London Transit Commission

The Way Ahead: London's Bus Rapid Transit Strategy – Business Case

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Executive Summary

The Way Ahead:

The Business Case for London's Bus Rapid Transit Strategy

Introduction

This Executive Summary provides an overview of the business case for transforming London's transit service through the introduction of a Bus Rapid Transit (BRT) Strategy. The business case is a broad-based assessment of the benefits and costs of a new BRT service and enhancements in associated transit services. It provides an understanding of how the BRT Strategy will improve the standard of living for City of London residents and improve the competitiveness of businesses in the region. The justification for the BRT Strategy is undertaken from a public sector perspective, taking into account not only the financial implications of the new BRT service, but also the transportation user benefits (only some of which translate into higher farebox revenues) and the economic, environmental and social impacts of the BRT Strategy.

Background: Smart Moves and the BRT Strategy

The BRT Strategy was developed as an integral part of the London 2030 Transportation Master Plan (TMP) entitled "Smart Moves" and approved by City Council in June 2012. Conceived as an integrated growth management and transportation planning program, the TMP is a transportation strategy that not only accommodates population and economic growth in London over the next 20 years, but also attempts to shape that growth through the spatial distribution of economic and other activities and through sustainable transportation outcomes. Five "Smart Moves" or strategic initiatives were recommended as part of the 20-year "new mobility" TMP. These Smart Moves are:

1. Rethinking Growth to Support the Transportation Master Plan
2. Taking Transit to the Next Level
3. Actively Managing Transportation Demand
4. Greater Investment in Cycling and Walking Infrastructure
5. More Strategic Program of Road Network Improvements

Transit ridership in London has grown on average at 4.1% per year between 1996 and 2012, when it carried 23.5 million riders. As a result, the current transit network is approaching the limits of its capacity, with peak period frequencies already at 5 minutes or less along major corridors where multiple bus routes are utilized. For this reason, Smart Move #2 proposes "Taking Transit to the Next Level" with a Bus Rapid Transit (BRT) Strategy.

The TMP provides the planning rationale for two BRT corridors: one north-south and one east-west. These corridors represent the best performing segments from five of the eight corridors identified in the Long Term Transit Growth Strategy. The corridors are designed to better link downtown London to post-secondary institutions and other key activity centres in the community, such as the London Health Sciences Centre. This has been aptly described as the "centres" and "corridors" approach to transportation in ReThink London's discussion paper entitled Providing Transportation Choices.[1] In essence, Smart Move #2 would transform London's transit service into a more effective and sustainable network for getting people to their workplaces, schools and other destinations in the City.

The transformation of London's transit service is closely intertwined with Smart Move #1, which is focused on managing the City's growth. The TMP recommended that the City reshape its current pattern of growth – based on population growth of about 1% per year – to focus on intensification, which would involve directing at least 40% of

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1. ReThink London is the process for updating the City's Official Plan.

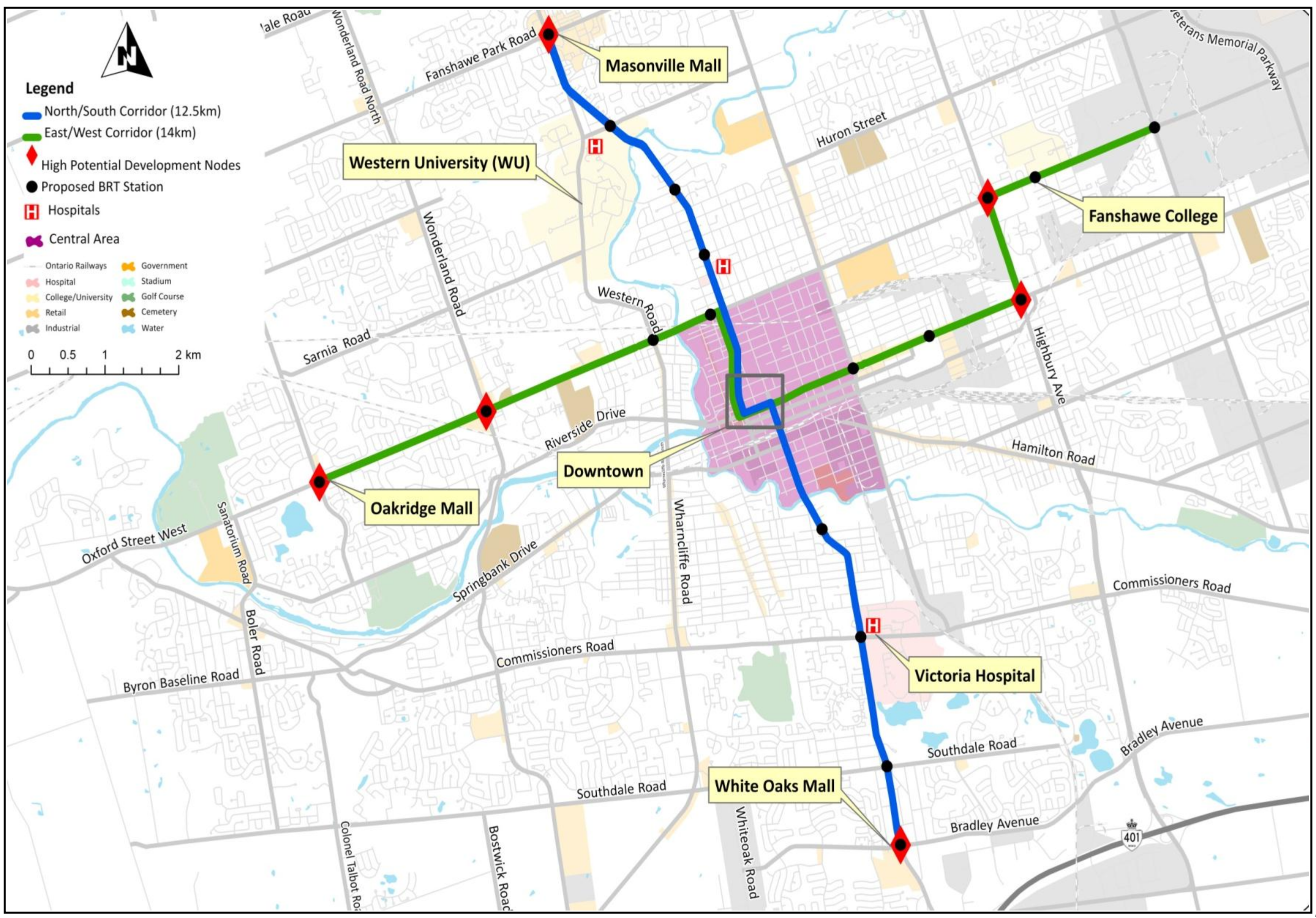
future population and employment growth into the downtown area and along the proposed rapid transit corridors. The introduction of higher-order transit corridors provides a critical platform for this intensification, which in turn can further support robust transit ridership on the proposed BRT corridors.

