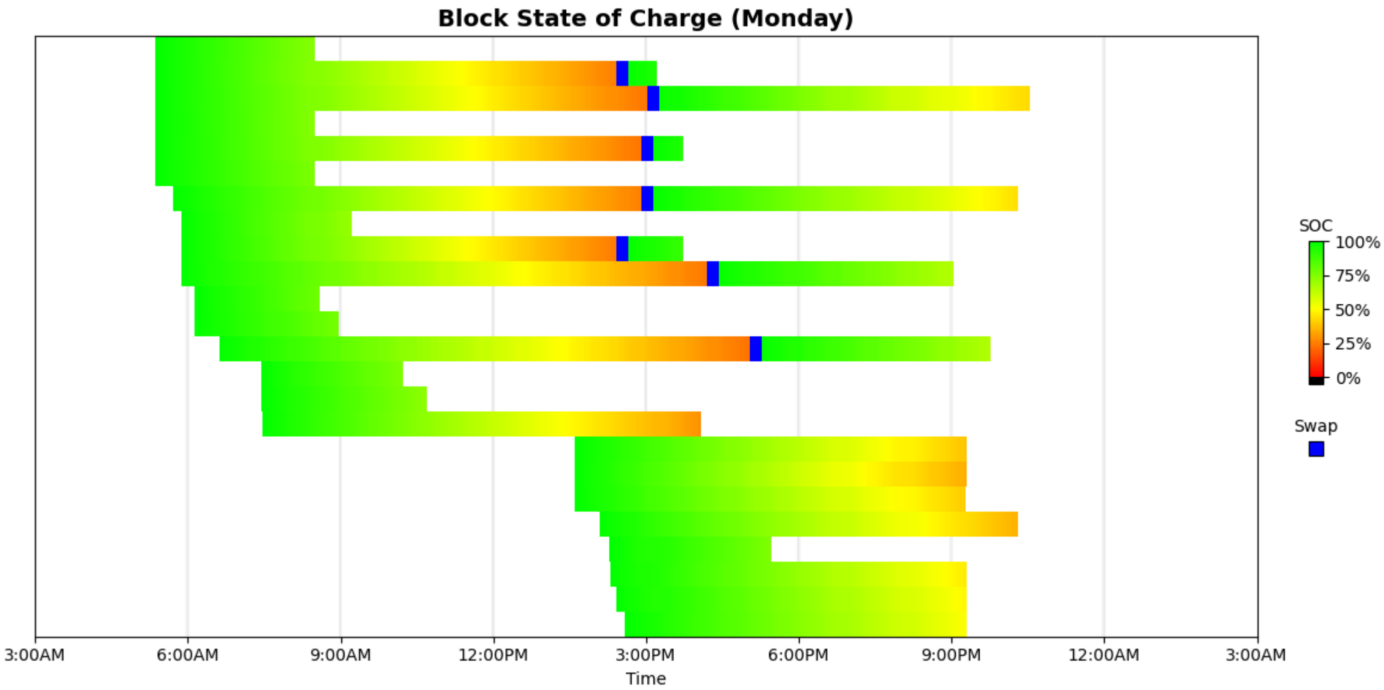


Figure 13. 525kWh BEB Depot Charging Only - Weekday Service Block SOC Heatmap

The modelling reveals which existing service blocks are feasible without the need for en-route charging or a bus swap to complete service. **Table 24** shows which service blocks are feasible with 525 kWh buses and infeasible, respectively. A total of 17 blocks (71%) can be replaced with BEBs at a 1-to-1 ratio without the need for en-route charging. The remaining 7 blocks (29%) would require either en-route charging or a bus swap to complete service.

Table 24. Summary of Feasible Blocks without Swap for 525 kWh BEB

Feasible with 525 kWh Bus			Infeasible with 525 kWh Bus
1225529	1225534	1225574	1225553
1225533	1225569	1225514	1225541
1225540	1225519	1225547	1225575
1225544	1225566		1225567
1225556	1225579		1225524
1225557	1225580		1225509
1225592	1225597		1225550

Power Requirements

Figure 14 shows the daily power demand profile for 525kWh BEBs at the depot facility if Milton Transit elects to continue with depot charging only. The highest power demand occurs overnight, peaking at 450 kW, when buses return to the depot and are plugged in. There are two peaks during the day, one between

5pm to 7pm and another between 10pm to 4am. Between 5am to 3pm, the demand is relatively low.

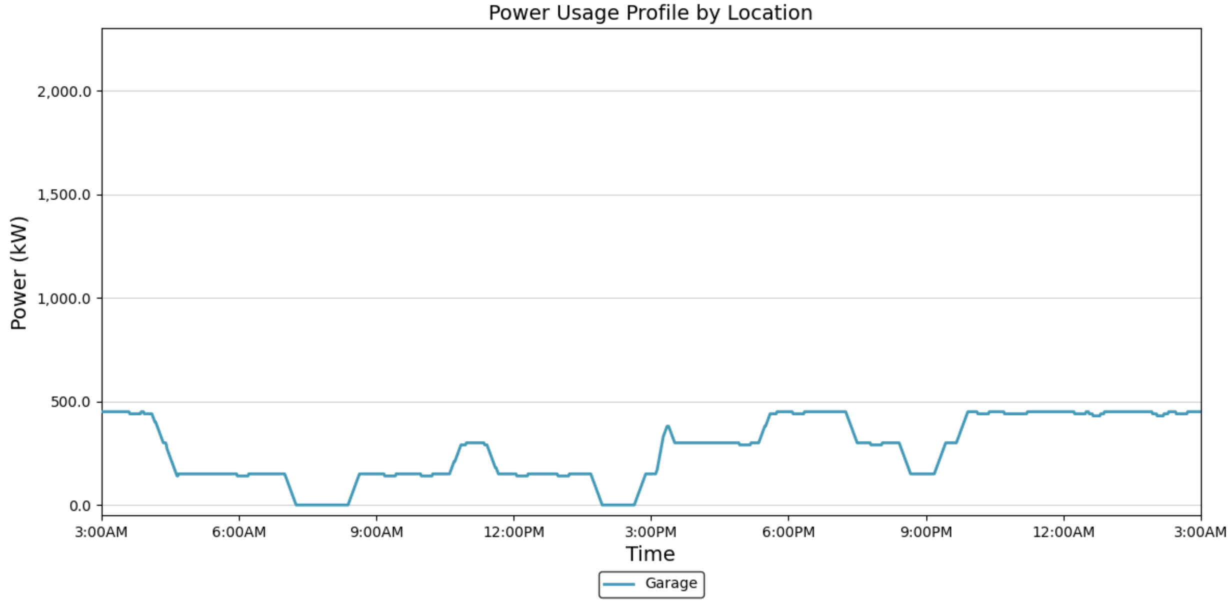


Figure 14. 525kWh BEB Depot Charging Only Maximum Daily Power Profile at Depot Facility

Vehicle Battery Capacities

Figure 15 shows what the percentage of Milton Transit's service becomes feasible without en-route charging by battery size. With 525 kWh buses, 71% of weekday services blocks can be replaced one-to-one without en-route charging. Increasing to 675 kWh, feasibility increases to 83% and a bus battery capacity would need to be at least 1 MW for 100% of service blocks to be feasible.

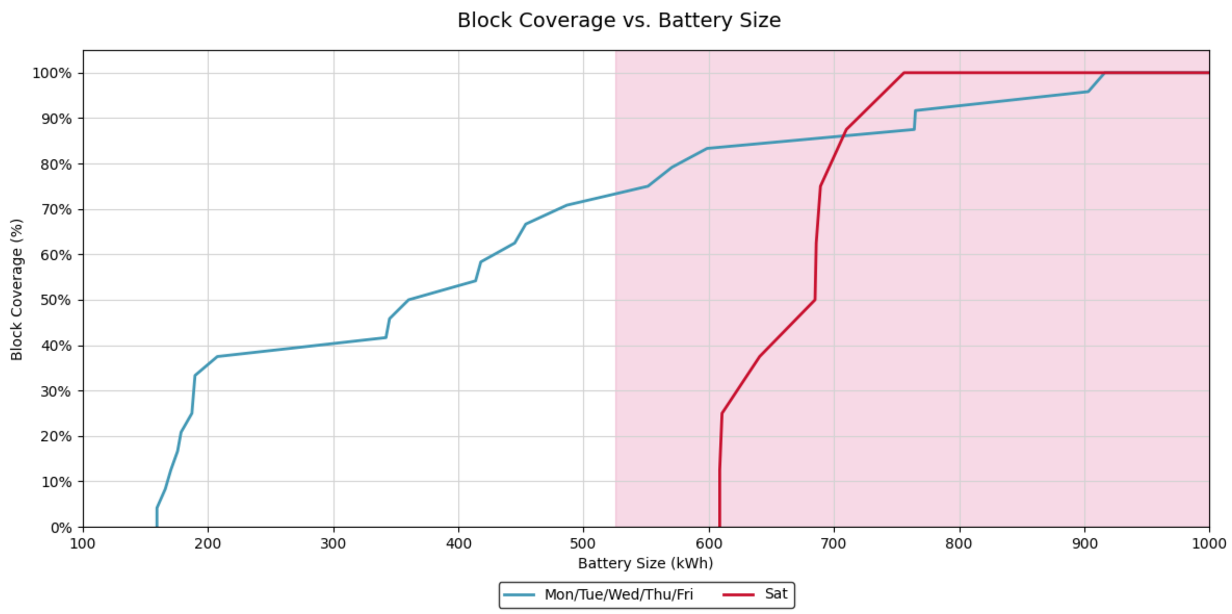


Figure 15. Block Feasibility by Required Vehicle Battery Size

MODEL RESULTS: 675 KWH BATTERY CAPACITY

Below is a review of the main components of the transit service and operations that are likely to change and should be considered when transitioning to a 675kWh BEB fleet using depot charging only. **Figure 16** shows an estimate of the increase in non-revenue hours and kilometres as well as the estimated number of vehicles required to continue the current transit service.

- Revenue hours and kilometres remain the same
- Non-revenue hours: **21% increase**
- Non-revenue kilometres: **21% increase**
- Peak Vehicle Requirement: **6% increase**
- At least 4 depot chargers will be required:
  - (4) 150 kW plug-in chargers
- (12) 675kWh BEBs can be deployed before an increase in fleet size is required

With a 675kWh BEB, there are operational improvements in Milton service as only four blocks (three fewer blocks than the 525kWh BEB) are feasible with only one swap and the rest are feasible without swaps. The vehicle battery states of charge on each block during weekday service are shown in **Figure 17**.

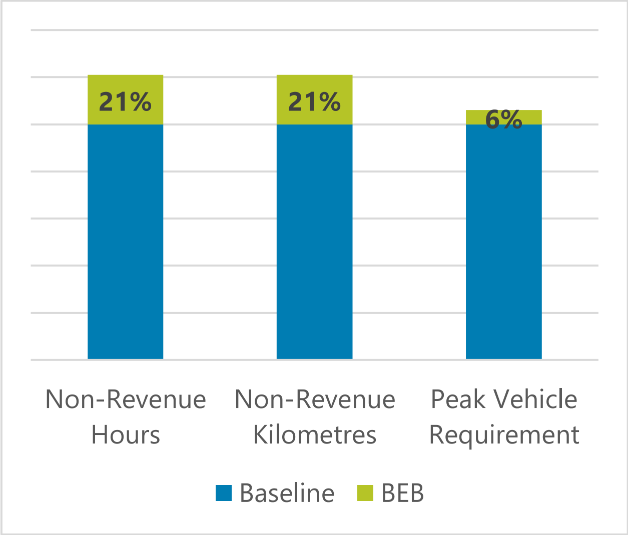


Figure 16. 675kWh BEB Depot Charging Only Model Outputs

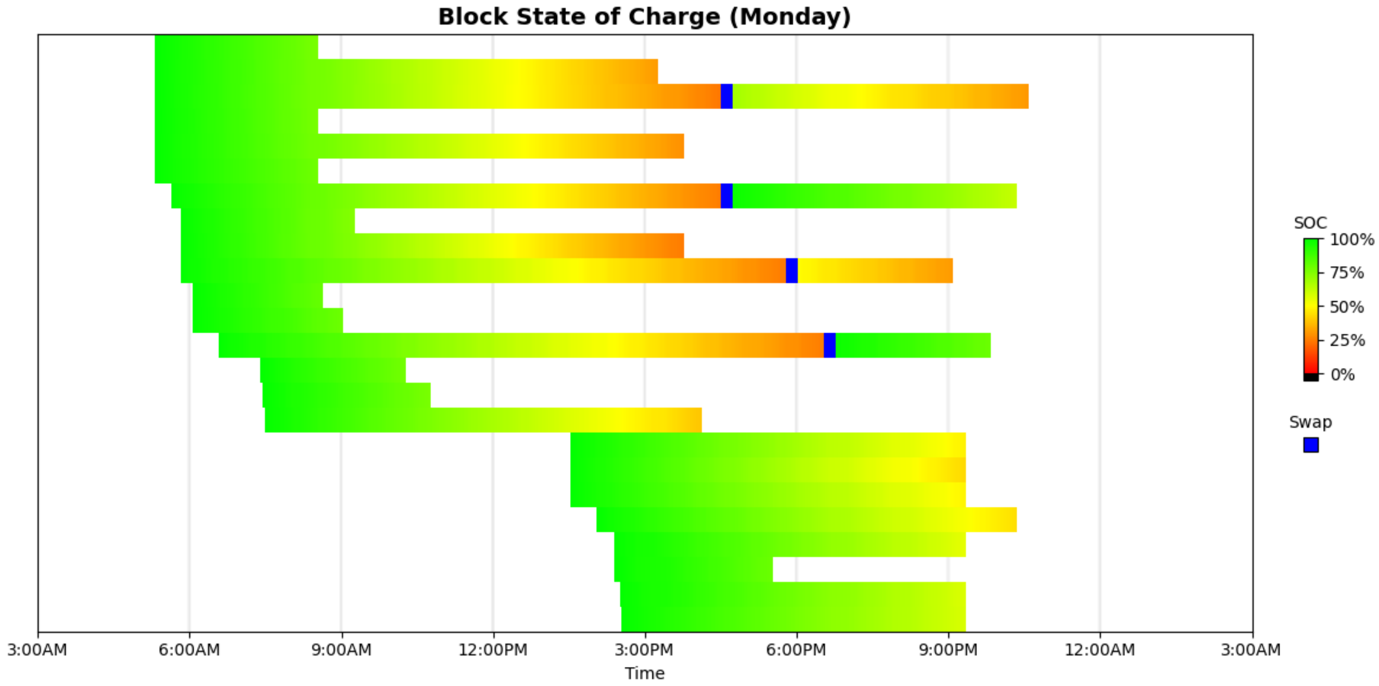


Figure 17. 675kWh BEB Depot Charging Only - Weekday Service Block SOC Heatmap

Table 25 shows which service blocks are feasible with 675 kWh buses and infeasible, respectively. A total of 20 blocks (83%) can be replaced with BEBs at a 1-to-1 ratio without the need for en-route charging. The remaining 4 blocks (17%) would require either en-route charging or a bus swap to complete service.

Table 25. Summary of Feasible Blocks without Swap for 675 kWh BEB

Feasible with 675 kWh Bus			Infeasible with 675 kWh Bus
1225529	1225534	1225574	1225541
1225533	1225569	1225514	1225524
1225540	1225519	1225547	1225509
1225544	1225566	1225553	1225550
1225556	1225579	1225575	
1225557	1225580	1225567	
1225592	1225597		

Power Requirements

Figure 18 shows the daily power demand profile for 675kWh BEBs at the depot facility if Milton Transit elects to continue with depot charging only. The power demand is highest in the evenings and overnight, peaking at 600 kW. This is primarily due to the buses returning to the depot facility and being plugged in. There is a peak in demand at 6 pm, and then between 11 pm and 6 am. Demand is relatively low between 7 am and 3 pm.