Project Overview

The BRT Strategy is not a single new project. It is a fundamentally different way of approaching urban passenger transportation in London. The BRT Strategy includes both new infrastructure and service improvements that would transform how public transit services are delivered in London. The two components to the strategy are:

1. A BRT Network consisting of two corridors: one running north-south along the Richmond Street and Wellington Road corridors and one running east-west along the Oxford Street and Dundas Street corridor, with the two corridors intersecting within the downtown area. The preferred BRT corridors and proposed station locations are shown in Figure A below
2. Enhanced local feeder services to support ridership on the BRT corridors

Figure A. Preferred BRT Corridors with Proposed Stations



Source: City of London 2030 Transportation Master Plan, Final Report, Volume 2, p. 3-3

When the BRT Strategy is fully implemented in 2020 or later, it will improve travel time performance, increase the passenger capacity of the transit network and improve the quality of service for transit passengers. This will be achieved through several characteristics that differentiate BRT from other, local bus services:

- Frequent service along the BRT corridors, allowing riders to use the service without needing to consult a schedule.
- Limited key stops along the BRT corridors.
- Transit priority measures including traffic signalization, queue jumps up to an including bus-only lanes.
- Distinct buses: BRT services will use distinctly branded, higher-capacity, articulated buses.
- Enhanced stations: that is, bus stops with larger, more prominent waiting areas, larger shelters, seating, and potentially an enclosed waiting area.

Base Case Scenario

For evaluation purposes, the BRT Strategy is compared to a Base Case scenario which is defined by the two following key features:

- All road widenings recommended in the TMP will be implemented, but not the road widenings required for the BRT Strategy
- The London transit network will continue to operate as a local bus network much as it does today, but with a continued "business-as-usual" increase in bus fleet size in order to address continued ridership and network growth

These features suggest that the base case will not be a zero-cost option relative to today. This is not only due to the road widenings, but also to the continued bus fleet expansion of approximately 3 additional regular buses per year for the first decade of the evaluation horizon (2020-29). The capital costs incurred for bus fleet expansion under the Base Case would be approximately $35 million in 2012 dollars. It is important to note that under the BRT Strategy Scenario these capital costs and the associated operating costs would go toward the BRT program (e.g., the capital spending could go instead toward articulated buses instead). Under the Base Case, the same investment is less effective as regular buses are added to network which is already operating at capacity.

Evaluation Approach

The methodology for this business case is based on a Multiple Account Evaluation (MAE) approach. The MAE approach examines costs and benefits of the BRT strategy relative to the base case scenario in both quantitative and qualitative terms.

The MAE approach represents the transit industry's tool of choice for building business cases for rapid transit investments, because it provides considerable flexibility in building a comprehensive business case, while maintaining the rigorous standards recognized in transportation economics. This flexibility is exhibited in two important ways. First, the MAE approach provides the analytical tools to test whether there is a clear basis to proceed with the funding and implementation of the BRT strategy from a public sector perspective. These analytical tools consist of comparing the incremental financial costs (i.e. capital and operating costs) arising from the BRT Strategy against the incremental transportation user benefits and environmental benefits associated with the BRT Strategy. The results are summarized in the form of a net present value figure or a benefit-cost ratio that captures the relevant costs and benefits associated with the BRT Strategy over the thirty-year horizon from 2020 through to 2049. However, this litmus test is based only on the costs and benefits that can be quantified and monetized (i.e. expressed in money terms), such as capital and operating costs and those transportation user benefits and environmental benefits which can be monetized. In this respect, it can be considered a conservative or narrow economic test of the feasibility of a project.

Second, the MAE approach provides a way of considering other economic costs and benefits which are not included in the narrow economic test. This refers to economic costs and benefits that cannot be quantified and monetized (e.g. improved reliability, or social and community impacts); or to economic impacts which are not strictly incremental[2] relative to the base case and hence cannot be added to the other monetized costs and benefits. This is achieved by categorizing the costs and benefits into five separate accounts, thereby providing the basis for a comprehensive review of the costs and benefits. These accounts consist of:

- Transportation user account, which captures travel time savings, auto operating cost savings and safety benefits from reduced road traffic
- Environmental account, which captures the impact on GHG emissions
- Financial account, which consists of the net capital and net operating costs (transportation and maintenance) associated with the BRT Strategy
- Economic development account, which capture the impact of capital spending on employment and output in the short-term and the impact of additional services and operations associated with the BRT Strategy over the long term
- Social and community account, which describes the impacts of the BRT Strategy on land use shaping and specific socio-economics groups

Key Findings

The results of the BRT Strategy compared to Base Case Scenario are presented in Table A below. In order to provide a comparison on a "like-for-like" basis, the dollar figures are presented in 2012 currency and the values for the full 30-year horizon are discounted back to a single net present value (NPV) using a real discount rate of 5%. (The sum of the undiscounted values is also provided in the last column, where relevant). These values and other input assumptions are summarized in Appendix 4 of the Report.

In strict benefit-cost terms, the BRT Strategy would be expected to generate $1.8 of benefits for every $1 investment in the net capital and net operating costs required to deliver the transformation of London's transit service, as shown in Table A below (see Financial Account). The investment required for the BRT Strategy is summarized in the financial account, which shows that the net incremental capital costs under the BRT Strategy amount to $300 million in NPV terms over the 30-year period. Net new operating and maintenance costs for the BRT Strategy were estimated at $114 million. Both these capital and operating costs – which amount to $414 million – exclude all capital and operating spending which would have otherwise occurred in the Base Case Scenario in order to provide a continuation of the current transit service.

The benefits from the BRT Strategy for the full 2020-49 period consist of the $735 million under the transportation user account and $2 million of GHG emissions savings under the environmental account. Together, the combined benefits exceed the capital and operating costs associated with the BRT Strategy by $323 million in NPV terms (or by a ratio of 1.8:1). The same figures can be expressed in terms of an economic rate of return of 11.3% over the 30-year period. All these benefits would be lost to London if the BRT Strategy did not proceed.