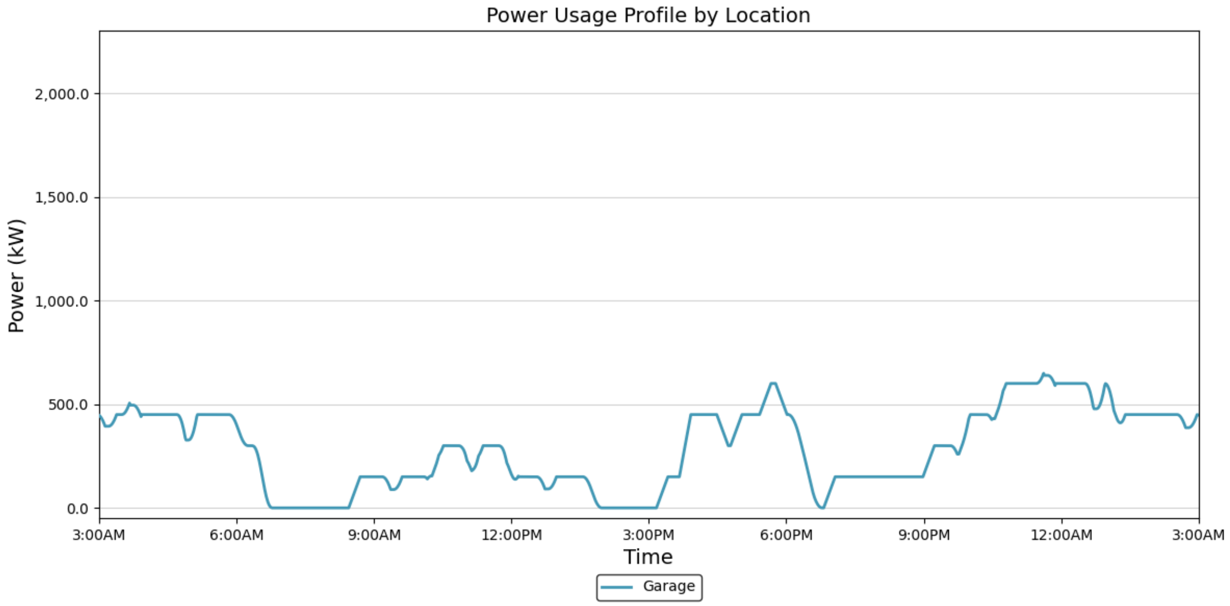


Figure 18. 675kWh BEB Depot Charging Only Maximum Daily Power Profile at Depot Facility

DEPOT & EN-ROUTE CHARGING SCENARIOS

This scenario evaluated a fleet of 525kWh BEBs with on-board diesel auxiliary heaters that would utilize plug-in depot chargers and overhead pantograph chargers en-route positioned at Milton GO Station. Layover times in the existing schedule were used to identify the most ideal locations for en-route chargers.

There was one location identified as having a significant amount of layover time available for buses to charge.

The review of the en-route charging locations does not consider the complexity associated with property ownership, access, existing utilities, and other site constraints that may limit or be prohibitive for these activities. This illustrative exercise would require additional study prior to committing to this work.

MODEL RESULTS: 525 KWH BATTERY CAPACITY

Below is a review of the main components of the transit service and operations that are likely to change and should be considered when transitioning to a BEB fleet utilizing enroute charging in addition to depot charging. **Figure 19** shows an estimate of no increases in non-revenue hours and kilometres as well as no estimated increases in the number of vehicles required to continue the current transit service.

- Revenue hours and kilometres remain the same
- Non-revenue hours and kilometres remain the same
- Peak Vehicle Requirement remains the same
- At least 2 en-route chargers will be required:
    - (2) 450 kW pantograph chargers at Milton GO Station

With the introduction of en-route chargers at Milton GO Station, all service blocks can be completed without the need for schedule modifications or bus swaps as shown in **Figure 20**. Though en-route charging improves feasibility, there are several complexities the Town would need to consider at Milton GO Station.

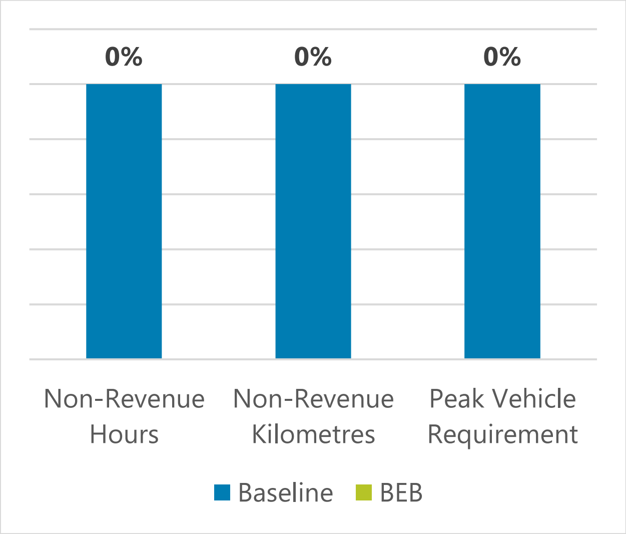


Figure 19. BEB Depot and En-Route Charging Model

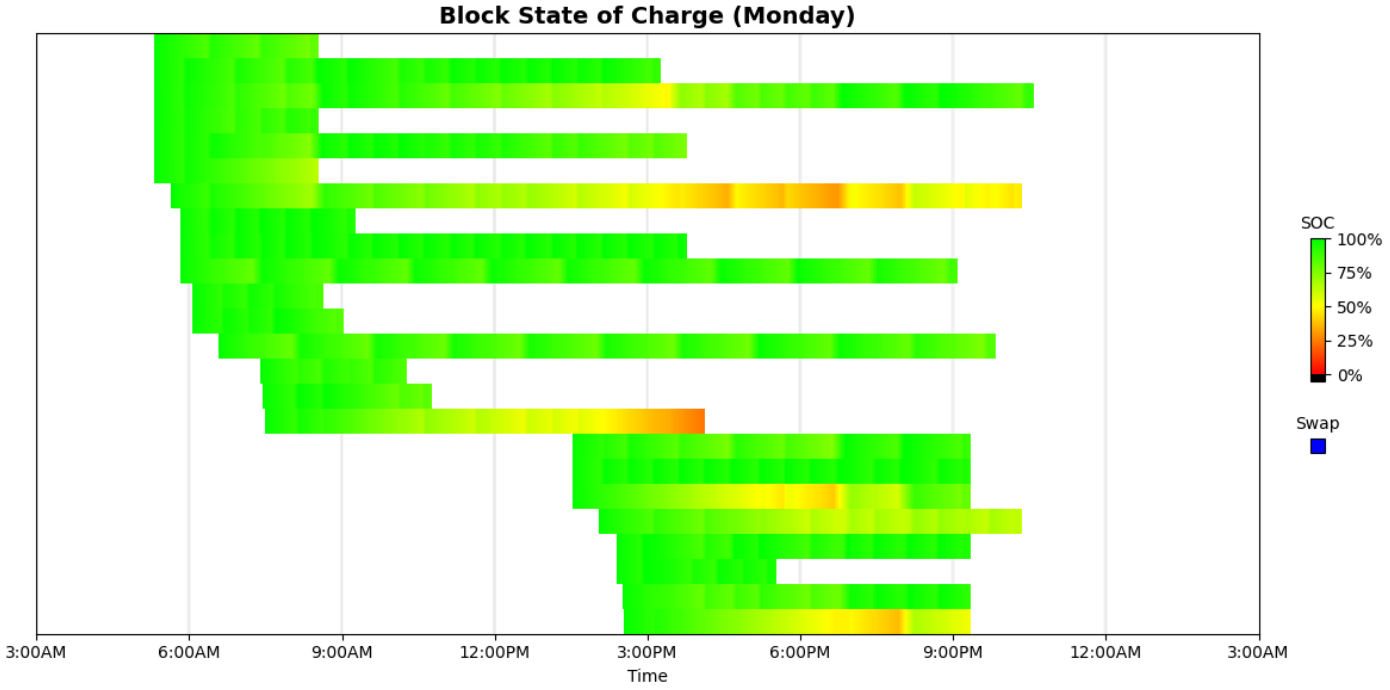


Figure 20. 525kWh BEB Depot and En-Route Charging - Weekday Service Block SOC Heatmap

Power Requirements

Figure 21 shows the daily power demand profile at the depot facility, peaking at 300 kW, if Milton Transit elects to deploy en-route chargers in the future. The overnight peak demand is slightly reduced and the demand during the day is lower, and more uniform compared to the depot charging only scenario.

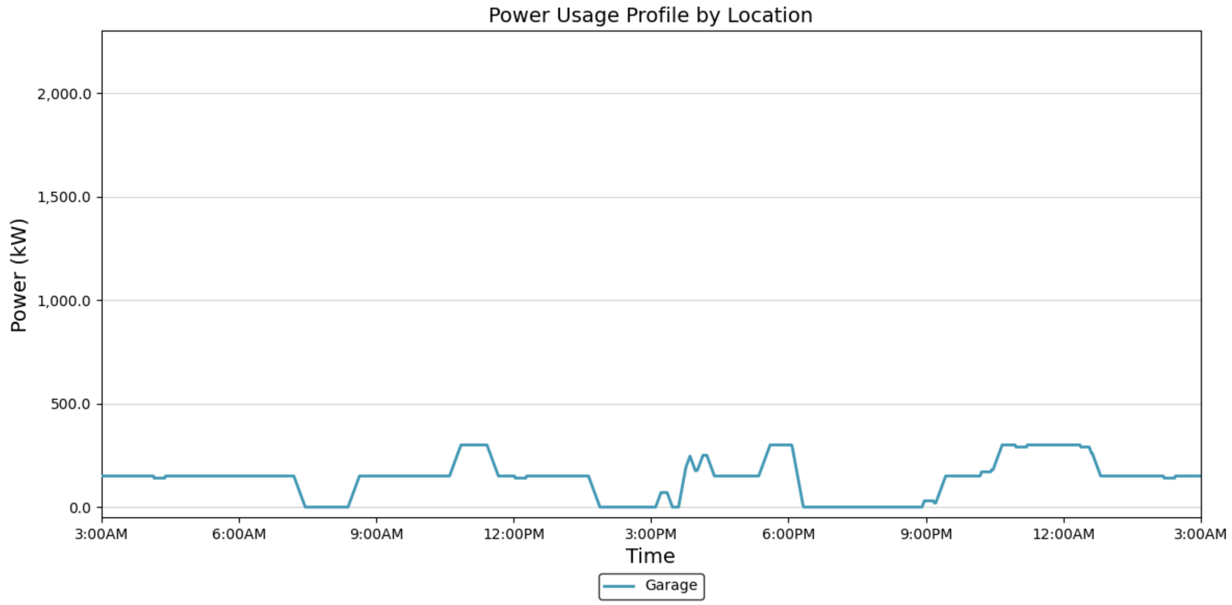


Figure 21. Depot and En-Route Charging Maximum Daily Power Profile at Depot Facility

ON-DEMAND/SPECIALIZED SERVICE

Milton Transit on-demand services were modelled separately from fixed route services due to the available data types. The modelling effort for Milton Transit's specialized fleet is based on operating data provided by the agency, as well as battery and charging specifications of BEB equivalents. Existing specialized vehicle average daily miles and hours were considered in the modelling, derived from provided monthly vehicle data. The total energy consumption of the BEB fleet is computed using the average-case vehicles to forecast overall site energy and fleet size impacts.

To protect the life of the BEBs' batteries and avoid range anxiety, a minimum state of charge (SOC) of 20% and a maximum SOC of 90% to protect the life of the battery is assumed. These assumptions are reflected in the analysis by assuming a usable battery capacity equal to 70% of the vehicle's nameplate battery capacity. The use of accessory equipment like wheelchair lifts can also impact the energy consumption, but the impacts are difficult to predict. Accessory equipment does not typically significantly impact energy consumption, but to account for unknown additional energy requirements a 10% energy consumption buffer was added to the daily energy needs of each vehicle that is equipped with a wheelchair lift.

If the daily amount of energy required exceeds the available energy for that vehicle type, then the cases for an increase in fleet size or mid-day fast charging are considered. These additional cases facilitate protecting the vehicle's health while avoiding interruptions to normal operations. Three scenarios were considered: a baseline (business as usual) scenario, a scenario reflecting an expanded BEB fleet, and a scenario where the fleet is not expanded but mid-day recharging is supported.

MODEL INPUTS

This energy modelling effort was conducted to understand the feasibility of fleet operations using BEBs and to forecast the magnitude of infrastructure needed to support a transition to a BEB fleet. **Table 26** lists the operational profile of each vehicle modelled; a total of six Arbocs were modelled, assuming four active and two spares and flex profile vehicles are assumed to have the same operational profile as the other Arbocs in service for which data was available. The total energy consumption of the BEB fleet is computed using both the average- and worst-case vehicles, which allows overall site energy and fleet size impacts to be more accurately predicted.

Table 26. Specialized Fleet Modelling Inputs

Vehicle ID	Quantity Modelled	Average Daily Time (Hours)	Max Daily Time (Hours)	Average Daily Distance (km)	Max Daily Distance (km)
M2031 (Arboc)	3	7:27:06	11:36:00	144.42	249.03
M1922 (Promaster)	1	7:58:36	16:31:12	163.88	457.35
M1923 (Promaster)	1	8:35:18	21:19:48	180.83	531.78
M1921 (Promaster)	1	8:29:55	14:43:48	161.39	411.28
M2021 (Promaster)	1	11:43:56	30:59:24	233.84	545.79
M1924 (Promaster)	1	7:58:39	11:43:12	157.9	362.46
M2022 (Promaster)	1	7:59:57	12:42:00	166.82	398.74
M2032 (Arboc)	3	7:35:06	8:51:00	150.36	209.45

MODEL RESULTS

Milton Transit's specialized fleet can complete most routes on an average day without any increase in required fleet size or the use of DCFCs depending on the operational profile. On a worst-case day, no vehicles can complete their service on a single charge without fleet or service modifications. Two alternate scenarios were modelled, where either the fleet size increases or vehicles are brought back to the depot facility for charging mid-day.

BASELINE SCENARIO

First, a baseline scenario was modelled to identify the number of vehicles and chargers required to support a BEB fleet based on current operating characteristics. **Table 27** shows which vehicles can complete service on a worst-case day and which cannot. This model illuminated challenges with some BEBs' ability to complete the service required of them on a single charge as shown in the Average Day Feasibility and Worst Case Day Feasibility columns below.

Table 27. Baseline Scenario Model Results

Vehicle ID	Average km	Max km	Shift Length	Shifts	Average Day Feasibility	Worst Case Day Feasibility
M2031 (Arboc)	144.42	249.03	10.00	1	Feasible	Infeasible
M1922 (Promaster)	163.88	457.35	10.00	1	Feasible	Infeasible
M1923 (Promaster)	180.83	531.78	10.00	1	Feasible	Infeasible
M1921 (Promaster)	161.39	411.28	10.00	1	Feasible	Infeasible
M2021 (Promaster)	233.84	545.79	10.00	1	Infeasible	Infeasible
M1924 (Promaster)	157.9	362.46	10.00	1	Feasible	Infeasible
M2022 (Promaster)	166.82	398.74	10.00	1	Feasible	Infeasible
M2032 (Arboc)	150.36	209.45	10.00	1	Feasible	Infeasible

The vehicles reaching maximum distance per day experienced battery capacity utilization challenges, leading to the need for an increased fleet size to facilitate bus swaps or mid-day recharging at the depot facility. Without these accommodations, the fleet would not be able to complete their service.

EXPANDED FLEET SCENARIO

This model scenario assumes that all vehicles that were feasible on a worst-case day remain unchanged, but the five vehicles that could not meet service requirements are assumed to be swapped on-street with a fully charged vehicle to finish service. When daily mileage exceeds the range capability of the BEB, the model will add an additional vehicle to the fleet. Vehicles would remain on the street until their battery reaches 20% SOC and then would be swapped with a fully charged bus for the remainder of service. To accommodate bus swaps, the fleet would need to increase by 8 vehicles, one for each active vehicle reaching the maximum daily distance. **Table 28** indicates the *minimum* infrastructure that would be needed to maintain service but, in practice, the fleet may be charged by higher powered chargers.