2. *Incremental impacts refer to impacts which are all lost if the project does not proceed.*

Table A. Multiple Account Evaluation Summary (2020 – 2049)

	Criteria	BRT Strategy Net Present Value 2012$ M (unless otherwise noted)
Transportation User Account	Transportation User Benefits (NPV $M)	735
	Qualitative User Benefits	✔✔✔
Environmental Account	GHG Emissions (NPV $M)	2
Financial Account	Net Incremental Capital Costs (NPV $M)	(300)
	Net Incremental Operating Costs (NPV $M)	(114)
	Benefits Less Costs (NPV $M)	323
	Benefit-Cost Ratio	1.8
	Economic Rate of Return	11.3%
Economic Development Account	ECONOMIC IMPACTS DURING CONSTRUCTION	
	Employment (person-years)	3,500
	Income (2012$ M)	129
	GDP (2012$ M)	288
	LONG-TERM ECONOMIC IMPACTS, 2030	
	Employment (person-years)	110
	Income (2012$ M)	9
	GDP (2012$ M)	20
	Land Value Uplift ($M)	90
Social Community Account	Land Use Shaping	✔✔
	Impacts on Socio-Demographic Groups	✔✔

Note: ✔= slightly positive impacts;
✔✔= positive impacts;
✔✔✔= very positive impacts.

The transportation user benefits of $735 million consist primarily of travel time savings for transit users, but also include auto operating cost savings and travel time savings resulting from less driving. These results are conservative for several reasons:

- There is likely to be additional latent demand for transit services as the BRT Strategy is put in place. This is because the current transit service is already operating at close to full capacity at peak periods, resulting in significant service level deterioration as it copes with continued increases in ridership demand (i.e. in-vehicle crowding, longer wait times at bus stops, etc). The service level deterioration has an adverse feedback effect on ridership demand. However, once transit network capacity is added and service quality is restored, ridership will also bounce back. This means that the BRT Strategy scenario should benefit from additional latent demand that is not factored into the results
- The capital and operating costs estimated under the BRT Strategy do not take account of any savings which are likely to result from a restructured and optimized transit route network (e.g. removal of overlapping services).
- Conservative assumptions have been used to convert travel time benefits into monetary values (e.g. the growth in the value of time is limited to 0.5% per year in real terms, which is well below the assumptions in other benefit case assessments in Ontario)

As a result, Table A denotes a relatively high level of benefits (three ticks) for the BRT Strategy under the category of qualitative user benefits (i.e. benefits which are not captured in the formal quantitative results).

Consideration of the Economic Development account and the Social and Community Account further strengthens the case for the BRT Strategy, since the latter provides substantial economic development opportunities and service improvements to the entire population. The economic impacts resulting from the capital spending (for the new dedicated bus lanes and the additional rolling stock) would result in direct and indirect impacts of approximately 3,500 full-time equivalent jobs (i.e. 3,500 person-years of employment), $129 million in additional income and $288 million in GDP during the construction period. These figures are reported for Ontario as a whole, although the construction activity will stimulate primarily local job creation.

There are also significant economic impacts which result from the additional operations and maintenance expenditure to support the BRT Strategy. The sum of the direct and indirect impacts would be approximately 110 full-time equivalent jobs, $9 million in additional income and $20 million in GDP creation for the year 2030 and for each other year in which the BRT Strategy is in operation.

As regards the Social and Community Account, the BRT Strategy will provide a critical platform for the intensification of residential and employment growth in the downtown and along the BRT corridors. Greater intensification is highly dependent on improved transit within the existing urban boundary. In auto-dependent areas, land development requires the construction of large amounts of parking to accommodate all of the cars that are used to access these developments. In suburban areas, parking is usually provided in surface lots that consume large amounts of land and force buildings to be spread apart. Often, this parking is set between the street and the building, degrading the quality of the pedestrian experience along these streets and along building accesses. In areas where convenient, high-frequency, higher-order transit is provided, parking requirements are able to be relaxed. Travel demand that would otherwise be served by autos can instead be served by transit. Relaxed parking requirements can result in a reduction in the amount of structured parking provided, making intensification more cost-effective and attractive to the market. In this way, the BRT Strategy can help make intensification under the TMP more feasible and more attractive to prospective developers.

The BRT Strategy will also provide significant benefits for several socio-demographic groups such as students (both school-age children and post-secondary students), the elderly and low-income groups, all of whom tend to rely more heavily on transit than other groups in London. In addition, the BRT Strategy will help make public transit a more attractive and feasible commuter travel option for the 18-34 age group – known as Millennials – which are postponing car purchases, driving less and looking for alternatives to auto-dependence compared to earlier generations.

Summary

The London Bus Rapid Transit Strategy represents a unique, once-in-a-generation opportunity to transform the scale and quality of London’s transit network in order meet the population growth and ridership demands for the City and the wider region. The results demonstrate a strong business case for the BRT Strategy proposed as part of the Transportation Master Plan. This is based on comparing the transportation user benefits and the environmental benefits to the additional capital and operating costs required for the Strategy. In addition, the BRT Strategy generates broader economic development impacts and social and community impacts.

If there is remaining doubt as to the value that this BRT strategy brings to London, consider London’s transit network without any improvements. The existing network has been successful in generating substantial increases in ridership over the last several years, but is now at the breaking point. Buses on many routes are crush-loaded through most of the day and are unable to accommodate any more passengers. At some stops, users are left at the curb and forced to wait longer for another bus. It is not possible for the existing level of service to accommodate growth in London's population or a further mode shift to transit. Incremental additions to transit service may partially alleviate crowding along certain routes during certain time periods, but these are insufficient to fully solve future capacity constraints. Though there may not be large fiscal outlays toward infrastructure or services in the Base Case, there would be negative impacts on the population, particularly groups that are dependent on transit, such as the elderly, youth, and lower-income individuals. These groups will bear the brunt of the degraded service quality and reduced mobility that will result from the Base Case. Further, London is not likely to achieve its 40% intensification target with the Base Case transit network, resulting in more sprawl at the periphery and less investment within the downtown and other built neighbourhoods.

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1. Introduction

1.1 Purpose of Report

The purpose of this report is to develop a business case for the London Bus Rapid Transit (BRT) Strategy. In essence, this means assessing in the broadest terms the economic return on investment for the London Transit Commission (LTC) and the City of London to proceed with the introduction of a BRT service. The assessment is undertaken from a broad public sector perspective and hence, takes into account not only the financial implications of proceeding with the transformation of the transit network in London, but also the transportation user benefits and the economic, environmental and social impacts of the BRT Strategy.[3] The BRT Strategy is an integral part of the London 2030 Transportation Master Plan (TMP) which was approved by City Council in June 2012. The Transportation Master Plan provides the planning rationale for two BRT corridors: one running north-south along the Richmond Street and Wellington Road corridors and one running east-west along the Oxford Street and Dundas Street corridor.