Table 28. Expanded Fleet Scenario Analysis

Vehicle ID	Daily Maximum Distance (km)	BEB Fleet Size	Minimum Charger Level & Output	Peak Load (kW)	Maximum Daily Energy Consumption (kWh)
M2031 (Arboc)	144.42	4	15 A Level 2	14.4	221.5
M1922 (Promaster)	163.88	2	15 A Level 2	7.2	151.8
M1923 (Promaster)	180.83	2	15 A Level 2	7.2	166.2
M1921 (Promaster)	161.39	2	15 A Level 2	7.2	149.5
M2021 (Promaster)	233.84	2	30 A Level 2	14.4	180.0
M1924 (Promaster)	157.9	2	15 A Level 2	7.2	146.1
M2022 (Promaster)	166.82	2	15 A Level 2	7.2	153.6
M2032 (Arboc)	150.36	4	15 A Level 2	7.2	228.9

MID-DAY RECHARGING SCENARIO

To identify the infrastructure needs of a BEB fleet supported by mid-day recharging, another scenario was modelled where the overall fleet size does not change from the current fleet size, but vehicles are brought back to the depot facility during the day to recharge between shifts. Similar to the expanded fleet scenario, only 1 vehicle would need to be brought back to the depot facility on an average day, but on a worst-case day all vehicles would need to return for mid-day recharging at least once throughout the day to maintain the same level of service. In the model, this is reflected by splitting one shift into either two 5-hour shifts or three 4-hour shifts, depending on the operational profile of the vehicle. When breaking down the existing profile into multiple shifts, all vehicles can complete service on both an average and worst-case day without the need for an increase in fleet size. **Table 29** indicates the *minimum* infrastructure that would be needed to maintain service but, in practice, the fleet may be charged overnight by higher powered chargers; mid-day recharging would utilize the transit fleet's DCFCs and would require between 54 and 79 minutes to recharge between shifts.

Table 29. Mid-Day Recharging Scenario Analysis

Vehicle ID	Shift Maximum Distance (km)	Shifts	BEB Fleet Size	Minimum Charger Level & Output	Peak Load (kW)	Maximum Daily Energy Consumption (kWh)
M2031 (Arboc)	124.515	2	3	30 A Level 2	21.6	88.4
M1922 (Promaster)	152.45	3	1	30 A Level 2	7.2	28.8
M1923 (Promaster)	177.26	3	1	30 A Level 2	7.2	32.2
M1921 (Promaster)	205.64	2	1	30 A Level 2	7.2	41.7
M2021 (Promaster)	181.93	3	1	30 A Level 2	7.2	39.5
M1924 (Promaster)	181.23	2	1	15 A Level 2	3.6	39.9
M2022 (Promaster)	199.37	2	1	30 A Level 2	7.2	42.4
M2032 (Arboc)	104.725	2	3	30 A Level 2	21.6	89.2

APPENDIX B: FACILITY ASSESSMENT

DEPOT CHARGING

Depot charging refers to the siting and use of charging infrastructure at the facility where buses are typically stored overnight. At the depot, the main difference between plug-in and pantograph dispensers is the way the vehicle is connected to the charger. Charging speeds will be similar because both dispensers use the same charging modules to deliver the same amount of energy.

There are trade-offs with picking either plug-in or pantograph as the connection option. Pantographs take up less space if mounted to existing overhead structures and can offer an automatic way of connecting the vehicle that doesn't require an operator or service person to physically plug in a cable. Some of the drawbacks are that they're heavier, more expensive (estimated 2x due to structure construction and additional equipment), require more maintenance, require precise vehicle alignment under the pantograph, and interference with wireless communication between the dispenser and the bus may lead to disruptions in the charging process.

Plug-in charging (**Figure 22**) has the benefits of typically being less expensive, with fewer physical alignment issues and typically fewer communication issues (since there is a hard-wired communication between the charger and dispenser and dispenser and the bus). The downsides are that someone must physically plug the bus in, it typically takes up more floor space (but can also be mounted to the ceiling), requires cable management, and plug-in connectors are more easily damaged.

The CCS plug-in charging standard, SAE J1772 model, has been around since 2011 and is a more mature standard that has received several revisions. The first version of charging standard for pantograph down, J3105-1, was published in 2020. At present, some aspects of the standard are being refined to address some of the issues mentioned above.

For the depot facility, a dispenser for each bus is recommended to ensure that when the fleet is parked at night all vehicles can be charged without the need to circulate buses through a limited number of charging bays. It is likely that there will be times when a charger or dispenser will occasionally be out of service due to failure or routine maintenance. Since transit fleets typically maintain a fleet size that includes several spare buses beyond the number required to meet peak service each day, having at least one dispenser per bus will also provide for resiliency in that there will effectively be spare chargers.

Manufacturers offer products that enable several dispensers to be powered from a single charging cabinet. This can be achieved either through "sequential charging," where buses are put in a queue and charged individually, or through "parallel charging," where power is shared among multiple connected vehicles. This infrastructure reduces the amount of charging modules required and provides multiple dispensers and charging options. Despite this advantage, the failure of a single charging cabinet can impact the charging of multiple buses.

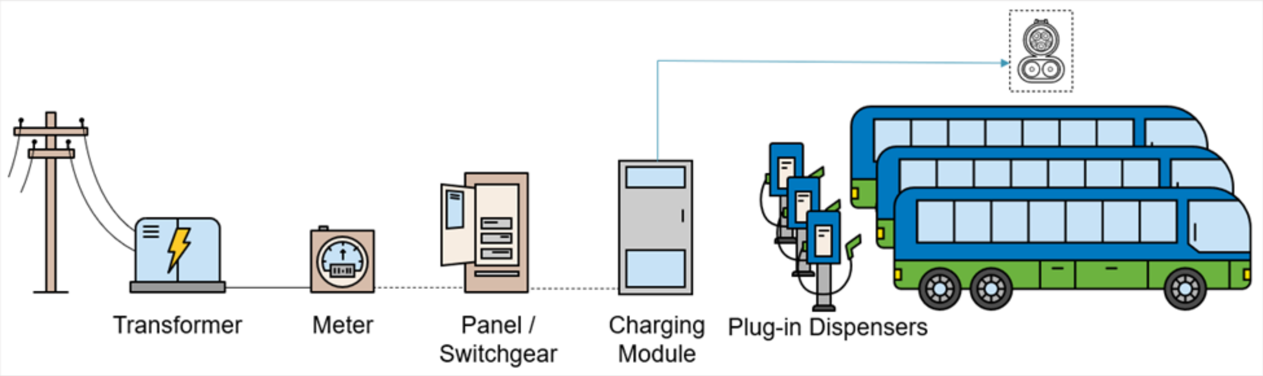


Figure 22. Equipment Required to Feed a Single Charging Module with 3 Plug-In Dispensers

Charging modules come in different sizes and power levels depending on the amount of charging required. Some modules can serve up to four dispensers, with the majority of chargers capable of serving up to three dispensers. Regardless of size, it's important to match the number of dispensers to the number of vehicles stored at the facility.

EN-ROUTE CHARGING

En-route or layover charging is a term used for high-speed charging infrastructure that is placed along a bus route (**Figure 23**). This infrastructure allows BEBs to charge during layover time, which can be as little as 5 minutes, in order to regain some or all of their energy. The current en-route chargers have a rating of approximately 450 kW; however, no bus can currently accept that much power, so several charger manufacturers have begun to reduce their largest charger offering to between 300 and 360 kW. Should future bus models begin to accept higher power charging, the charger size may increase in the future.

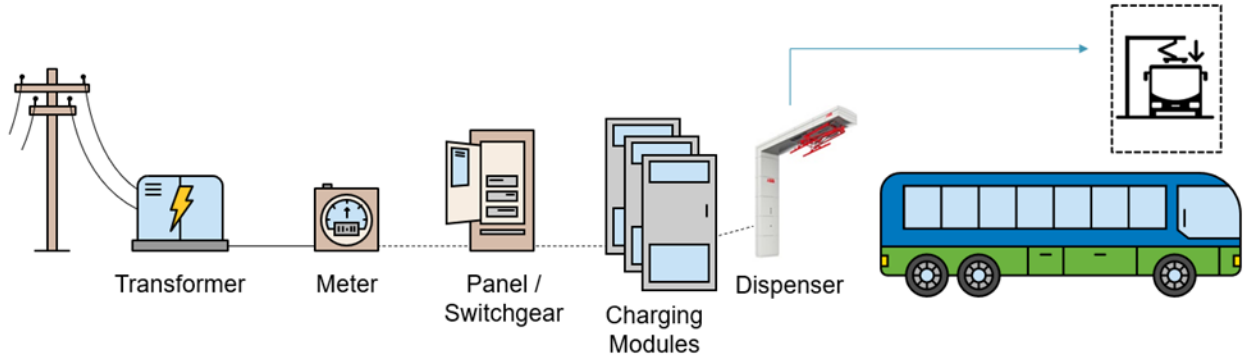


Figure 23. Equipment Required to Feed a Single High-Speed Pantograph Charger

Typically, all the charging equipment in **Figure 23** will be required on each en-route site, but sites with multiple en-route chargers are able to share larger transformers and switchgear. Charging modules can be separated from the dispensers by 100 metres with some manufactures extending to up to 150 metres. Charging modules and upstream electrical equipment should be in "back of house" areas away from passengers, if possible. Having electrical equipment located away from passenger areas makes it easier for repair and servicing without impacting the public. Charging modules also generate heat and minimal noise when in operation which is not ideal for customers. Locating charging modules in fenced compounds is further recommended to avoid risk of vandalism.

En-route quick charging requires a large amount of power for each charging station. Facilities that have separate drop-off, layover and pick-up areas are ideal for en-route charging since a fast charger in the layover location can potentially serve multiple routes. Terminus locations without separate drop-off/layover/pickup locations can also use en-route charging but may require additional pantograph dispensers that will allow for charging at the gate where vehicles normally park for the duration of the layover.

CHARGING INFRASTRUCTURE CONSIDERATIONS

The following sections list factors that were considered when developing the concept plans. They were developed using industry best practices and considered the fact that the Town has the ability to design a brand new facility to accommodate EV charging infrastructure.

DEPOT CHARGER SELECTION

There are currently a number of charging solutions, including plug-in, pantograph, and wireless inductive charging available for use in transit applications. For Milton Transit, facility space planning constraints may restrict the type of charger dispensers that are operationally feasible. For charging in the indoor parking structure, wall mounted chargers would be a good option for the two outer most parking lanes; while for the four inner parking bays, either would employ overhead retractable plug-in cable reels or overhead pantograph chargers could be installed. These options minimize space requirements within the building by eliminating the need for bay restriping to include space for ground-mounted dispensers and protective bollards.

As the Town is designing its new facility, it should consider designing its roof height to accommodate overhead pantograph charging for the rows of inner parking bays that are not adjacent to a wall. Pantographs are an option for space-saving charging infrastructure. Pantographs require that they be mounted at a particular height above the vehicle. As shown in **Figure 24** the typical depot pantographs need to be mounted around 1.175m above the bus. With the ceiling structure being 5.5m to 6.5m above the ground, the application may require a separate gantry or ceiling mounted structure to support the pantograph at the appropriate height, being around 4.5m off the ground.

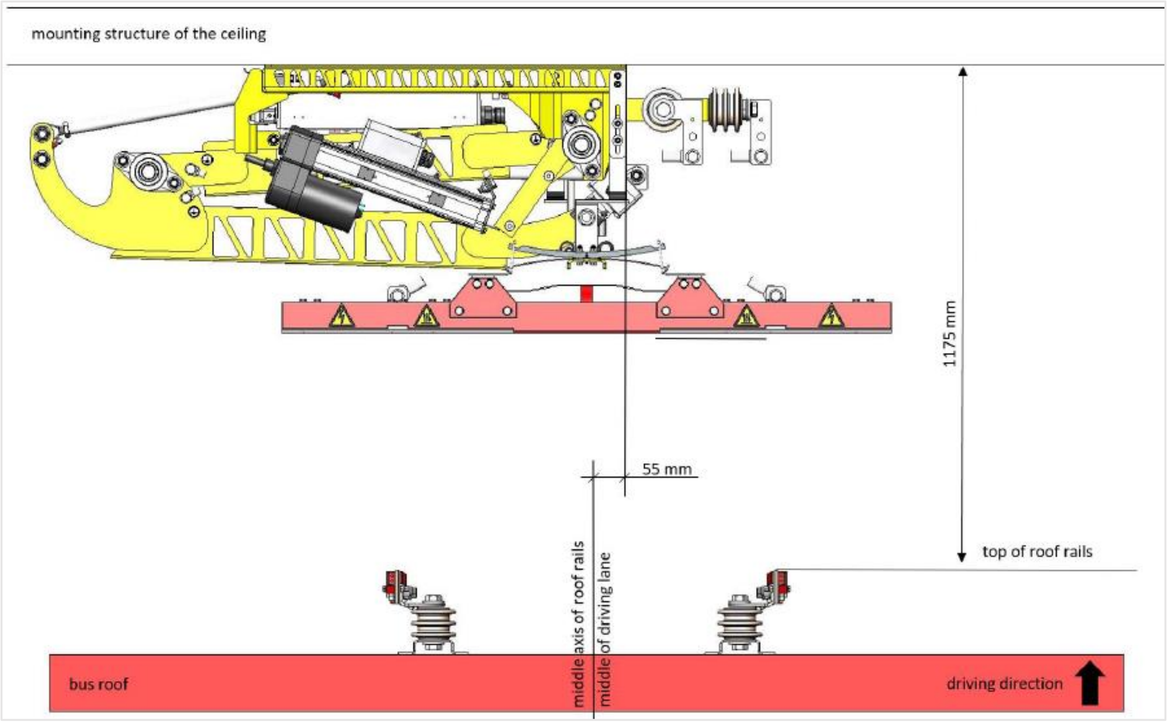


Figure 24. Wabtec Optimal Installation Position of Depot Pantograph

Ceiling- or wall-mounted cable retractors (**Figure 25**) that have enough cable range to reach the vehicles are a viable option. However, a detailed design is necessary to identify specific locations and determine whether any conflicts with other infrastructure exist where the equipment would be mounted. Motorized cable reels that raise and lower the connectors when not in use are also available. When using motorized retractors, there should also be consideration given to how the reels will be activated, such as by pull cord, remote switch, or other automated custom solutions, or other available options.

Figure 25. Example of Wall Mounted Cable Reel

ROOF STRUCTURAL LOADING

During the new facility design, the structural capacity will need to be designed to accommodate the additional weight of the pantograph or charger reel. The weights of equipment can vary significantly by manufacturer, and this may limit which types of dispensers could be used if mounting to the ceiling structure. In some cases, powered cable reels can be mounted on the wall to avoid putting additional weight on the roof structure of a building. The installation cost between the pantographs and cable reels is not significantly different.

Table 30 provides information gathered from manufacturer specification sheets. It should be noted that the cable reel dispensers have a significant advantage in terms of the usable range between the dispenser and the bus which can make them a good option for areas with high ceilings.

Table 30. Dispenser Weight and Dimension Specifications of Select Manufacturers

Type	Manufacturer	Model	Weight	Useable Range	Dimensions
Pantograph	Wabtec	ChargePANTO	387 kg	1.50 – 1.7 m	2247 x 1250 x 574 mm
Pantograph	Wabtec	DepotPANTO	90 kg	1.0 m max	1524 x 825 x 475 mm
Pantograph	Schunk	SLS 301	90 kg	0.36 m max	1580 x 1020 x 1000 mm
Cable Reel	Wabtec	ChargeREEL	125 kg	6.7 m max	900 mm reel diametre

EN-ROUTE PANTOGRAPH CHARGERS

It is important to monitor the utilization of pantograph chargers if they are deployed for en-route charging. To secure a charge, drivers must align the vehicle correctly with the charger. One way to help drivers align the vehicles is by implementing a system, such as an indicator, that they can use for positioning. Some agencies have used markers both inside and outside the bus and/or speed bumps to help with positioning as shown in **Figure 26**. Given that potential charging stations at transfer points would be situated outdoors and exposed to snow, relying on on-ground markers may not be the best approach for Milton Transit. It may be more practical to adopt another method, such as aligning the front bumper with a landmark that won't be obstructed by snow in the winter, like a bus stop sign.

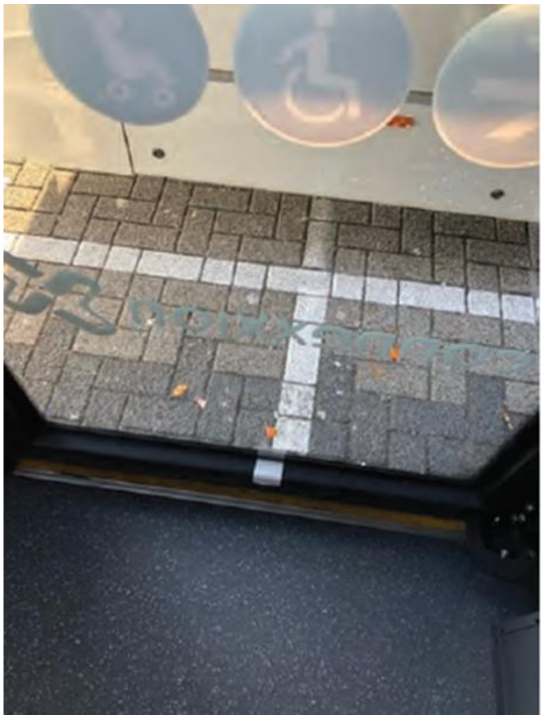


Figure 26. Example of Alignment Markers for Proper Bus Positioning[11]

UTILITY COORDINATION

Unanticipated utility infrastructure costs and long lead times for critical equipment such as transformers are causing delays for implementing fleet electrification, but the Town's anticipated construction date in 2026 provides sufficient time to address these barriers. Furthermore, it will be important for the Town to understand how Milton Hydro's approved rate tariff will impact its fleet's charging costs.

As the Town is currently in the conceptual stages of facility planning, it was determined that a conversation with Milton Hydro about site specifics was premature. Therefore, a series of considerations is provided below for the Town to consider as they coordinate with Milton Hydro on the design.

FACILITY UTILITY CONSIDERATIONS

Currently, most EV charging infrastructure is designed to operate at 480 V which is commonly used in the US. If Milton Hydro is unable to provide a 480V connection and instead can only provide a 600V connection,

[11] **Source:** Guidebook for Deploying Zero-Emission Transit Buses | Blurbs New | Blurbs | Publications (trb.org)

a step-down transformer will need to be purchased to serve the charging equipment. By the time the Town is ready to construct its facility, more EV vendors may offer 600V equipment rated for Canada. The step transformer cost is dependent on size, ranging from $40,000 USD for 300 kVA to $70,000 USD for 1000 kVA).

SITE CONSTRAINTS

A new bus depot facility is currently being considered for construction. Site constraints of the proposed facility are not known at this time. The facility should have access to adequate electrical utility infrastructure that can provide the anticipated energy needed for the electric bus conversion.

PRIMARY AND SECONDARY METREING

Typically, utilities provide service connections to clients either as primary or secondary metered services.

For a primary metered service connection, the utility brings power to the client at distribution and transmission voltage. The client is responsible for designing, constructing, owning, operating, and maintaining a substation or other medium voltage electrical equipment to step this voltage down and distribute it throughout the facility. Metering equipment for the client is done at the distribution/transmission voltage which is more costly than the equipment required for secondary metering but results in a lower cost per kwh. The client may also choose a primary service even if their power requirement can be provided as a secondary service if the client needs a different voltage than what the utility can supply as a secondary service voltage. The primary meter cost will vary depending on the utility.

Secondary metering service connections have a transformer owned and maintained by the utility that reduces the voltage from the primary distribution voltage to a standardized lower voltage, either 600 V three phase, 208 V three phase, or 120-240 V single phase. With a secondary metering service, a utility meter is then installed downstream of the transformer. Secondary services are generally preferred because they are less expensive and maintained by the utility. However, secondary services can be limited to a maximum service size that is determined by each utility.

Since the new Milton bus depot location has not yet been determined and the potential en-route location may undergo substantial redevelopment, conversations with the utility regarding existing capacity were not completed at this time. Milton should begin discussions with the utility as soon as possible, even while selecting the property as the utilities ability to serve a large bus charging load could have a potential impact on necessary utility feed improvements and costs required to provide adequate power to the site.

REDUNDANT FEEDS

For critical infrastructure such as that which would power Public Transit services, redundant power feeds to a site are used to increase the reliability of the utility service. This is commonly achieved by bringing a separate circuit to the site that is fed from a different circuit and power line, preferably from a separate substation.

If the redundant feed comes from the same substation and a different circuit this only protects the site from an outage on one of the power lines, such as a tree falling on the power line or a pole breaking. In the event of an outage at the substation, both feeds may experience an outage depending on how the utility designed or operates the system. For this application, a redundant feed from the same substation is only practical if an alternate circuit is already nearby the site, otherwise a new power line would need to be brought to the site from the nearest location, which can be cost prohibitive. Redundant feeds from a separate substation provides the most robust utility feed for a site and are recommended whenever possible as they can be less costly and more reliable than other redundant sources. Energy resiliency is discussed elsewhere within this appendix.

ELECTRICAL INFRASTRUCTURE OWNERSHIP

Some municipalities in other regions have looked to partner with their local utilities to install and maintain electrical infrastructure and charging equipment. Business models such as charging as a service (CaaS) and energy as a service (EaaS) are two examples where a third-party service provider offers energy-related assets and services to customers.

CaaS focuses specifically on providing EV charging infrastructure, whereas EaaS encompasses a wider range of energy-related assets and services, including energy storage, renewable energy sources, and energy management systems. Working with local utilities or third parties there may be an opportunity to leverage their expertise to allow the transit agency to focus on its core business which is operating transit service. Utilities have expertise in electrical infrastructure maintenance, energy management, energy market trends, renewable energy and regulatory compliance that can ensure that charging infrastructure is installed and scaled to meet the demands of the transit agency, and that energy usage is optimized to minimize costs.

Reliability and backup power are also critical components that can be included in EaaS agreements and are often factored into the service level agreements (SLAs) between the EaaS provider and the customer.

In utility discussions with Milton Hydro, the Town can bring up these alternative options for consideration.

UTILITY RATE CONSIDERATIONS

Electrical costs are determined based on the utility’s approved rate tariff which in Ontario is regulated and approved by the Ontario Energy Board (OEB). In Ontario's energy system, customers are classified into two categories: Class A and Class B.

A Class A customer in Ontario's energy system refers to a larger business or industrial customer that has an average peak demand of more than 5 megawatts (MW) in any of the previous twelve months. These customers have the option to participate in the Industrial Conservation Initiative (ICI) program, which allows them to reduce their Global Adjustment (GA) charges by reducing their electricity consumption during periods of peak demand.

A Class B customer refers to a residential or smaller business customer that has an average peak demand of less than 5 MW in any of the previous twelve months. These customers are charged a regulated price for the electricity they consume, which is set by the OEB and is based on the Hourly Ontario Energy Price (HOEP). Class B customers also pay a GA charge calculated on an hourly basis and is included in the overall electricity price that Class B customers pay.

Customers in Ontario also have the option of purchasing electricity from third party energy retailers approved by the OEB. When purchasing electricity through energy retailers, customers are still responsible for other aspects of electricity like delivery, regulatory and global adjustment charges.

- **Monthly Service Charges ($):** Base charges, assessed monthly included for every meter location. This likely will not change with adding BEB's to the fleet.
- **Energy Consumption Charges ($/kwh):** Charges for quantity of electrical energy consumed over a monthly period. Charge is based on kilowatt-hours (kWh) that are used, and the price Milton Transit will pay depends on the time of day and time of year the BEBs are charging vehicles from the grid. (See below).
- **Demand Charges ($/KW):** Demand is measured in kilowatts (kW) and the demand charge is a $/KW fee assessed based on the highest kW level drawn in the monthly billing period. This charge is of particular importance to fleet managers of BEBs. For example, if Milton Transit charged BEBs in the middle of the afternoon at the exact time it is drawing its peak power for its other electric services, this may significantly increase its monthly demand charge. The use of charge management systems can help mitigate the effect of demand charges with BEBs and other EVs.

APPLICABLE UTILITY CHARGES

Based on the Milton Hydro utility rates (Milton Hydro - Electricity Rates), time-of-use rates were updated on November 1, 2023. Milton Hydro has three General Service rate schedules and one Large User (over 5,000 kW) schedule. Based on the predicted energy consumption to electrify the existing bus fleet, four chargers would peak at approximately 600 kW, which would qualify for the General Service 50 kW to 999 kW rate schedule. Increased fleet size may require additional charging load and may push Milton Transit to one of the larger rate categories (i.e. General Service 1,000 to 4,999 kW or Large User).

- **Monthly Service Charges:** The Milton Hydro Monthly Service Chargers include a Customer Charge and a $0.25 SSS Administration Charge. The Customer Charger is $86.74 for the 50 to 999 kW and $682.42 for the 1,000 to 4,999 kW General Service categories.
- **Demand Charges**: There are numerous demand charges that apply to Milton Hydro rates including Distribution Variable, Transmission Network and Connection, rate riders, etc. Excluding the riders, the Demand Charges range from $11.4941 to for 50 to 999 kW and $10.1767/kW for the 1,000 to 4,999 kW General Service categories, respectively.
- **Energy Consumption Charges**: Energy consumption charges can be difficult to predict with some rate schedules. Milton Hydro includes $0.0052/kWh for regulatory charges. Milton Hydro's rate schedule does not appear to vary with rate category. Milton Hydro currently charges $0.182/kWh for On-Peak, $0.122/kWh for Mid-Peak, and $0.087/kWh for Off-Peak winter rates, but the online rate schedule doesn't indicate to which service class these apply. Winter rates run from November 1 through April 30, while Summer rates run from May 1 through October 31. Off-peak rates occur from 7 PM to 7 AM under both seasonal schedules while Mid- and On-Peak rates vary depending on season.

CHANGING UTILITY RATE STRUCTURES

It's important to note that the demand for electricity is increasing, partly due to the shift towards clean electricity in fleets and building systems. This increase in demand is causing some utilities in North America to modify their rate structures. The following are examples of different rate structures that utilities have implemented to accommodate the rising demand. These examples are intended to provide insight into how rates may evolve in the future.

SEASONAL CONSIDERATIONS

Many utilities utilize seasonal rates during different times of year. These rates generally reflect the rate changes from the bulk power provider and generally charge less when less is consumed (i.e. summer when daylight hours are longer and temperatures are more moderate).

Milton Hydro already utilizes Winter and Summer seasonal rates and will likely continue to do so.

TIME OF USE (TOU)

Some utilities also utilize TOU rates to incentivize customers to consume power during off-peak times, when possible, thus creating a peak-shaving effect. This approach allows utilities to defer large infrastructure projects that would otherwise be needed for high peak consumption but then not utilized during the majority of time. TOU rates also help to better regulate generation needs and mitigate costs.

Milton Hydro already utilizes TOU rates and will likely continue to do so.

ELECTRIC VEHICLE CHARGING RATES

Some utilities are beginning to incentivize electric vehicle adoption with specific EV tariff structures. These tariff structures are designed to accommodate the unique electricity needs of EV's and EV fleets, and to incentivize EV charging at times that are optimal for the grid. For example, the Ontario Energy Board (OEB) is introducing an "ultra-low" overnight rate for residential customers. As of 2023, this structure is not applicable to Milton Transit's fleet.

SEPARATE METRES/FEEDS FOR EV CHARGING

Many utilities have been employing a separate service and meter for electric vehicle charging. This meter is separate from the rest of the facilities at the site and means that it only measures the demand and consumption of EV charging.

Separate meters allow for the utility to isolate the demand and consumption of vehicle charging compared to other loads at the site which can allow them to apply discounted EV electricity rates. Separate meters or sub-meters are typically recommended for EV charging infrastructure even if the utility does not currently offer an EV rate. Utility tariffs are constantly changing and if an EV charging rate becomes available in the future, additional metering modifications will not be required.

Another reason this is preferable is that different departments within the Town are responsible for different expenses, such as bus operations for charging versus administration for building electrical and outside lighting. Separate meters or sub-meters will allow the Town to understand how much of their energy costs are going to move the fleet compared to normal building loads.

SOLAR GENERATION RATES

There are a few ways the PV system can benefit on-site loads. First, PV provides local power generation to offset the loads and reduce, or negate, the overall load during PV generation hours. In instances where the PV system is generating more energy than the load requires, the system can generate revenue through a net metering program. In the case of net metering, the excess solar energy is sold back to the grid/utility at a wholesale rate, which is typically less than the purchase price of energy, and the amount is credited to the owner's utility bill.

Due to most net metering policies, energy generated on-site from PV is most valuable when utilized to feed on-site loads. Further coordination with the utilities is recommended to ensure that future utility rates will allow for net metering and to understand any potential caveats or limits associated with it.

MAINTENANCE AREA CONSIDERATIONS

MAINTENANCE BAY CHARGING

It is not expected vehicles will be routinely charged in maintenance bays, however, there may be instances when having some charging capability in the maintenance bays can be useful. For example, in case of a charging issue with a vehicle, it can be placed in a maintenance bay to diagnose the problem.

Portable chargers are available that could be shared between maintenance bays and deployed as needed. They would require appropriate power for the equipment to be available to the maintenance bays which could be connected by a Mennekes connection and relocated between maintenance bays as needed.

VEHICLE ROOFTOP ACCESS

BEBs have a significant amount of equipment mounted on the roof of the vehicles including electrical converters, battery packs, and charging rails that will require service and/or troubleshooting. Fall protection systems will need to be in place that enable staff to safely work on those components of the vehicle. While personal fall protection equipment such as harnesses and retractors can allow this type of work to be done, the preferable way is to have permanent or portable scaffolding that allows staff to work on equipment without the need for personal fall protection equipment.

LIFTING DEVICES FOR ROOFTOP EQUIPMENT

Along with access to the roof of the vehicle, it may also be necessary to be able to lift items like battery packs on or off the roof for service and replacement. The capacity of cranes attached to the roof should be checked against the heaviest equipment the manufacturer expects will need to be moved on or off the roof of the vehicle.

SPARE PARTS STORAGE

Having an adequate supply of spare parts that will be unique to the BEBs and charging infrastructure is something that is recommended. With fewer vehicles on the road compared to internal combustion engine (ICE) vehicles, parts can have longer than normal lead times and having critical spares for both BEB and ICE vehicles will be necessary as the fleet transitions. The space requirement for those additional spare parts should be evaluated once information from the supplier has been provided in terms of the recommended quantity and type of critical spares.

FLOOR AND HOIST CAPACITY

The empty vehicle weight of a BEB is typically heavier than that of diesel bus due to the significant weight of battery packs in the vehicle. This varies by manufacturer and battery pack configuration. Publicly available curb weights of several diesel, hybrid and BEBs are listed in **Table 31** to illustrate the magnitude of the weight difference between the different vehicle types.

Table 31. Curb Weight of BEBs from Select Manufacturers

Propulsion	Manufacturer	Model	Curb Weight
Diesel	Nova	LFS	12,981 kg
Battery Electric	Nova	LFSe+	16,002 kg
Diesel	New Flyer	Xcelsior	12,587 kg
Diesel-Hybrid	New Flyer	Xcelsior Hybrid	13,200 kg
Battery Electric	New Flyer	Xcelsior Charge NG	15,440 kg (480 kWh)*
Battery Electric	Proterra	ZX5 Max	15,131 kg (440 kWh)*
Battery Electric	BYD	K9MD	16,089 kg (496 kWh)*

**Note: Curb weights are from Altoona testing reports. Configuration options such as higher capacity battery packs can significantly impact vehicle weights.*

The structural capacity of the concrete floor inside the garage should be assessed to understand the impacts of operating heavier vehicles. If sufficient as-built information is available for the facility this may be able to be done through a desktop engineering analysis. If capacity of the flooring is unable to support heavier vehicle types, it may be possible to purchase lighter vehicles or consider if modifications could be made to the existing foundation.

To evaluate the vehicle hoist capacity, the actual weight of vehicles purchased should be compared to the hoist capacity at the transit garage to ensure that the current equipment is capable of safely lifting the vehicles. Weight distribution of BEBs can be more disproportionate than diesel buses so it's important that manufacturers are able to provide not only total curb weight but also the specific weight on a per axle basis.

SOLAR AND BATTERY ENERGY STORAGE

Some transit agencies deploying BEBs add distributed energy resources like solar panels and battery energy storage systems (BESS) for added benefit. Understanding how these resources could be deployed and operated at existing and proposed facilities will assist in determining potential benefits for Milton Transit.

SOLAR PHOTOVOLTAICS (PV)

Solar PV is an increasingly popular choice for on-site supplemental energy generation as solar costs have decreased significantly over the last decade. Solar PV is typically not capable of offsetting the entire bus charging energy demand. However, PV can offset a meaningful portion of overall demand resulting in a "net load" that is lower than scenarios without PV. The overall impact of solar PV is dependent on a fleet's charging schedule. A solar installation will have a greater impact on demand charges, and thus, a utility bill, if fleet charging is aligned with solar PV production. Even if day-time fleet charging is limited, the integration of on-site solar may help offset Milton Transit's increased load.

The PVWatts® Calculator was used to estimate the solar energy that could be generated at the conceptual site. PVWatts® is a tool created by the National Renewable Energy Laboratory (NREL) and uses the location and weather data for each site to estimate a monthly generated power output of the solar PV system, including overall system efficiency losses.