The intent of the business case is to explore the feasibility of the BRT Strategy developed as part of the TMP and provide the economic, social and environmental rationale for the City of London and senior levels of government to prioritize and fund this investment in improved mobility and related economic, social and environmental outcomes. This report provides the rationale for a sustained and ongoing commitment by the LTC and the City to the full range of initiatives which must be pursued to realize the BRT Strategy. It also explains why the residents and businesses in London should support funding the BRT investment both through the farebox (as transit users) and through their contribution to property taxes, development charges and other revenue sources available to the City.

1.2 Report Structure

This report is divided into four sections:

- Section 1 provides a brief introduction, including a description of the BRT strategy project, its objectives, why it has been proposed and related opportunities and issues.
- Section 2 describes the Multiple Account Evaluation methodology used for the business case evaluation and the technical descriptions of the two scenarios assessed: the Base Case – that is, the continuation of the current level of transit service provided in London – and the BRT Strategy.
- Section 3 presents the results of the assessment of the BRT Strategy, which are categorized into the five accounts used in this evaluation, including the benefit-cost ratio.
- Section 4 summarizes the findings of the business case.

3. The business case does not address the financial capacity of the London Transit Commission or the City of London to undertake the BRT Strategy.

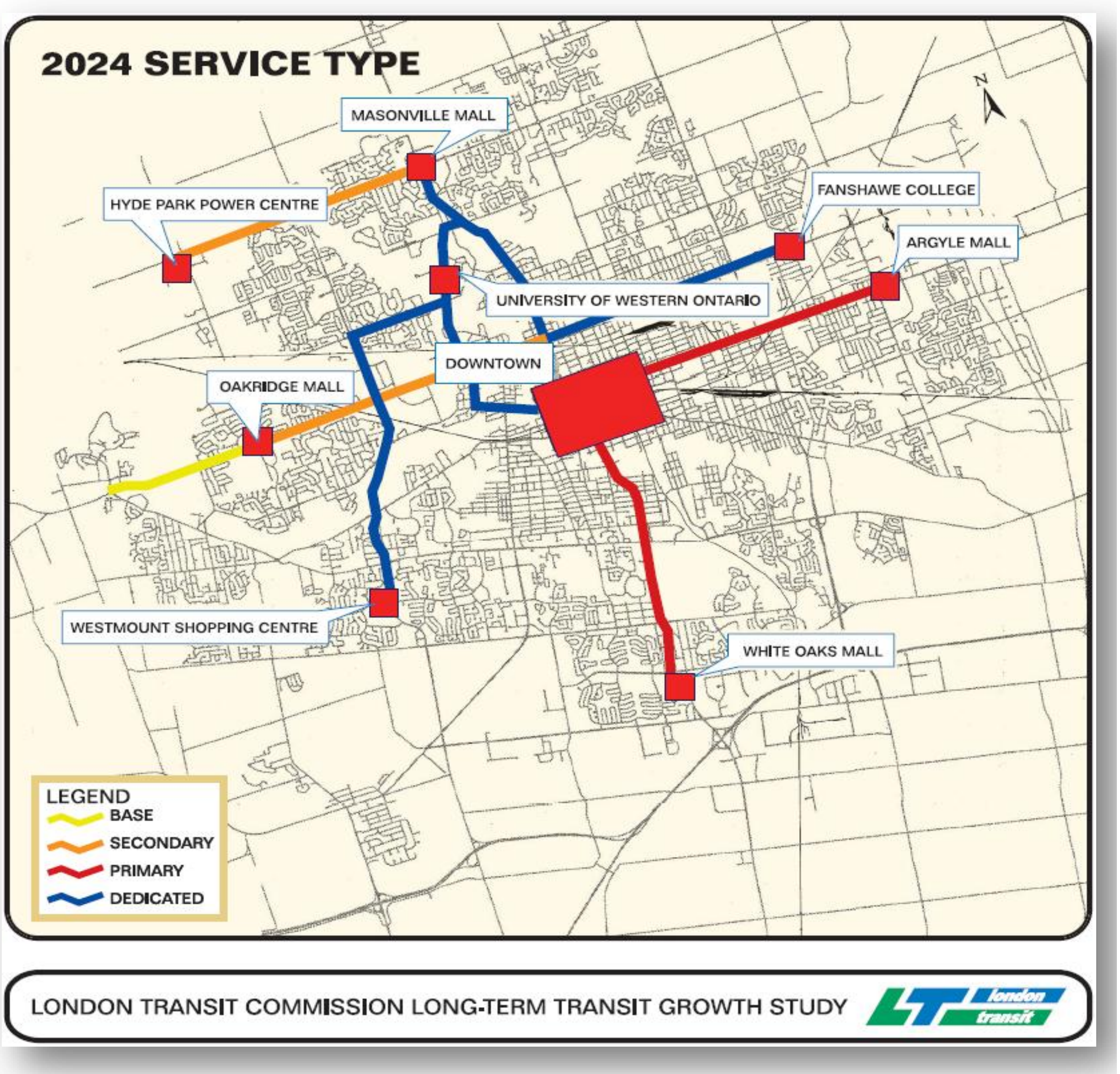
1.3 Project Rationale and Context

1.3.1 Context

1.3.1.1 London Transit Commission Long Term Transit Growth Strategy

The concept of a bus rapid transit (BRT) system in London originated with the completion of the *Long Term Transit Growth Strategy* by the London Transit Commission (LTC) in 2006. The study identified eight corridors for potential rapid transit implementation. Figure 1 shows the eight potential rapid transit corridors identified in the study.

Figure 1: Potential Rapid Transit Corridors Identified in the Long Term Transit Growth Strategy



1.3.1.2 London 2030 Transportation Master Plan

The City of London's 2030 Transportation Master Plan (TMP) was finalized recently under the title "A New Mobility Transportation Master Plan". Building on the previous TMP, the Bicycle Master Plan, and the Long Term Transit Growth Strategy, it sets out a long-term transportation strategy intended to guide the City's transportation and land use decisions to 2030 and beyond. The TMP was developed as an integrated growth management and transportation planning program. It sought to develop a transportation strategy that not only takes into account the expected population and economic growth in London over the next 20 years, but also attempts to shape that growth in terms of spatial distribution of economic and social activity and sustainable transportation outcomes.

One of the first tasks of the TMP was to identify existing travel patterns and mode choices within London. A travel survey was completed in 2009 to ascertain this information. The survey found that 63% of PM peak period trips were made by drivers, 10.5% by auto passengers, 12.5% by transit, and 8.4% by active transportation. The transit and active transportation mode shares both exceeded the 2004 shares for these modes. The observed transit mode share also exceeded the 10% transit mode share target established by the 2004 TMP. These findings indicate that the use of non-auto travel modes have been increasing in relative terms across the City of London.