The planned roof for Phase I (including office and storage) has a total area of 7,940 square metres. It is assumed that 80% of the rooftop area can be used for PV. This can accommodate approximately 680 kW DC of solar, which would yield 873,000 kWh in Year 1.

Aligning a roof-mounted solar installation with a new roof is optimal and can prolong the useful life of the roof by preventing UV degradation. For flat roofs, a ballasted racking system can secure panels and limit any penetrations to a single direction service connection from the roof to the electric service panel. Pitched roofs with a standing seam metal roof can utilize racking systems that clamp to the seam, similarly, reducing roof penetration needs to a single direction service connection.

A new installation would be connected to the grid through net-metering where any excess generated energy not used by charging infrastructure or building loads would be sold back to the utility and credited to Milton Transit for future use.

BATTERY ENERGY STORAGE SYSTEM (BESS)

Energy storage devices can play a critical role within a microgrid or distributed energy resource (DER) system. Although energy storage systems (ESS) are not a generation method, they can provide greater reliability and resiliency for a microgrid, along with potential energy bill reduction applications. They are especially useful when utilizing renewable generation methods, as it can help reduce some of the intermittency issues and extract more value out of those types of assets. Battery energy storage systems (BESS) are the most prominent and mature technology for distributed scale systems and microgrids.

For transit facilities, BESS systems are typically utilized for shifting loads in a strategic way that may help reduce demand charges and total energy costs associated with large charging loads that occur during peak rate hours. The size (kW) and duration (kWh) of a potential BESS is heavily dependent on the available space for installation as size of the system will increase as the nameplate capacity and operational duration increases. BESS size will vary from vendor to vendor, but most solutions are typically of a containerized configuration. Systems of this nature are generally modular and flexible in terms of size with footprints ranging from 2.4 m x 3.7 m upwards to 12 m x 2.4 m (12 m ISO containers).

Agencies that are not subject to a tariff that has time of use charges and those that have access to net-metering may not require BESS since the grid can effectively act as that storage mechanism. Beyond the initial capital cost of purchasing the BESS, they have a usable life and will need to be replaced after operating a certain number of cycles. There are also operating maintenance costs to consider as well as some efficiency losses as energy is put into and taken out of the BESS.

For Milton Transit, the electric vehicle charging system is already designed to manage the demand and keep it at a consistent level throughout the day. This means there are no significant peaks that would benefit from the addition of a BESS. Since the demand profile is relatively flat, there is no need to shift the load, and it is not recommended to use a BESS with the current tariff structure.

RESILIENCY CONSIDERATIONS

There are a number of technologies and strategies that can be considered at the Milton Transit facility to increase resiliency. Some involve installation of additional infrastructure while others are potential operational strategies that could reduce or mitigate risks which may impact service. These technologies may decline in price, and increase in efficiency, by the time construction commences in 2025-2026. This may include localized generation and battery energy storages systems as described above, along with items such as hydrogen fuel cells, spare buses, or service reductions. Each method provides different levels of support for the fleet and its infrastructure, and their costs to implement should be weight against the need for increased reliability.

While the electric utility will never be able to maintain a system that provides power 100% of the time to every customer, some improvements can increase reliability to an area or a single customer. Milton Transit must balance the operational risk and costs with the resiliency and reliability needs.

REDUNDANT GRID SOURCES

Depending on the base location another method to increase resiliency is to employ a redundant feeder from the utility grid. Ideally, this secondary redundant source is served by a separate circuit than the primary feeder and could provide power to the transit base in the event the primary source experiences an outage or fault. There are several main grid components that affect the grid source reliability.

SUBSTATIONS

The electric utility typically takes service from the generation and transmission grid at the utility's substation. The substation converts electricity from a high transmission voltage to the local medium voltage system. Due to land constraints and large load requirements, the local utilities generally operate multiple transformers within each substation and each transformer is connected to multiple medium voltage, distribution feeders. Most outages at the substation level are localized to a single substation transformer. The presence of multiple substation transformers provides redundancy during most normal operations. The utility usually plans maintenance outages to avoid impacting the entire substation; however, when planning for redundant power to the transit base chargers, Milton Transit should request redundant distribution feeders be fed from separate substations if feasible or at the least from separate substation transformers.

DISTRIBUTION FEEDERS

Medium voltage distribution feeders are installed and operated by the utility to supply electricity to their customers. Utility planners work to ensure that the grid will operate as reliably and efficiently as possible. Utility planners consider how to add new loads to the grid and how to best operate the local grid when maintenance or other outages impact an area or customer. In most cases, impacts to the distribution feeders are seldom known or experienced by the utility customer.

Unexpected outages at the distribution level are often localized and able to be fed from a separate distribution feed. Underground distribution feeder outages are most commonly caused by digging into the line. Underground feeder outages do not happen frequently but occur for a longer duration. To avoid long-duration underground outages, utilities typically operate a loop system that can be switched from one source to another to avoid lengthy delays.

Overhead distribution feeders are installed nearer to the ground than transmission lines, so they are more likely to be impacted by tree branches and animals contacting the bare conductors and shorting the system. Overhead distribution feeders are also not built to the same strength as the transmission lines, so wind and downed trees can also impact these overhead feeders. Overhead feeder outages occur more frequently than underground outages but are repaired much quicker because they are more accessible. Overhead feeders are often configured to allow multiple sources to back feed the line in the event of outage or maintenance.

Some factors for consideration of the distribution feeders may include:

- Whether the charging infrastructure will require a 100% redundant backup source; If 100% redundancy is required, this will increase cost and on-site space required for the utility to provide this level of redundancy.
- Providing separate distribution sources from two separate substations is most desirable but also most costly. If redundant distribution feeds are installed, the Town should consider utilizing sources from separate transformers within that substation.

INTERNAL COMBUSTION ENGINE (ICE) GENERATION

There are two traditional methods for generating power: combustion turbines and internal combustion engine driven generators. These technologies are both effective for generating power on a large or small scale, whether for primary power generation or backup power. Combustion turbines usually have a higher power output, ranging from 500 kW to 25 MW, but they can also be used to meet larger distributed loads. These machines require hydrocarbon fuel, such as natural gas, oil, or fuel mix, to operate. ICE generators come in a variety of sizes making them highly scalable. These machines have a high degree of reliability and can operate on demand but also require fuel input and maintenance. This provides high degrees of reliability and some resilience, but they may fall short in terms of environmental concerns due to the utilization of fossil fuels.

Using ICE generation to offset BEB charging load is generally not an optimal solution due to high maintenance costs, fuel input, and emissions that make it unsuitable for consistent use. However, these generation methods can still serve as backup power to enable reduced transit operations during electric service outages.

When selecting an ICE generator, footprint is an important consideration. A typical stationary diesel ICE backup generator will require a footprint of approximately 7 m^2/MW. Therefore, a 1.5 MW stationary backup generator would require approximately 10.5 m^2, not including ancillary equipment such as transfer switches or noise reduction enclosures.

In addition to stationary ICE generators, there are also portable ICE generators available in a variety of sizes up to about 2 MW. Charging infrastructure at facilities can be designed with capacity to connect portable generators. The benefits of having a portable generator at the depot facility should be considered. This option provides flexibility to relocate the generator as needed, in case of power outages, and eliminates the requirement for separate generators at each site where chargers are installed, including en-route charging locations. This also allows the option to scale up backup generation in the future by purchasing additional generators if reliability continues to be a challenge.

HYDROGEN FUEL CELL GENERATIONS

Hydrogen fuel cells can provide a large amount of power in a smaller footprint than other renewable sources and do not suffer from intermittency. Fuel cells also have low to no emissions depending on the fuel utilized but do require fuel input, additional infrastructure, and safety equipment to maintain high temperatures within the device and to safely store potentially volatile fuels.

Historically, fuel cells have relied on hydrogen as their primary fuel source. To use hydrogen fuel cells, a hydrogen fuel source must be available at the intended site. Hydrogen delivery can be accomplished either through on-site or off-site generation. On-site generation requires raw components that are readily available at the site, such as water or natural gas and electricity. The cleanliness of the hydrogen produced is largely determined by the source of the electricity used in the generation process. Renewable sources, such as hydropower, are considered more desirable than coal or hydrocarbon generation. Generating hydrogen on-site requires significantly more infrastructure than the existing facilities can accommodate. On the other hand, if hydrogen is generated off-site, storage tanks and pumps will be required to store and deliver the fuel to the fuel cells. Truck-and-tank delivery systems are typically used for off-site generation since hydrogen pipelines capable of supporting a 1 MW or larger generator are not currently available.

The size, form factor and fuel cell stack deployment are vendor dependent. A 440 kW containerized fuel cell will have a space requirement of 8.5 m x 3.4 m x 2.7 m or an approximate footprint of 0.07 m^2/kW. The estimated footprint includes only the space required for the fuel cell stacks and does not include the required space for ancillary equipment such as fuel storage or electrolyzers. A 1.5 MW containerized fuel cell installation would utilize 16 units and requires an approximately 100 m^2 footprint.

Similarly, a modular installation would have an approximate space requirement of 4.6 m x 2.7 m x 2.1 m for a 250 kW unit. A 1.5 MW modular installation would require 6 x 250 kW units with an estimated footprint of 100 m^2. These estimates do not include the necessary space for fuel storage and maintenance access.

In general, fuel cells are not ideal for emergency generator applications where the equipment is stored and operated only for a limited number of hours each year. The reason for this is that fuel cells need to maintain high operating temperatures to function effectively and efficiently. If a fuel cell is cold, it can take up to 10 hours to heat up to the optimal temperature. This long startup time is usually not acceptable for emergency generation applications. One potential solution to this problem is to equip the fuel cell to provide a small portion or the entirety of the full load during normal operation. This way, the fuel cell is always operating and maintains its ability to run during an outage. By operating in this way, the primary and backup power sources can effectively swap roles, so that the electrical grid serves as a backup to the fuel cell, providing the desired level of resiliency. Fuel cells have a very fast ramp rate, which means that they can quickly increase their power output to meet sudden demand. If a fuel cell is kept in hot standby mode and ramped up to full load during an outage, it can provide similar starting characteristics as internal combustion engine (ICE) generators. However, it's important to note that keeping the fuel cell in hot standby mode will require the consumption of natural gas or hydrogen during normal operation.

REDUCED BUS SERVICE

In the event of an outage, it's important to have a resiliency plan in place that involves reducing the number of bus services that are offered. This can help ensure that the buses are able to maintain a sustainable level of operation, depending on the severity, type, and duration of the outage (whether it's a utility, local, or software issue). Once the outage is resolved and the buses are fully charged, services can be returned to normal levels of operation. Different plans can be developed to optimize services for different outage categories to streamline service reductions. It should be noted that in the event of a large-scale outage, such as those caused by a large natural disaster, the overall demand for transit service will likely decrease as the disaster has larger regional impacts beyond local services. This should be considered if reduced operations plans are developed in the future. Overall, service reduction plans are dependent on the type and scale of an outage and are a viable option as a primary or secondary method of operation resiliency.

SPARE BUS CAPACITY

Maintaining a fleet of spare buses is also a viable option to sustain a higher percentage of operational transit routes in the event of an outage. This spare fleet would be in addition to the 6% spares that are described in **Table 16** and **Table** 35 since these spare buses would largely be reserved for utility outages when additional buses are needed for service. The size of the spare fleet would be dependent on the acceptable/anticipated outage duration and other system reliability factors.

Depending on the type and length of a potential outage, buses can be swapped with fully charged spares from a reserve fleet once they reach a low state of charge. Maintaining a reserve fleet of BEBs would allow Milton Transit to maintain their emissions goals while enabling a greater sense of resiliency for transit operations. However, a reserve fleet of this style is still limited by the charging infrastructure which may be impacted by the potential outage.

A reserve fleet containing diesel buses can provide a greater amount of bus swaps as they are not limited by potential charging outages. While this method may be viable during a phased fleet conversion, this would no longer be viable and considered once the entire fleet becomes battery electric.

While a reserve bus fleet can provide a greater sense of resiliency and allow for increased transit operations during an outage, there are significant costs and space requirements associated with purchasing and maintaining a reserve fleet that should be weighed against the benefits of developing and storing additional vehicles.

EN-ROUTE/LAYOVER CHARGING

In the event of an outage localized to a transit base, en-route chargers could be utilized to keep transit routes in service. An outage localized at a transit base could affect the charging infrastructure and the charging schedule at the base. As an alternative to significantly reducing transit services, specific routes could be rerouted to utilize en-route charging until the outage at the base is resolved. The duration in which this solution can be utilized for resiliency is dependent on the severity of the outage. Likely, this could be utilized for a short period of time to keep a single day’s routes in service without major revision of the transit routes. This would be dependent on the final charging infrastructure design and the location of en-route chargers.

RESILIENCY RECOMMENDATIONS

Historically, power outages experienced by Milton Transit have been short and infrequent. However, more frequent outages may occur due to extreme temperatures or severe weather events because of global climate change. There are several redundancies that Milton Transit could implement, but in the short-term these will be limited to a reduction of transit bus services and the potential implementation of a diesel backup generator. If the agency experiences a short, isolated outage, Milton Transit may be able to operate the existing service routes with decreased frequency, minimizing the impact reduced service has on riders. In the event of a widespread, prolonged outage, Milton Transit may reduce service to strictly critical operations; this may include the transport of first responders or hospital transport. To support critical operations, Milton Transit will likely need to operate at least 20% of the fleet although this may change depending on service coverage and requirements within the Town's business continuity plans and any commitments to providing transportation during emergencies.

Reduction of services at the beginning of the transition to BEBs would not necessarily require backup power as this service could be supported by the diesel fleet, but alternative redundancies will need to be considered when BEBs make up a larger portion of the fleet. While a backup generator may not be required immediately, it is suggested that the infrastructure be included in the initial phases of the transition to allow for service resiliency. Defining the operational goals and acceptable levels of service during an outage will determine the need and sizing of the infrastructure. There are cost-effective options that Milton Transit can utilize if the grid reliability changes or operational workarounds are insufficient, and a greater number of vehicles must be utilized to maintain critical operations.

Solar PV is being considered as an added improvement to the proposed new Milton Transit Facility. BESS is also considered as part of this study and will be further evaluated during design development via cost-benefit and high-level pros and cons assessment. In the future, Milton Transit may reconsider alternative backup power sources to reach a net-zero carbon footprint with 100% renewable energy.

Milton Transit will continue to evaluate new ways to mitigate the risk of reduced operations through redundancy in power delivery by fueling a portion of the BEB fleet using backup power or by partnering with the utility power provider for a redundant feed. As other municipalities begin planning for transitions to zero emissions and implementing alternative backup or redundant power methods, Milton Transit may opt for the same methods depending on performance and realized risk of outages now and in the future.

BUILDING CODE AND FIRE SAFETY

Indoor storage of vehicles is not a new concept, but the introduction of BEBs is an aspect that introduces new risks to facilities. Regulatory authorities are still working to determine if additional requirements will be needed. The biggest change with the introduction of BEBs and charging infrastructure is the increase in high voltage electrical equipment that is now being installed as well as the possibility of lithium-ion battery fires from vehicles stored inside facilities.

Each province and territory in Canada has its own building code, which may adopt the National Building Code of Canada (NBCC) or modify it to suit local requirements. These codes may include specific provisions related to fire safety in buildings that house BEBs or other hazardous materials. While the NBCC does not specifically address battery electric vehicles currently, it sets standards for fire safety, electrical systems, ventilation, and other aspects that would apply to any building.

The Canadian Electric Code (CEC) is a national standard for electrical installations in Canada. It provides requirements for the safe installation and use of electrical equipment, including charging stations for BEBs. Electrical codes are already in place that dictate measures that would be required for installation of high voltage electrical equipment and their required safety devices. Electrical designs will need to be done by qualified professionals and will be reviewed through the building permit process to ensure the designs meet relevant electrical code requirements.

Fire safety standards for BEBs are an emerging area and some codes have not yet caught up to determine what the requirements should be for facilities that house BEVs. Vehicle fires are not a new concept for buildings and while, to date, battery electric vehicle fires are statistically less common than internal combustion vehicles, they do happen and behave differently. For example, if thermal runaway occurs in a battery pack, the fire can be difficult to extinguish, may take hours to put out, and has the potential to reignite. While insurance rate premiums have not yet increased due to battery electric bus fires, that potential exists, and premiums may increase if bus fires increase. It is anticipated that the bus and charger manufacturers will continue to improve their battery monitoring, fire suppression, and overall safety to avoid harming public and operators as well as to avoid costly recourse such as vehicle recalls and lawsuits.