To encourage a further increase in non-auto modes, the target mode shares for 2030 have been increased. The new transit mode share target is 20%, the new active transportation mode share target is 15%, and the new auto mode share target (driver and passenger) is 60% (from 73.5% today).

The TMP was developed to accommodate increased demand for mobility in London and to achieve these target mode shares. After extensive public engagement, the TMP was approved by City Council in June 2012. The final plan contains five "Smart Moves" or strategic initiatives:

1. Rethinking Growth to Support the Transportation Master Plan
2. Taking Transit to the Next Level
3. Actively Managing Transportation Demand
4. Greater Investment in Cycling and Walking Infrastructure
5. More Strategic Program of Road Network Improvements

At the heart of this "new mobility" TMP is a Bus Rapid Transit (BRT) network that provides the underpinning for Smart Move #2. This strategy would introduce two new BRT corridors in London designed to link the downtown, post-secondary institutions and key activity centres in the community. This has been aptly described as the "centres" and "corridors" approach to transportation in ReThink London's discussion paper entitled Providing Transportation Choices.[4] The BRT Strategy would also involve more frequent service on all main routes and re-structured routes to feed the BRT services. In conjunction with the BRT, Smart Move #2 would also involve broader use of technology, more fare options (including Smart Cards) and expanded use of real time information, thereby making the transit system easier to use, more attractive to potential riders and more efficient. In essence, Smart Move #2 would transform London's transit service into a more effective and sustainable network for getting people to their workplaces, schools and other destinations in the City.

Taking London transit to the 'Next Level' is closely intertwined with Smart Move #1, which is about managing future growth. The City has been growing at a historical rate of about 1% per year. When this modest growth is combined with the 22% intensification target that preceded the TMP, it was felt that this "status quo does not support rapid transit, does not support downtown growth, and is not sustainable in the longer term" (p. ES-7). In light of this finding, the TMP recommended that the City reshape the current pattern of growth to focus on intensification. This would involve locating at least 40% of future population and employment growth in the City's built-up area and

4. ReThink London is the process for updating the City's Official Plan.

further directing that growth to the downtown area and along the proposed rapid transit corridors. The introduction of higher-order transit corridors provides an essential platform for this intensification, which in turn can further support robust transit ridership on the proposed BRT corridors. The City also has a vision to grow more rapidly than in the past. The TMP land use and rapid transit plan can support the City's ambition of achieving a 2% annual growth rate, but the TMP and this business case do not rely upon these growth forecasts. If this higher growth rate were achieved, it would only accelerate the need for a higher-order transit solution.

The other Smart Moves also support the proposed BRT strategy. Investing in active transportation infrastructure supports transit by improving the experience of transit users between trip ends and transit stops. Transportation demand management programs, such as transit pass programs, can help make transit travel a more attractive mode choice. Most importantly, a more strategic road widening program has been recommended. Road widening projects that are needed to support the implementation of rapid transit have been prioritized, and road widening projects to support growth have been carefully selected so that they do not compete with or undermine the demand for rapid transit. Heavily travelled corridors such as Sarnia Road (which parallels the Oxford West BRT segment), Wharncliffe Road (which parallels the Wellington Road BRT segment), and Adelaide Street (which parallels the Richmond Street BRT segment) were all identified as operating at, or over, capacity by 2030, but widening was not recommended in the TMP. Instead, these corridors have been identified for "capacity optimization" and/or transit priority to manage delays and travel times on these routes without undermining the effectiveness of the BRT corridors. Together, these measures will encourage a modal shift toward transit by making transit more competitive with auto travel.

Several messages emerged from the public consultation process undertaken during the development of the TMP. These were summarized by the following points drawn from the TMP:

1. Many participants said they liked the plan and were happy to see that the City is "recognizing the need for improved mass transit and money for mass transit".
2. Happy with increased emphasis on intensification and transit oriented development to reduce "sprawl".
3. Many said they were very happy with emphasis on active transportation.
4. Implementation will require a change in behaviour from the public.
5. Create a mechanism to "check in" on the progress of the Transportation Master Plan as it is being implemented.
6. Mixed opinions about road widening.

Source: City of London 2030 Transportation Master Plan, Final Report, Exhibit 3, p. 1-29.

The implementation plan for the TMP calls for a business case to evaluate the proposed BRT system. Other steps toward implementing a BRT system include completion of the corridor environmental assessments for the four legs of the BRT system, development of land use plans supporting intensification, implementation of short-term transit improvement measures, planning of a long-term restructured transit network that feeds the BRT system, identification of potential park-and-ride locations within the periphery of London, and development of a transportation demand management plan to encourage increased transit usage.

1.3.1.3 ReThink London

ReThink London is an integrated master planning initiative for the City of London that is currently nearing completion. This process is uniting the five overall themes of how to live, grow, move, prosper and green London. The products of the ReThink London will be used as inputs to the new City of London Official Plan.

The theme "How We Move" is about the desired transportation strategy for London over the next 20 years. This strategy is directly linked to the analysis and recommendations completed as part of the Transportation Master Plan. As part of this theme, a discussion paper entitled "Providing Transportation Choices" was produced to summarize the transportation-related feedback received during the ReThink London process. The paper notes that the feedback received was very similar to the recommendations of the TMP. Messages heard during ReThink include:

- Improvements to public transit
- Providing more transportation options in employment areas
- Bicycle network improvements
- More desirable walking environments
- Reducing conflicts between modes, notably at-grade heavy rail crossings
- Improved transportation connections, such as a central transit hub
- Parking options
- De-emphasis of cars throughout the city

These comments align with the five Smart Moves in the TMP, which support improved transit and active transportation, limited road improvements, and land use patterns that support this shift in modal emphasis.

The ReThink London initiative is also preparing an urban structure plan that confirms the nodes and corridors targeted for intensification in London. This urban structure plan will incorporate the land use strategies (Smart Move #1) from the TMP into the overall master planning process for the City. Developing an urban structure plan is a critical component of achieving a successful transit network. Intensification within nodes and corridors will help generate transit ridership and improve the efficiency of the network. As a master planning initiative, ReThink London is attuned to the linkages between land use and transportation. These linkages aren't limited to supporting increased density within intensification areas, but extend to ensuring a mix of uses within intensification areas, developing a grid type of street network instead of "loops and lollipops", and implementing urban design that is supportive of walkable, transit-friendly communities. ReThink is also recommending strategies for continued growth in London. Supporting growth within London and accommodating at least 40% of this growth through intensification will further enhance ridership on the BRT system and the feeder transit network.

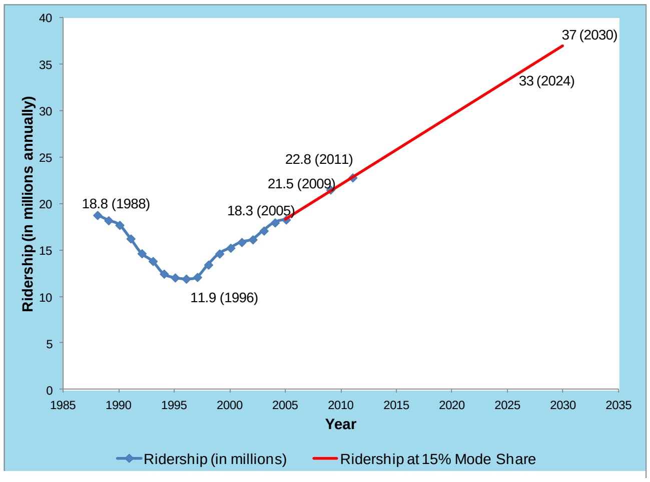
The recommended land use and transportation strategies developed during ReThink London will be used to update the Official Plan.

1.3.1.4 London Transit Ridership Trends

Transit ridership in London has experienced tremendous gains in recent years. Annual ridership has been growing since 1996, in part due to a 20% increase in transit service during the same time period. In the 2004 TMP, an aggressive transit ridership growth forecast based on a 15% mode share indicated that the City would need to accommodate 37 million riders per year by 2030 (see red line in the figure to the right). The blue data points for 2009 and 2011 refer to recent ridership data results.

From 2010 to 2012, ridership has increased by nearly 11% despite only a modest 2% increase in service hours over the same time period. This has led to a deterioration in service quality, with complaints about late schedules, missed

Transit Ridership Trends / Forecasts



Source: City of London 2030 Transportation Master Plan, Final Report, Volume 2, p. 1-4

passengers, and overcrowding increasing 55% over the past three years. This suggests that the transit network is already approaching the limits of its capacity. Since lower service quality discourages ridership, this also suggests that there is a potentially strong latent demand for transit services if service quality can be restored. On the other hand, if service quality continues to languish, it is likely to undermine continued ridership growth and the attainment of the 15% transit mode share target.

1.3.2 Project Objectives

As part of the City of London Strategic Plan 2011-2014, City Council identified five strategic outcomes to guide future planning and contribute to a continuation of the high quality of life in London. These include:

A Vibrant and Diverse Community

A Green and Growing City

A Sustainable Infrastructure

A Caring Community

A Strong Economy

While the realization of many of these objectives depends on the provision of transportation infrastructure and services, the recommendations within the TMP are primarily designed to provide Sustainable Transportation Infrastructure; support a Green and Growing City; and in doing so, support a Strong Economy. The implementation of a BRT Strategy in London provides many specific benefits that will allow the City to satisfy many of these objectives.

A well-designed BRT system makes the transit network a more attractive travel mode by achieving better travel times than traditional transit routes. It also increases neighbourhood property values and attracts future residential and business development along its path, because BRT services improve accessibility to these areas and hence their attractiveness relative to other parts of the City. In addition, a BRT service can contribute to energy conservation and reduction of greenhouse gas emissions when compared to auto travel. Finally, a BRT network can enhance the City's image and quality of life. In summary, the proposed BRT system for the City of London represents an infrastructure investment that can:

- Support economic growth and intensification of employment and residential uses in the downtown area, thereby contributing to a more vibrant, walkable and attractive city core;
- Enhance the potential for intensification of employment and residential uses along the BRT corridors and at station nodes along the corridors, thus supporting the redevelopment and revitalization of key neighbourhoods;
- Reduce the amount of additional road widening required to support future growth;
- Increase transit capacity in high-demand corridors that are already at capacity, thereby relieving existing crowded conditions and providing capacity to support future growth in a more sustainable manner;
- Improve transit travel time, and in doing so provide a more attractive alternative to auto travel within the urban built up areas, thereby improving mobility options and reducing reliance on travel by car;
- Improve the operation of the region-wide labour market through better commute options throughout the region (i.e. the BRT and feeder services), thereby ensuring that employers, including manufacturing firms on the periphery of the region, have access to a larger pool of qualified labour and that workers have access to a larger pool of jobs; and
- Slow the appropriation of land for greenfield development within the periphery of London.

As such, the BRT Strategy is about enabling the City of London to achieve its long-term objectives of economic growth through sustainable infrastructure investment. It is intended to support economic development and shape future growth to create a more attractive city-core – one which can better compete in attracting and retaining the talented and creative individuals required for a knowledge-based economy.