Fleet operators have been proactive in thinking about how to mitigate these risks and while the current building codes may not explicitly dictate requirements, there are suggestions that can be provided based on experience as to what transit agencies should consider in terms of additional fire safety measures:

- Develop a fire safety plan with the local fire department that addresses how to deal with a fire.
- Performing a facility fire safety risk assessment to evaluate aspects such as:
  - Rating of the building fire suppression system in vehicle storage areas.
  - Availability of water for the fire department to be able to extinguish fires.
  - Emergency power shut offs for charging equipment.
  - Manual HVAC controls to exhaust smoke and fumes from a vehicle fire.
- Having an ongoing dialogue with first responders after implementation so that first responders are familiar with the facility, vehicles, and tools available to deal with fires at the facility.

APPENDIX C: BUDGET & FINANCIAL PLAN

This appendix breaks down all details of the financial analysis, including assumptions, model results, and supplementary tables for cost breakdowns over the whole analysis period.

FLEET TRANSITION SCENARIOS

The financial analysis considers two scenarios for Milton Transit's fleet transition. Each scenario evaluates the capital, operating, maintenance, and fuel/electricity costs over the 2023-2050 period. The assumptions used are detailed further below. The two scenarios evaluated reflect the following:

- **Baseline (Business as Usual) Scenario:** Reflects the scenario where no transition to BEBs occurs. All replacements of the current diesel fleet are with new diesel buses. Specialized 6m and 8m vehicles are replaced with new gas-powered vehicles.
- **BEB Transition Scenario:** This scenario reflects the full transition of Milton Transit's fleet to 675 kWh BEBs, and in-depot charging only as part of a phased transition beginning in 2024. Specialized 6m and 8m fleet vehicles are replaced with BEV equivalents.

LIFECYCLE COST ANALYSIS

The lifecycle cost analysis compares the lifecycle cost of implementing each scenario described above. The analysis includes the cost of purchasing buses and related infrastructure, ongoing O&M costs, and fuel and electricity costs.

KEY COST ASSUMPTIONS

The analysis relies on several assumptions like bus operating statistics and purchasing schedules for the Baseline and BEB Scenarios. Capital costs include vehicle purchase costs, BEB charging infrastructure costs, annual cost of transfers to reserve for equipment replacement, and any required electric utility service upgrades.

The projections in this analysis are based on numerous assumptions using the best available data. However, there are several "known-unknowns" in the analysis that have not been quantified. For completeness, they are listed here to reflect that projections may vary from the forecasts used in this analysis.

- **BEB prices:** BEB prices may fall over the near-medium term as technology advances. This analysis uses current pricing and does not factor in the potential for price parity with diesel buses.
- **Vehicle charger service life:** the service life of charging infrastructure is an unknown because there is not data available on the average service life based on actual performance. A 12-year service life is assumed for transfer to reserve costs, but the annual maintenance costs is intended to capture the annualized replacement cost of a charger.
- **Labor and staffing costs:** the precise quantity and type of staffing and training needed will vary based on the precise fleet needs, who performs the training, and when it occurs. As a result, it is not quantified in this analysis.
- **Insurance costs:** due to the higher electricity demand and BEBs to be used at Milton Transit facility, the Town noted potential increased insurance costs. These are noted as an unknown in this analysis and not quantified.

VEHICLE CAPITAL COSTS

Table 32. Capital Cost Assumptions, 2023$ presents the unit cost assumptions for conventional and battery electric buses and specialized transit vehicles. These include the purchase costs and mid-life rehabilitation costs.

Table 32. Capital Cost Assumptions, 2023$

Capital Assumptions	
Diesel Bus Cost	$915,024
Battery Electric Bus Cost (675 kWh)	$1,909,686
Repowering Cost	$600,000
6m Specialized Transit (ICE)	$218,473
6m Specialized Transit (BEB)	$393,319
8m Specialized Transit (ICE)	$258,888
8m Specialized Transit (BEB)	$462,843
Diesel Bus Midlife Rehabilitation Cost	$120,300
BEB Midlife Rehabilitation Cost	$7,000

INFRASTRUCTURE CAPITAL COSTS

Table 33 identifies the capital costs associated with charging infrastructure required for BEVs listed in the replacement schedule. As noted in the fleet modelling analysis, the Milton Transit Facility has been designed to phase in additional infrastructure primarily including substations, 150 kW charging equipment, circuit breakers, and other infrastructure needed to facilitate charging for the BEB fleet. Costs are presented in 2023 dollars, similar to other capital costs modelled.

Table 33. Infrastructure Unit Cost Assumptions, 2023$

Infrastructure	Unit Cost
Plug-In Depot Charger Cabinet (150 kW)	$154,097
Plug-In Depot Charger Wall-Mounted Dispenser	$25,265
Plug-In Depot Charger Overhead Reel Dispenser	$32,158

OPERATING AND MAINTENANCE COST ASSUMPTIONS

Ongoing operating and maintenance (O&M) costs for Milton Transit's conventional diesel fleet and their modelled BEB replacements are part of this analysis.

- **Bus Operations:** The operating cost per hour was based on Milton Transit's submission to CUTA 2021 Conventional Transit Statistics. The total cost of operations was inflated to 2023 dollars, then divided by total vehicle hours. This cost is applied to total estimated operating hours for diesels and BEBs throughout the transition plan.
- **Bus Maintenance:** The maintenance cost per kilometre for diesel buses was calculated based on Milton Transit's submission to CUTA 2021 Conventional Transit Statistics. The total maintenance cost was inflated to 2023 dollars, then divided by total vehicle kilometres. A literature review of

maintenance costs for BEBs identified a range of 10%-30% cost savings relative to diesel, primarily due to fewer part replacements and simpler drivetrain maintenance. For BEB annual maintenance costs, a 10% cost savings assumption was applied to remain conservative. This is based on the Argonne National Laboratory's Total Cost of Ownership study completed in 2021.[12]

- **Fuel Efficiency:** Litres per 100 kilometres (L/100km) was calculated as an average of the diesel consumption divided by total vehicle kilometres travelled recorded by Milton Transit reported in CUTA 2021 Conventional Transit Statistics.[13]
- **Maintenance of BEB Charging Equipment:** Costs shown in reflect annualized maintenance cost values from a service level agreement for a charger representative of proposed EV charging equipment.

OPERATING COST ASSUMPTIONS

The cost of labor in both scenarios is based on the anticipated operating hours in both scenarios. The cost per hour is assumed to be the same, but the total cost in the BEB Transition Scenario is greater due to an increase in non-revenue hours to deadhead to and from the garage. Fuel efficiency, spare ratio, and other KPIs are not impacted by reduced services to COVID in 2021. Pre-COVID GTFS data was used in the vehicle modelling and is reflected in operating statistics used in the financial analysis.

Table 34. Unit Operating Cost, 2023$

	2023$
Operating Cost ($/hour)	$98.59

[12] Comprehensive Total Cost of Ownership Quantification for Vehicles with Different Size Classes and Powertrains (anl.gov)

[13] Fuel efficiency rates and KPIs are not impacted by reduced transit service due to COVID in 2021.

Table 35. Annual Operating and Maintenance Cost Assumptions (2023$)

Conventional Fleet Operating Assumptions	Diesel	BEB
Operating Costs ($/hr)	$98.59	$98.59
Maintenance Cost ($/km)	$0.64	$0.58
BEB Maintenance Cost Efficiency Factor	-	10%
Charger Efficiency	-	95%
Charger Maintenance Cost ($/year)	-	$5,959
Average Useful Life of New Bus	12	12
Bus Fuel Efficiency (L/100 km)	46.1	-
Diesel Heater Efficiency (L/km)	-	0.034
Spare Bus Ratio (Peak Fleet/Total Fleet)	6%	6%
Fixed Route Transfer to Reserve ($/year)	$76,252	$159,140

FUELING COST ASSUMPTIONS

Estimated annual diesel fuel and electricity reflect a combination of growth rate assumptions. Additionally, the following assumptions and sources were used to estimate projected change in cost of diesel and electricity.

DIESEL AND GASOLINE FUEL COSTS

The analysis assumed diesel fuel costs in 2023 are $1.49 per litre, as identified in the 2024 Budget. The analysis assumes that gasoline fuel costs in 2023 are $1.46 per litre as identified in Milton's 2024 Budget. The wholesale prices had provincial and federal taxes layered on, including the unrecoverable net HST. Wholesale fuel costs were assumed to remain constant. The carbon tax was assumed to escalate in line with the latest federal carbon pricing plan, while other provincial and federal taxes were assumed to remain constant for the duration of the analysis. All BEBs were assumed to have diesel heaters to ensure electric power can focus on maintaining maximum driving range. The average fuel efficiency of diesel heaters was obtained based on industry experience to estimate the diesel usage per kilometre travelled.

Table 36. Diesel and Gasoline Unit Cost Assumptions, 2023$

	2023	2025	2030	2035	2040	2045	2050
Diesel Cost ($/Litre)	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49
Gasoline Cost ($/Litre)	$1.46	$1.46	$1.46	$1.46	$1.46	$1.46	$1.46
Diesel Carbon Levy ($/Litre)	$0.17	$0.25	$0.45	$0.45	$0.45	$0.45	$0.45
Gasoline Carbon Levy ($/Litre)	$0.14	$0.21	$0.37	$0.37	$0.37	$0.37	$0.37

ELECTRICITY COSTS

Electricity costs are included in the analysis were based on a per kilowatt-hour (kWh) usage fee. The values used in the analysis were determined from published rates available from Milton Hydro. The dollar per kWh

($/kWh) usage fee was based on the weighted average cost per kWh from Milton Hydro and the Global Adjustment Factor for 2023. The analysis assumes a 5% efficiency loss between chargers and BEBs.

Table 37. Electricity Unit Cost Assumptions, 2023$

	2023
Electricity Price ($/kWh)	$0.20
Demand Charge ($/kW)	$11.67

MAINTENANCE COST ASSUMPTIONS

A literature review of maintenance costs for BEBs identified a range of 10%-30% cost savings relative to diesel, primarily due to fewer part replacements and simpler drivetrain maintenance. For BEB annual maintenance costs, a 10% cost savings assumption was applied to remain conservative.

Table 38. Maintenance Cost Unit Assumptions, 2023$

	2023
Diesel Maintenance Cost ($/km)	$0.64
BEB Maintenance Cost ($/km)	$0.58

SPECIALIZED FLEET ASSUMPTIONS

In addition to the conventional fleet, Milton Transit also operates a specialized fleet, currently containing 8m and 6m ICE vehicles. 8m and 6m vehicle capital and operating expenses are presented separately from the conventional fleet. 8m and 6m vehicle operating statistics were calculated from Milton Transit data for 2022. The average daily kilometres driven, hours utilized, and assumed utilization were combined to calculate the operating statistics for the fleet on an annual basis. The 8m specialized fleet is expected to remain at 8 vehicles. The 6m specialized fleet is expected to grow from 8 vehicles to 15 vehicles to meet future service needs. **Table 39** shows the operating assumptions for the specialized transit fleet.

Table 39. On-Demand Fleet Operating and Maintenance Cost Assumptions, 2023$

Non-Conventional Fleet Operating Assumptions	Diesel/Gasoline	BEB
Maintenance Cost ($/km)	$0.61	$0.55
8m Fuel Efficiency (L/100 km)	41.0	-
6m Fuel Efficiency (L/100 km)	31.9	-
Average BEB:Diesel Transition Ratio	-	1.00
Daily Energy Usage per 6m Vehicles (kWh)	-	76.9
Daily Energy Usage per 8m Vehicles (kWh)	-	88.6
Average Useful Life of Specialized Vehicles (years)	7	8
8m Average Daily Kilometres Driven	177	177
6m Average Daily Kilometres Driven	147	147
8m Average Daily Hours Utilized	10	10
6m Average Daily Hours Utilized	10	10
8m Specialized Transfer to Reserve ($/year)	$36,984	$57,855
6m Specialized Transfer to Reserve ($/year)	$31,210	$49,165

BASELINE SCENARIO

The Baseline Scenario is defined as where there is no transition to electric vehicles over the study period. As described above, the Baseline Scenario refers to the current diesel fleet being replaced strictly by new diesel buses in alignment with the current fleet retirement schedule. **Table 40** below shows the annual total number of hours and kilometres operated by the diesel fleet; this service level is assumed to grow from 2023 through 2040 in the Baseline Scenario. While there is expected to be service growth from 2041-2050, this is assumed to be flat in the analysis due to uncertainty about the timing and quantity of future fleet expansion.

Table 40. Baseline Scenario Annual Service Levels

	2023	2025	2030	2035	2040	2045	2050
Kilometres Travelled	1,222,080	1,222,080	2,749,680	3,360,721	3,360,721	3,360,721	3,360,721
Hours of Operation	53,034	53,034	119,327	145,844	145,844	145,844	145,844
Litres of Fuel Consumed	563,785	563,785	1,268,516	1,550,408	1,550,408	1,550,408	1,550,408

BASELINE CAPITAL COST ESTIMATES

Under the Baseline Scenario, the fleet mix remains entirely diesel and gasoline vehicles for the duration of the study period. Milton Transit's fleet retirement schedule as of November 2022 was used to determine the capital purchases needed each year. **Table 41** illustrates the near-, mid-, and long-term total number of replacement ICEVs purchased based on the fleet retirement schedule. These vehicle purchases also assume that some vehicles are replaced more than once between now and 2050, thus a total that is larger than the 45 vehicles.

Table 41. Baseline Scenario Periodic Capital Purchases Assumptions Based on the Fleet Retirement Schedule

	Replacement			Growth			Total		
	Phase 2A	Phase 2B	Phase 3	Phase 2A	Phase 2B	Phase 3	Phase 2A	Phase 2B	Phase 3
	2025-2028	2029-2030	2031-2040	2025-2028	2029-2030	2031-2040	2025-2028	2029-2030	2031-2040
Baseline Scenario									
Bus – 12M	-	7	12	16	3	25	16	10	37

Table 42 presents the annual costs estimates based on the unit cost and growth rate assumptions and the annual fleet needs shown in **Table 41** above. The values are in 2023 dollars.

Table 42. Annual Capital Cost Estimates, Selected years, 2023$, Millions

	Replacement			Growth			Total		
	Phase 2A	Phase 2B	Phase 3	Phase 2A	Phase 2B	Phase 3	Phase 2A	Phase 2B	Phase 3
	2025-2028	2029-2030	2031-2040	2025-2028	2029-2030	2031-2040	2025-2028	2029-2030	2031-2040
Baseline Scenario									
Bus – 12M	-	$6.4	$11.0	$14.6	$2.7	$22.9	$14.6	$9.2	$33.9
Bus – 6M	$1.3	$0.4	$4.4	$0.7	$0.4	$0.9	$2.0	$0.9	$5.2
Bus – 8M	$0.5	$1.0	$1.6	-	-	-	$0.5	$1.0	$1.6

BASELINE OPERATING COST ESTIMATES

The annual operating costs between 2023 and 2050 are calculated by multiplying the hours of operation by the estimated hourly operating cost. presents the near-, mid-, and long-term total periodic operating costs under the Baseline Scenario.

Table 43. Baseline Scenario Periodic Operating Cost Estimates, 2023$, Millions

	2023 - 2030	2031 - 2040	2041 - 2050
Operating Costs	$64.1	$138.6	$143.8

BASELINE MAINTENANCE COST ESTIMATES

The annual maintenance costs between 2023 and 2050 are calculated by multiplying the kilometres travelled by the estimated per kilometre maintenance cost. presents the near-, mid-, and long-term total periodic operating costs under the Baseline Scenario.

Table 44. Baseline Scenario Periodic Maintenance Costs Estimates, 2023$, Millions

	2023 - 2030	2031 - 2040	2041 - 2050
Maintenance Costs	$13.0	$26.7	$28.2

BASELINE FUELING COST ESTIMATES

Under the Baseline Scenario, the only fuel required to operate the fleet is diesel. The annual diesel fuel costs were calculated based on the annual kilometres travelled, the average fuel economy, and the cost of diesel. The estimated diesel fuel consumed by buses was calculated by multiplying the average fuel economy from Milton fleet data and the total kilometres travelled. The litres of fuel were then multiplied by the average price per litre of diesel detailed in the O&M Cost Assumptions section above. The diesel cost calculation is shown in **Table 45** below.