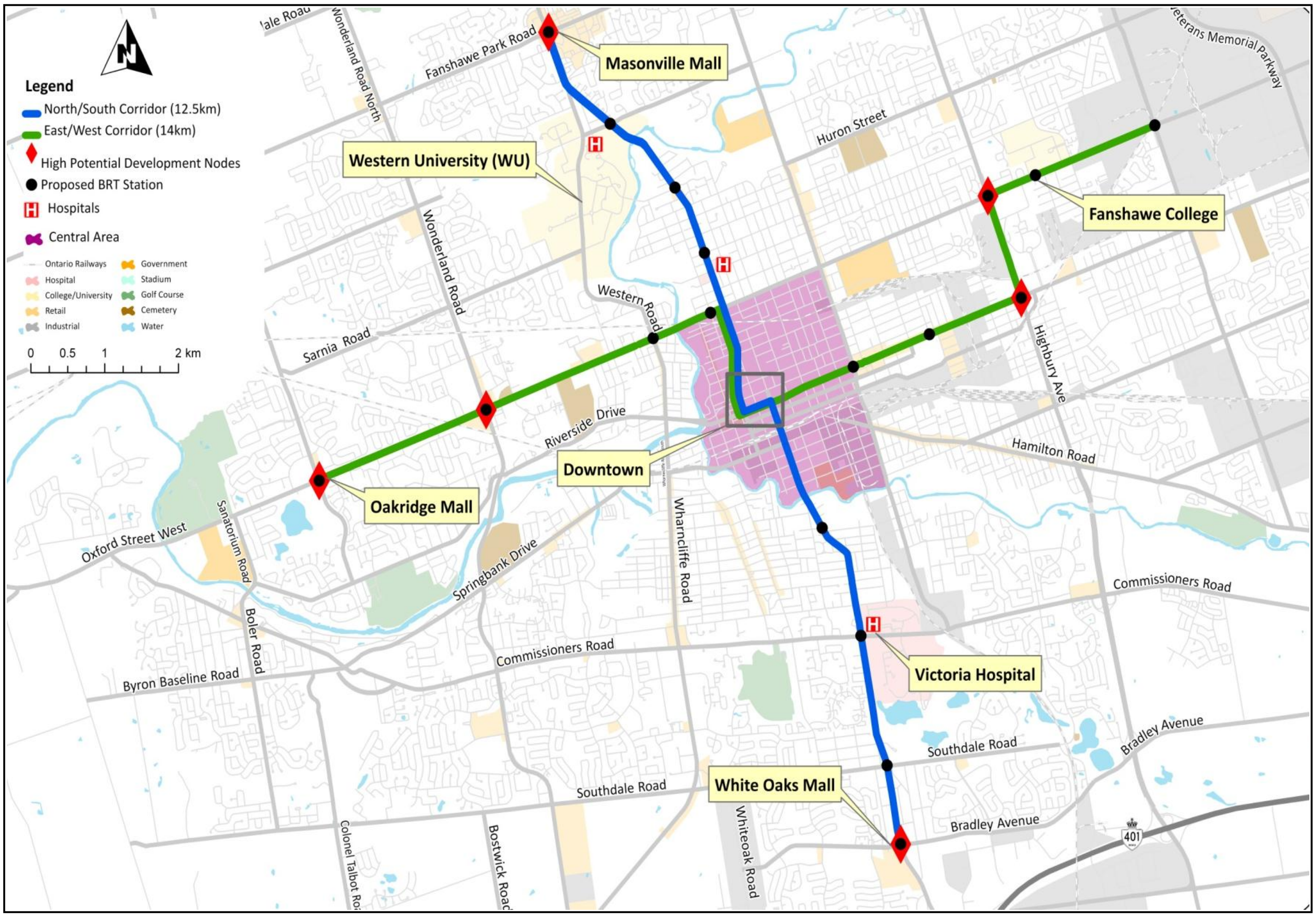
1.4 Project Overview

1.4.1 Project Description

The BRT strategy is not a single new program or project. It is a fundamentally different way of approaching urban transportation in London. The BRT strategy includes both new infrastructure and service improvements that would transform how public transit services are delivered in London. The two main components to the strategy are:

BRT Network: The BRT network consists of two corridors, one north-south and one east-west, intersecting within the downtown area. These corridors incorporate the best performing segments from five of the eight corridors identified in the Long Term Transit Growth Strategy. The preferred BRT corridors and proposed station locations are shown in Figure 2.

Figure 2: Preferred BRT Corridors with Proposed Stations



Source: City of London 2030 Transportation Master Plan, Final Report, Volume 2, p. 3-3

At full implementation, the BRT network will improve travel time performance, increase the passenger capacity of the transit network and improve the quality of service for transit passengers. This will be achieved through several characteristics that differentiate BRT from other, local bus services:

Frequent Service: .... There will be sufficiently frequent service along both corridors during LTC's daily span of service, allowing riders to use the BRT without needing to consult a schedule.

Limited Stations:.................. BRT services will only stop at major intersections or other nodes (typical station spacing of about 1 km), thereby increasing average bus speeds and reducing in-vehicle travel time.

Priority Over Auto Traffic:.... BRT services will generally use reserved bus lanes that are closed to other vehicles. In the interim and in highly-constrained areas, BRT services may use semi-exclusive high-occupancy vehicle lanes instead of reserved bus lanes. Intersections will be equipped with transit signal priority and queue jump lanes in certain locations that will allow buses to bypass queues, reducing travel time and delays.

Distinct Buses:...................... BRT services will use higher-capacity, articulated buses that are branded to differentiate them and the BRT service from local services and provide improved customer amenities.

Enhanced Stations: .... Instead of standard bus stops with a small or no shelter on the side of the road, the BRT network will incorporate stations with larger, more prominent waiting areas, larger shelters, seating, and potentially an enclosed waiting area. Stations may be adjacent to the curb or in the median, depending on where buses operate on the road.

<u>Enhanced Local (Feeder) Service:</u> The frequency of local bus services will be increased to further support increased ridership on the BRT routes. Increasing the frequency of local bus routes will provide better service to neighbourhoods that are not adjacent to the BRT corridors. It will also transform the transit network into a feeder-trunk structure, with local routes feeding the trunk BRT corridors and increasing potential ridership on the BRT corridors and through the network.

As the BRT services are phased in, there is likely to be an opportunity to restructure the local route network – including schedules and routing – to better connect with and serve the BRT corridors. Many of the current routes are focused on providing service to the downtown. The implementation of BRT services will allow local bus services to be restructured to cross and interconnect with the BRT corridors. Riders to downtown could transfer from the local route to the BRT, thereby increasing BRT ridership while providing "crosstown" service along corridors perpendicular to the BRT. This would improve the attractiveness of travel by public transit relative to auto travel even for trips which do not begin or end in the downtown core.

The combination of the BRT network and the enhanced local feeder service would represent a transformation of London's entire transit network. This would mean improved transit commuting times not only in the downtown core, but across the whole city. It would also mean a more integrated labour market in the City of London and surrounding areas where employees depend at least in part on public transit to get to work. Hence, employers, including those in peripheral areas, would obtain access to a wider geographic pool of qualified labour; and job seekers would obtain access to wider geographic selection of available vacancies.

1.4.2 Opportunities and Issues

The BRT strategy provides an opportunity to improve travel time by transit and thereby also provides improved travel choices for auto users in London. These BRT Strategy opportunities benefit certain neighbourhoods and institutions in London, but they also alleviate the overcrowding of the transit network, thereby supporting improved quality of service for the entire network.

1.4.2.1 Alleviation of System Crowding and Service Degradation

LTC has been successful in attracting increased transit ridership year-over-year for several years. Between 2010 and 2012, system-wide ridership increased by nearly 11%. Over the ten-year period from 2002 to 2012, system-wide ridership increased by 45%, according to the 2013 Conventional Service Plan. For much of this period, the ridership growth was accommodated primarily by existing spare capacity on buses. Specifically, bus service hours grew by only 12% during the 2002-12 period. In other words, ridership has grown at almost four times the rate of increase in the capacity of the LTC transit network (i.e., 45% vs. 12%).

At this point, there is little spare capacity left on current bus services. Buses are now routinely experiencing crush-load conditions at many times of day on many routes.

Table 1 summarizes system-wide capacity utilization during six weekday time periods.

Table 1. Weekday System Average – Capacity Summary per Revenue Service Hour

LTC Weekday System Average - Capacity Summary per Revenue Service Hour			
Time Period	**Seated Capacity**	**Boardings (persons)**	**Boardings as % of Seated Capacity**
Early AM (6AM to 7 AM)	37.3	27.5	74%
Peak AM (7AM to 9 AM)	38.1	49.2	129%
Peak PM (2 PM to 6 PM)	38.4	66.6	173%
Base (9AM to 2PM)	38.1	60.1	158%
Early Evening (6PM to 9 PM)	38.6	63.4	164%
Late Evening (9PM to 12 PM)	37.5	46.8	125%
System average for weekday	**38.2**	**58.1**	**152%**

Notes: Seated capacity and actual load refer to number of persons.
Source: London Transit Commission (LTC) 2012 Annual Service Report,p.3.