Table 45. Baseline Scenario Periodic Diesel Costs, 2023$, Millions

	2023 - 2030	2031 - 2040	2041 - 2050
Diesel Fuel Costs	$10.3	$22.3	$23.1

BASELINE SPECIALIZED TRANSIT FLEET COSTS

Milton Transit currently operates a specialized transit fleet with gasoline and diesel buses. Under the Baseline Scenario, it was assumed there is no transition to electric vehicles over the study period. The current paratransit fleet will be replaced by new gasoline buses on an as-needed basis. Capital purchases for the specialized fleet was based on the projected retirement of existing vehicles and the future service expansion plan.

Table 46 summarizes the capital purchase plan of paratransit vehicles for selected years.

Table 46. Specialized Fleet Periodic Total Capital Purchases

	Replacement			Growth			Total		
	Phase 2A	Phase 2B	Phase 3	Phase 2A	Phase 2B	Phase 3	Phase 2A	Phase 2B	Phase 3
	2025-2028	2029-2030	2031-2040	2025-2028	2029-2030	2031-2040	2025-2028	2029-2030	2031-2040
Baseline Scenario									
Bus – 6M	6	2	20	3	2	4	9	4	24
Bus – 8M	2	4	6	-	-	-	2	4	6

Table 47 displays the costs associated with the purchase schedule of specialized gas vehicles in **Table 45.**

Table 47. Baseline Scenario Specialized Transit Periodic Capital Cost Estimates, 2023$, Millions

	Replacement				Growth			Total	
	Phase 2A	Phase 2B	Phase 3	Phase 2A	Phase 2B	Phase 3	Phase 2A	Phase 2B	Phase 3
	2025-2028	2029-2030	2031-2040	2025-2028	2029-2030	2031-2040	2025-2028	2029-2030	2031-2040
Baseline Scenario									
Bus – 6M		$1.3	$0.4	$4.4	$0.7	$0.4	$0.9	$2.0 $0.9	$5.2
Bus – 8M	$0.5	$1.0	$1.6	-	-	-	$0.5	$1.0	$1.6

Table 48 contains the annual maintenance costs for the specialized vehicles.

Table 48. Baseline Scenario Periodic Operations & Maintenance Costs, 2023$, Millions

	2023 - 2030	2031 - 2040	2041 - 2050
Annual Maintenance Cost	$3.4	$5.9	$6.6

Table 49 summarizes the annual fuel costs for the baseline scenario for selected years over the 2023 to 2050 period.

Table 49. Baseline Scenario Periodic Total Fuel Costs, 2023$, Millions

	2023 - 2030	2031 - 2040	2041 - 2050
Average Unit Cost of Gasoline[14]	$1.46	$1.46	$1.46
Cost of Gasoline ($millions)	$2.4	$4.9	$5.4
Gasoline Fuel Carbon Tax ($millions)	$0.5	$1.3	$1.4
Total Cost of Fuel	**$2.9**	**$6.2**	**$6.8**

BASELINE SUMMARY

Under the Baseline Scenario, the total cost of implementation was estimated to be $692.7 million in 2023 dollars. The total capital costs are $209.6 million. Total lifecycle O&M costs of $483.1 million include operations, maintenance, and propulsion costs. The full results of the Baseline scenario are shown in **Table 50** below.

[14] Average cost of gasoline in first year of year excerpt

Table 50. Baseline Scenario Summary, 2023$, Millions, 2023-2050

2023$, Millions	Baseline
Buses	$108.0
Midlife Rehabilitation	$81.4
Specialized Transit	$20.2
Related Infrastructure	-
Lifecycle Capital Costs, Total	**$209.6**
Operations & Maintenance	$398.4
Propulsion	$55.7
Related Infrastructure O&M	-
Lifecycle O&M, Fixed Route	**$454.1**
Operations & Maintenance	$15.8
Propulsion	$13.2
Lifecycle O&M, Specialized Transit	**$29.0**
Total Lifecycle Costs, Entire Fleet	**$692.7**

BEB TRANSITION SCENARIO

As described above, the BEB Transition Scenario refers to the current diesel fleet being replaced with BEBs in alignment with the current fleet retirement schedule. In the model, blocks are converted from diesel to electric buses using a two-step prioritization method. Blocks are prioritized first if they can be converted on a one-to-one basis (diesel to BEB) without the need for en-route charging infrastructure. After the initial conversion, BEBs are reprioritized based on blocks that can be converted on a one-to-one basis with the greatest total kilometres travelled.

Table 51 below shows the incremental annual total number of hours, kilometres, litres of diesel, and kWh of electricity operated and consumed by the fleet; as diesel buses are phased out and BEBs are introduced into the fleet, the total operating hours and kilometres increases due to an increase in non-revenue hours and miles, impacting costs and fuel consumption. In later years of the transition, diesel consumption is attributed solely to diesel auxiliary heaters equipped on the BEBs.

Table 51. BEB Transition Scenario Annual Service Levels

	2023	2025	2030	2035	2040	2045	2050
Diesel							
Kilometres	1,222,080	1,222,080	2,142,465	1,412,991	152,760	-	-
Hours	53,034	53,034	92,893	62,878	6,629	-	-
Litres of Diesel	563,785	563,785	1,010,538	719,711	181,731	116,546	116,546
BEB							
Kilometres	-	-	646,590	1,980,741	3,247,809	3,402,182	3,402,182
Hours	-	-	27,312	82,752	137,085	143,520	143,520
kWh	-	-	1,071,532	3,256,665	5,372,031	5,625,623	5,625,623

BEB TRANSITION CAPITAL COST ESTIMATES

The focus for the BEB Scenario is the financial impact of the changes in fleet mix and associated capital infrastructure and service plans over the 2023 to 2050 period.

Table 52 illustrates the near-, mid-, and long-term total number of vehicles and chargers purchased based on the fleet retirement schedule. These vehicle purchases also assume that some vehicles are replaced more than once between now and 2050, thus a total that is greater than 45 buses.

Table 52. BEB Scenario Periodic Capital Purchase Assumptions

	Replacement			Growth			Total		
	Phase 2A	Phase 2B	Phase 3	Phase 2A	Phase 2B	Phase 3	Phase 2A	Phase 2B	Phase 3
	2025-2028	2029-2030	2031-2040	2025-2028	2029-2030	2031-2040	2025-2028	2029-2030	2031-2040
BEB Transition Scenario – Diesel/Gasoline									
Bus – 12M	-	-	-	8	-	-	8	-	-
Bus – 6M	3	-	-	2	-	-	5	-	-
Bus – 8M	1	-	-	-	-	-	1	-	-
BEB Transition Scenario – Battery Electric									
BEB – 12M	-	6	11	8	3	25	8	9	36
BEB – 6M	3	2	20	1	2	4	4	4	24
BEB – 8M	1	4	6	-	-	-	1	4	6

BEBs were assumed to be purchased two years prior to entering service. Once BEBs can no longer replace a diesel bus on a one-to-one basis without enroute chargers, we assumed additional BEBs are purchased to cover routes with bus swaps. As noted in the Key Cost Assumptions section above, 1 diesel bus is converted ("repowered") to a BEB halfway through its service life. Diesel purchases along with BEBs are made through 2029, after which only BEB vehicles are purchased.

Table 53 presents the annual costs estimates based on the unit cost assumptions and the annual capital needs.

Table 53. BEB Scenario Periodic Total Capital Cost Estimates, 2023$, millions

	Replacement			Growth			Total		
	Phase 2A	Phase 2B	Phase 3	Phase 2A	Phase 2B	Phase 3	Phase 2A	Phase 2B	Phase 3
	2025-2028	2029-2030	2031-2038	2025-2028	2029-2038	2031-2040	2025-2028	2029-2030	2031-2038
BEB Transition Scenario – Diesel/Gasoline									
Bus – 12M	-	-	-	$7.3	-	-	$7.3	-	-
Bus – 6M	$0.7	-	-	$0.4	-	-	$1.1	-	-
Bus – 8M	$0.3	-	-	-	-	-	$0.3	-	-
BEB Transition Scenario – Battery Electric									
BEB – 12M	-	$11.5	$21.0	$15.3	$5.7	$47.7	$15.3	$17	$69
BEB – 6M	$1.2	$0.8	$7.9	$0.4	$0.8	$1.6	$1.6	$1.6	$9.4
BEB – 8M	$0.5	$1.9	$2.8	-	-	-	$0.5	$1.9	$2.8
Charging Infrastructure Cost									
Infrastructure	$10.3	$3.7	$17.8	-	-	-	$10.3	$3.7	$17.8

In addition to the cost of vehicles and chargers, lump sum phasing costs shown in **Table 54** include budgetary pricing provided by electrical infrastructure OEMs for unit substations, and typical unit costs for other civil and electrical work (conduits, grounding, patching), and other anticipated construction expenses. The per-phase costs also factor in a 4% engineering design and a 20% contingency based on concept plan details.

Table 54. Infrastructure Phasing Assumptions, 2023$

Phase	Cost	Purchase Year	Key Equipment
Phase 1	$7,472,500	2025	2667 kVA unit substation (#1), initial deployment of chargers as shown in the phasing plan and concept figures.
Phase 2A	$2,827,400	2025-2028	Expansion of DCFC and Level 2 charging infrastructure.
Phase 2B	$3,748,000	2029-2030	2667 kVA unit substation, Eighteen (18) 150 kW wall-mounted plug-in dispensers, thirteen (13) 7.2 kW specialized transit chargers
Phase 3	$17,785,500	2031-2038	2667 kVA unit substation (#2), ultimate deployment of chargers as shown in the phasing plan and concept figures.

Over the 2023 to 2050 period, total capital costs for the BEB Scenario were estimated to be $273.6 million in 2023 dollars. As shown on the previous figures and tables, the bulk of the BEB fleet transition would occur between 2025 and 2035, with the remaining diesel buses in service replaced by BEBs by 2041. To accommodate the BEB fleet, a total of forty-five (45) 150 kW in-depot dispensers will be acquired between 2024 and 2032.

BEB TRANSITION OPERATING COST ESTIMATES

In the model, blocks were converted from diesel to electric buses using a two-step prioritization method. Blocks were prioritized first if they can be converted on a one-to-one basis (diesel to BEB) without the need for enroute charging infrastructure. After the initial conversion, BEBs were reprioritized based on blocks that can be converted on a one-for-one basis with the greatest total kilometres travelled.

Table 55 summarizes the annual vehicle operating costs and annual transfers to reserves for replacement between 2023 and 2050. As noted above, by 2042 the entire fleet has been transitioned to BEBs.

Table 55. BEB Scenario Periodic Total Operating Cost Estimates, 2023$, millions

	2023 - 2030	2031 - 2040	2041 - 2050
Diesel Operating Costs	$54.6	$48.0	$0.3
BEB Operating Costs	$10.0	$89.9	$141.2
Diesel Bus Transfers to Reserve	-	-	-
BEB Transfers to Reserve	$11.6	$60.2	$74.5
Electrical Infrastructure Transfer to Reserve	$2.3	$3.7	$2.3
Total	**$78.5**	**$201.8**	**$218.3**

BEB FUELING COST ESTIMATES

Based on the methodology described in O&M Cost Assumptions, summarizes the fuel and electricity cost estimates for the BEB scenario for selected years over the 2023 to 2050 period. These costs were estimated to be $19.4 million for diesel and $21.7 million in 2023 dollar terms for electricity. Diesel fuel consumption in the latter years of the study period is from the auxiliary heaters on board BEBs.

Table 56. BEB Transition Scenario Fuel and Electricity Annual Usage

	2023	2025	2030	2035	2040	2045	2050
Litres of Diesel	563,785	563,785	1,010,538	719,711	181,731	116,546	116,546
kWh	-	-	1,071,532	3,256,665	5,372,031	5,625,623	5,625,623

Table 57. BEB Scenario Periodic Total Fuel and Electricity Cost Estimates, 2023 $, Millions

	2023 - 2030	2031 - 2040	2041 - 2050
Diesel Fuel Costs	$6.9	$6.0	$1.2
Electricity Costs	$0.8	$8.2	$12.7
Carbon Levy Costs	$2.0	$2.7	$0.5
Total Fueling Costs	**$9.7**	**$16.9**	**$14.5**

BEB TRANSITION MAINTENANCE COST ESTIMATES

Table 58 summarizes the annual vehicle maintenance costs, mid-life rehabilitation costs, and the annual EV chargers' maintenance costs between 2023 and 2050. As noted above, by 2041 the entire fleet has been transitioned to BEBs.

Table 58. BEB Scenario Periodic Total Operating Cost Estimates, 2023 $, Millions

	2023 - 2030	2031 - 2040	2041 - 2050
Diesel Maintenance Costs	$8.4	$7.7	$0.05
BEB Maintenance Costs	$8.7	$85.8	$141.2
Related Infrastructure Maintenance	$0.04	$0.5	$0.9
Total	**$17.2**	**$94.0**	**$142.1**

BEB TRANSITION SPECIALIZED TRANSIT FLEET COSTS

Milton Transit offers specialized and on-demand transit services along with its fixed route fleet. Capital purchases of 6m and 8m "Specialized" vehicles based on the projected retirement of existing vehicles and planned introduction of new vehicles are shown in **Table 59.** The totals include purchases of replacements in future years, so the total purchases exceed the 23 vehicles of the expanded fleet.

Table 59. BEB Scenario Periodic Specialized Transit Capital Purchases

	Replacement			Growth			Total		
	Phase 2A	Phase 2B	Phase 3	Phase 2A	Phase 2B	Phase 3	Phase 2A	Phase 2B	Phase 3
	2025-2028	2029-2030	2031-2040	2025-2028	2029-2030	2031-2040	2025-2028	2029-2030	2031-2040
BEB Transition Scenario – Diesel/Gasoline									
Bus – 6M	3	-	-	2	-	-	5	-	-
Bus – 8M	1	-	-	-	-	-	1	-	-
BEB Transition Scenario – Battery Electric									
BEB – 6M	3	2	20	1	2	4	4	4	24
BEB – 8M	1	4	6	-	-	-	1	4	6

Figure 27 below displays the specialized fleet composition by vehicle type for selected years in the study period. Based on the planned retirement of current diesel vehicles, the entire baseline fleet is expected to be converted by 2033. There is one growth 6m ICEV that is purchased during Phase 2A, which remains in service until 2035. This chart is constructed based on the purchase schedule outlined above and in the Fleet Deployment Plan. The chart accounts for the two year lag between purchase and entering service.

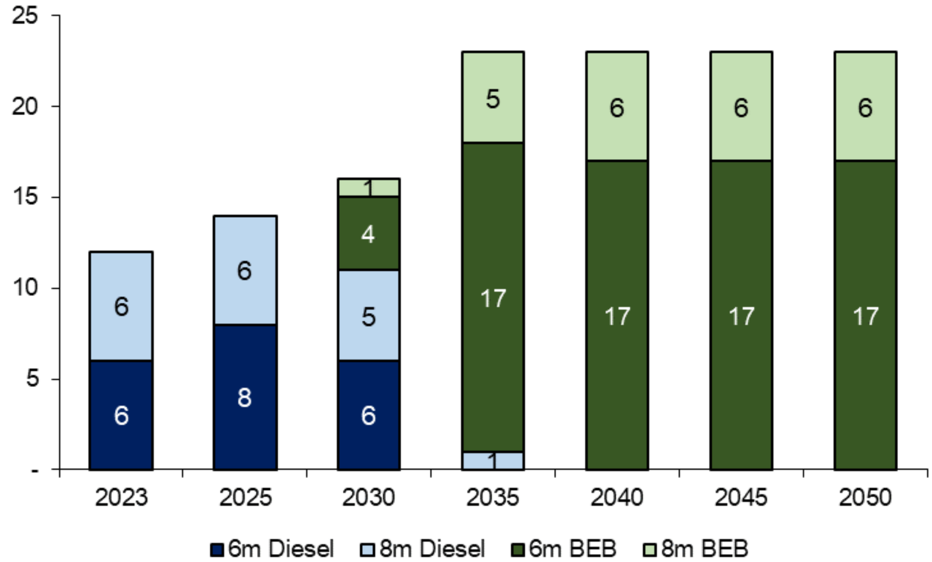


Figure 27. Specialized Fleet Composition, Selected Years

Table 60 displays the costs associated with the purchase of specialized transit vehicles.

Table 60. Specialized Transit Capital Costs, 2023$ Millions

	Replacement			Growth			Total		
	Phase 2A	Phase 2B	Phase 3	Phase 2A	Phase 2B	Phase 3	Phase 2A	Phase 2B	Phase 3
	2025-2028	2029-2030	2031-2040	2025-2028	2029-2030	2031-2040	2025-2028	2029-2030	2031-2040
BEB Transition Scenario – Diesel/Gasoline									
Bus – 6M	$0.7	-	-	$0.4	-	-	$1.1	-	-
Bus – 8M	$0.3	-	-	-	-	-	$0.3	-	-
BEB Transition Scenario – Battery Electric									
BEB – 6M	$1.2	$0.8	$7.9	$0.4	$0.8	$1.6	$1.6	$1.6	$9.4
BEB – 8M	$0.5	$1.9	$2.8	-	-	-	$0.5	$1.9	$2.8

Table 61 below contains annual cost estimates for O&M for the specialized transit fleet in 2023$.

Table 61. BEB Scenario Periodic Specialized Fleet Maintenance Costs, 2023$, Millions

	2023 - 2030	2031 - 2040	2041 - 2050
Specialized ICE O&M	$3.0	$0.4	-
Specialized BEB O&M	$0.3	$5.3	$6.5
Transfer to Reserve, Specialized BEB	$2.3	$12.3	$13.2
Total	**$5.7**	**$18.0**	**$19.6**

Table 62 below shows the annual fuel cost estimates for the specialized transit fleet for selected years.

Table 62. BEB Scenario Periodic Specialized Fleet Fuel Costs, 2023$, Millions

	2023 - 2030	2031 - 2040	2041 - 2050
Annual Electricity Costs	$0.1	$1.0	$1.2
Annual Diesel Fuel Costs	$1.8	$0.2	-
Annual Carbon Levy Costs	$0.5	$0.1	-
Total Fuel Costs	**$2.3**	**$1.3**	**$1.2**

BEB TRANSITION SUMMARY

Under the BEB Transition Scenario, the total cost of implementation was estimated to be $729.8 million in 2023 dollars. The total capital costs are $273.6 million. Total lifecycle O&M costs of $456.3 million include operations, maintenance, lifecycle replacement costs, and propulsion costs. O&M costs make up the largest fraction of the total with approximately $435.6 million in costs in 2023 dollars.

Table 63. BEB Scenario Summary, 2023$, Millions, 2023-2050

2023$	BEB Transition Scenario
Buses	$204.5
Midlife Rehabilitation	$2.8
Specialized Transit	$34.4
Related Infrastructure	$31.8
Life Cycle Capital Costs, Total	**$273.6**
Operations & Maintenance	$393.0
Propulsion	$41.1
Related Infrastructure O&M	$1.5
Life Cycle O&M, Fixed Route	**$435.6**
Operations & Maintenance	$15.5
Propulsion	$5.1
Life Cycle O&M, Specialized Transit	**$20.7**
Total Fleet Lifecycle Costs	**$729.8**

LIFECYCLE COST COMPARISON

This section provides a comparison of the capital, O&M, and fuel/electricity cost estimates among the three scenarios over the entire 2023-2050 period. All values are presented in 2023$ terms, unless otherwise noted.

CAPITAL COST COMPARISON

Table 64 provides a comparison of total capital costs among the two scenarios. As shown in the table, capital costs in the BEB Scenario are $64.0 million more expensive due primarily to the difference in vehicle costs, as well as the additional equipment and infrastructure investments that would be required for BEB implementation.

Table 64. Capital Cost Comparison, 2023$ Millions, 2023-2050

	Baseline	BEB	Variance
Diesel – Replacement	$42.1	$6.4	-$35.7
Diesel Replacement Quantity	45	7	
Diesel – Growth	$65.9	$11.0	-$54.9
Diesel Growth Quantity	72	12	
BEB – Replacement	-	$72.6	$72.6
BEB Replacement Quantity	-	38	
BEB – Growth	-	$114.6	$114.6
BEB Growth Quantity	-	60	
8m Specialized ICE – Replacement	$6.2	$0.8	-$5.4
8m ICE Replacement Quantity	24	3	
8m Specialized BEB – Replacement	-	$9.7	$9.7
8m BEB Replacement Quantity	-	21	
6m Specialized ICE – Replacement	$11.6	$0.7	-$10.9
6m ICE Replacement Quantity	53	3	
6m Specialized BEB – Replacement	-	$19.7	$19.7
6m BEB Replacement Quantity	-	50	
6m Specialized ICE – Growth	$2.4	$0.9	-$1.5
6m ICE Growth Quantity	11	4	
6m Specialized BEB – Growth	-	$2.8	$2.8
6m BEB Replacement Quantity	-	7	
Total Fleet Purchases	**$128.2**	**$239.0**	**$110.8**
Diesel Midlife Rehabilitation	$81.4	$2.3	-$79.2
BEB Midlife Rehabilitation	-	$0.5	$0.5
Additional Infrastructure	-	$31.8	$31.8
Total Fleet Lifecycle Capital Costs	**$209.6**	**$273.6**	**$64.0**

O&M COST COMPARISON

Table 65 provides a comparison of total operating and maintenance cost estimates over the 2023 to 2050 period based on the assumptions described in the prior sections. As mentioned earlier the primary unknown for O&M costs is vehicle maintenance costs for BEBs and associated infrastructure. The technology is still relatively new and long-term detailed analysis of vehicle maintenance costs is not available.

Table 65. O&M Cost Comparison, 2023$ Millions, 2023-2050

	Baseline	BEB	Variance
Diesel O&M	$414.2	$121.8	-$292.4
BEB O&M	-	$286.7	$286.7
Diesel Bus – Transfer to Reserve	$89.0	-	-$89.0
BEB – Transfer to Reserve	-	$153.7	$153.7
8m Specialized Gas Transfer to Reserve	$5.1	-	-$5.1
8m Specialized BEB Transfer to Reserve	-	$8.8	$8.8
6m Specialized Gas Transfer to Reserve	$11.3	-	-$11.3
6m Specialized BEB Transfer to Reserve	-	$20.3	$20.3
Electrical Infrastructure Transfer to Reserve	-	$8.3	$8.3
Related Infrastructure O&M Costs	-	$1.5	$1.5
Total Fleet Lifecycle O&M Costs	**$519.7**	**$601.2**	**$81.4**

Finally, **Table 66** provides a comparison of total costs for diesel fuel and electricity over the 2023 to 2050 period. Based on the assumptions in this analysis, the BEB Scenario would have lower fuel and electricity costs in 2023-dollar terms.

Table 66. Fuel and Electricity Cost Comparison, 2023$ Millions, 2023-2050

	Baseline	BEB	Variance
Diesel Costs	$49.5	$16.6	-$32.9
Electricity Costs	-	$23.8	$23.8
Carbon Levy Costs	$19.4	$5.7	-$13.6
Total Fleet Lifecycle Propulsion Costs	**$68.9**	**$46.2**	**-$22.7**

NET PRESENT VALUE (NPV) ANALYSIS

A net present value (NPV) analysis was conducted to compare the BEB Scenario to the Baseline Scenario. Costs over the 2023 to 2050 period are presented in 2023 dollars. The analysis evaluated the direct cost impacts to Milton Transit to understand the additional costs of implementing a BEB transition plan relative to operating business-as-usual.

This analysis assumed growth in service levels according to the proposed fleet expansion schedule provided by Milton Transit. The analysis only looks at direct cost impacts to Milton and does not attempt to monetize public benefits to society.

Additionally, the analysis assumed that capital costs will not be offset by grant or incentive funding. Including additional funding sources, such as ICIP or ZETF, may affect the results of the analysis. However, since these funds have not been applied for or secured by Milton, they are not included in this analysis.

The transition to BEBs is anticipated to cost $37.1 million more than maintaining a fully diesel fleet for the BEB scenario. The result shows that the higher capital costs of BEB buses is not offset by O&M and propulsion cost savings relative to the Baseline Scenario. Please note that the transfer to reserve costs is not included in the totals for either scenario, as this would substantially overstate the projected costs.

Table 67. Overall Lifecycle Cost Comparison, Millions of 2023$, 2023-2050

2023$	Baseline Scenario	BEB Transition Scenario	Variance
Buses	$108.0	$204.5	$96.6
Midlife Rehabilitation	$81.4	$2.8	-$78.7
Specialized Transit	$20.2	$34.4	$14.2
Related Infrastructure	-	$31.8	$31.8
Life Cycle Capital Costs, Total	**$209.6**	**$273.6**	**$64.0**
Operations & Maintenance	$398.4	$393.0	-$5.5
Propulsion	$55.7	$41.1	-$14.6
Related Infrastructure O&M	-	$1.5	$1.5
Life Cycle O&M, Fixed Route	**$454.1**	**$435.6**	**-$18.5**
Operations & Maintenance	$15.8	$15.5	-$0.2
Propulsion	$13.2	$5.1	-$8.1
Life Cycle O&M, Specialized Transit	**$29.0**	**$20.7**	**-$8.3**
Total Fleet Lifecycle Costs	**$692.7**	**$729.8**	**$37.1**

INFRASTRUCTURE FINANCING OPTIONS

There are several external financing opportunities available to Milton to secure funding for its BEB fleet transition. The two primary external funding sources are the Investing in Canada Infrastructure Program (ICIP), and the Zero Emission Transit Fund (ZETF).

The ICIP is administered by Infrastructure Canada and has invested $131 billion in over 85,000 projects. This program has already funded several other municipalities' transit fleet buses, including conventional transit and other mobility services. The federal government will invest up to 40% for most municipal public transit costs, though this may increase to 50% for rehabilitation projects. Funding provided by Infrastructure Canada is divided among the provinces who distribute funding by municipality.

The ZETF is administered by the Canadian Infrastructure Bank, and targets projects that enable or implement transit fleet electrification. The ZETF offers flexible financing solutions, including grants and loans to applicants. ZETF funding decisions are determined by project viability, estimated operational savings, and estimated GHG emission reduction. Approximately $2.75 billion in funding is earmarked for the ZETF program to numerous municipal transit agencies.

Funding from either program may be used to offset planning, capital, and operating costs associated with transitioning diesel fleets to BEBs or alternative fuel technologies. As this funding has not been secured by Milton, it is not included in this analysis.

APPENDIX D: GHG EMISSIONS ANALYSIS

Greenhouse gas (GHG) emission reductions is an additional benefit of transitioning from diesel buses to BEBs. HDR performed supplementary calculations to quantify the impacts of BEB operations on GHG emissions relative to the Baseline Scenario.

ASSUMPTIONS AND METHODOLOGY

The analysis quantified GHG impacts based on estimates of diesel fuel and electricity usage by conventional transit buses over the 2023-2050 period. The following assumptions were used to quantify emissions based on litres of fuel and kWh of electricity consumed.

The emission rate for diesel fuel is 2.681 kilograms (kgs) of carbon dioxide (CO_2) per litre of fuel. The emission rate for gasoline fuel is 2.28 kgs of CO_2 per litre of fuel. This value was obtained from the Canadian National Inventory Report, 2023. The emission rate was multiplied by the annual litres of fuel consumed to calculate the annual kgs of CO2 emitted. To quantify the impact of electricity usage on GHG emissions, the total kWh of electricity used per year was multiplied by the corresponding Electricity Emission Intensity factor for Ontario from 2023 to 2050. This factor represents the kg of CO_2 per kWh based on the average electricity grid mix for the province. The intensity factor declines over time due to anticipated introduction of new renewable power generation sources. The Electricity Emission Intensity Factor was obtained from the Average Grid Electricity Emission Intensities table in the ZETF GHG+ Guidance Modules, Annex C.

GHG EMISSION REDUCTION IMPACTS

Based on the assumptions above, the GHG emissions from BEB operations are summarized in **Table 68** below. Over the study period, BEBs will reduce emissions by approximately 76,900 tonnes.

Table 68. Total GHG Emissions (CO_2 in Tonnes), Baseline and BEB Scenarios

	2025	2030	2040	Total
Diesel	2,168	4,134	5,156	120,466
BEB	-	-	-	-
Total, Baseline Scenario	**2,168**	**4,134**	**5,156**	**120,466**
Diesel	2,168	3,144	487	40,374
BEB	-	40	174	3,131
Total, BEB Scenario	**2,168**	**3,184**	**662**	**43,505**

This reduction is due to the dramatically lower operating emissions of BEBs relative to diesel buses. **Figure 28** below shows the annual GHG emissions from operations as the fleet mix changes in the BEB Scenario. There is a substantial decline from approximately 2,200 tonnes of GHGs per year to just below 700 tonnes per year in the BEB Scenario.

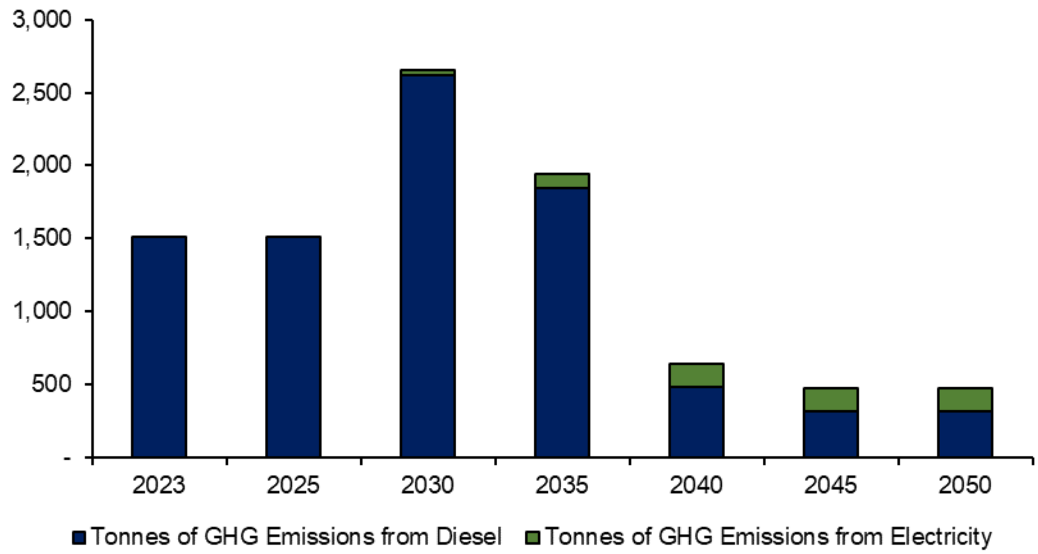


Figure 28. Annual GHG Emissions, BEB Scenario, tonnes

The cumulative percent reduction in GHG emissions is shown in **Figure 29** below. The annual reduced emissions grow substantially over time as the diesel fleet is converted to BEBs. By the end of the transition to BEBs, emissions are reduced by approximately 90%.

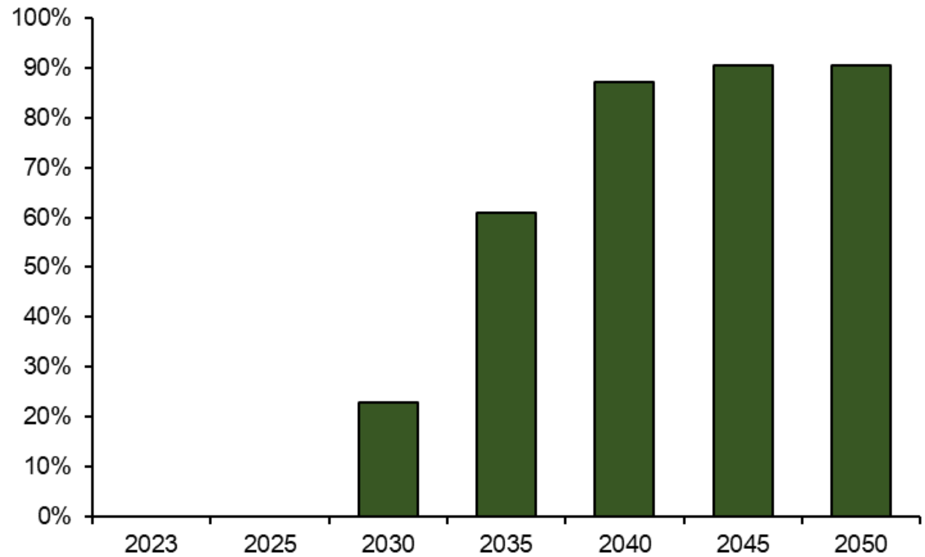


Figure 29. Percentage GHG Reductions from Baseline in BEB Scenario