It is evident that, other than during the early morning period, buses routinely operate with standing loads. In particular, from the midday through to the early evening, buses have average passenger loads exceeding 60 passengers per bus. These crowded conditions have resulted in a deterioration of the quality of service as reflected in large increases in passenger complaints through 2012 and into 2013, many of them about overcrowding and about buses passing by stops (and passengers unable to board) because the buses are at capacity. Moreover, there is little or no room to increase service frequencies on the busiest routes, because buses are already operating at 5-minute intervals although these are from different bus routes using the same road corridor.

It follows that further increases in transit ridership in London can only be achieved through a major expansion of transit service capacity. The existing system cannot handle any more ridership, whether it is due to population growth or a mode shift from autos. In fact, further population growth will result in continued service degradation and in further suppression of transit ridership demand. Implementation of the BRT Strategy, with high-capacity, high-frequency service along the main corridors leading to/from downtown, combined with restructured and enhanced feeder services throughout the city, would substantially increase the capacity of the transit network, restore service quality and restore the suppressed demand for transit. This increased capacity would be able to accommodate further increases in ridership through to 2030.

It is also worth noting that a BRT Strategy can improve service quality without necessarily increasing the size of the bus fleet. By providing faster service between destinations, a BRT service can achieve higher frequency (or shorter wait times between buses) with the same number of buses and service hours. The higher frequency also represents an increase in network capacity.

1.4.2.2 Growth Management

Over the last several decades, London has grown into a mid-sized city with a steady growth rate of about 1% per year. This growth has occurred primarily as suburban, auto-oriented development in greenfield areas at the periphery of London, although there has been a more recent trend towards redevelopment and intensification within the downtown and other existing built up areas. Despite this, the long term growth forecasts used in the previous TMP featured a continuation of the greenfield growth pattern, with only 22% of future growth accommodated through intensification. The City's historical transportation investments have been made in response to suburban growth pressures and these investments have primarily been new or widened roads in the outer neighbourhoods of London. The road expansion in the periphery has supported further peripheral growth, continuing the cycle of low-density urban sprawl.

The transit system, though successful in attracting ridership over the last several years, has not expanded at a rate keeping up with ridership growth. As a result, the transit service has been concentrated in established corridors at the expense of lower density suburban areas. The limited expansion of transit discouraged intensification in these areas. Car travel is still perceived as the essential mode of transportation in London. This makes infill development more challenging because of the need to provide additional parking, which often takes the form of more costly structured parking (i.e., parking in underground or multi-storey facilities).

As part of the TMP process, Council moved to support a greater level of intensification. The recommended land use plan proposed a balanced approach to growth and was formulated to reflect many of the growth management policies developed in the award-winning provincial policy document, *Places to Grow: Growth Plan for the* Greater Golden Horseshoe. The plan targets a 40% intensification rate, meaning that 40 percent of all additional urban growth in the City would be directed to *urbanized areas* within the existing built envelope, with the balance developed in new settlement areas on the urban fringe. Within the *urbanized area,* the projected growth was distributed between the *downtown* (37.5%), *transit nodes and bus rapid transit (BRT) corridors* (37.5%), and the *rest of the urban area* (25%). In addition, employment growth is also considered, with 52% of jobs directed toward the *urbanized* area and 48% of jobs directed toward the *fringe areas*. Allocation of employment growth within the *urbanized area* is distributed between the downtown (27%), Western University (WU) / London Health Sciences (LHS) – university campus (9%), LHS (Victoria Campus) (9%), remaining nodes and corridors (28%), and the rest of the urban area (27%).

Transit services play an important role in support of the realization of the intensification targets above. A sufficient level of transit services and walking and cycling infrastructure are required in the appropriate areas in order to provide meaningful transportation choices and thereby reduce car dependency. The increased attractiveness of non-auto modes supports the growth of these more sustainable modes, reduces auto demand and reduces requirements for building parking spaces with infill development.

Road corridors in many of these areas have limited right-of-way widths and cannot be expanded. Improving transit allows these corridors to accommodate higher levels of travel demand while improving the allocation of available road space to better serve all modes of travel. Providing higher-order transit within specific corridors creates an even more attractive service in these areas and provides a platform upon which to focus intensification, creating higher-density nodes and corridors.

1.4.2.3 Downtown London

Downtown London is one of the areas in which intensification is planned to occur. The downtown area already contains a concentration of employment and is the hub of the existing bus system, with 70% of the bus routes converging into the area. Despite the existing concentration of employment, there are many surface parking lots or other vacant lots in the downtown, which are ripe for redevelopment opportunities. Moreover, the City is finalizing a Downtown Parking Strategy covering both short and long-term parking. The parking strategy is expected to include pricing initiatives, which can further support the attractiveness of transit relative to autos.

As noted in the previous section, many of the streets in the downtown area have constrained rights-of-way that are unlikely to be expanded. These constraints limit the ability to expand streets to accommodate transit. Therefore, there are two options for accommodating transit:

- Run buses in mixed traffic: This is the current option in London. Buses use general-purpose lanes and are impacted by any auto congestion that occurs.
- Convert existing lanes to exclusive or semi-exclusive transit lanes: This option rededicates existing road space to transit, either by creating exclusive bus lanes or semi-exclusive high-occupancy vehicle lanes. Converting lanes increases the person-carrying capacity of the corridor and improves transit travel times, but converting existing auto lanes, used for either travel or parking, may also increase road congestion on the remaining general-purpose lanes.

Converting auto lanes to transit is preferred when encouraging transit or implementing higher-order transit. The BRT strategy calls for a mixture of road widening to support BRT and converting existing auto lanes to semi-exclusive or exclusive transit lanes where the right of way width is constrained. However, the exact arrangement for incorporating the BRT within the existing street rights-of-way will be determined as part of a future environmental assessment.

Another issue for the BRT network in the downtown area is the exact alignment of the BRT route. Appendix C of the TMP performed an initial evaluation of six alignment options within the downtown. More recently, the Downtown Master Plan, which is currently being finalized, proposed a draft routing through the downtown core for both the North/South and the East/West BRT services. The draft routing is consistent with the direction set in the TMP and is expected to be refined under the final version of the Downtown Master Plan. The routing of the BRT service may also require a re-routing of some of the 19 regular scheduled services which currently operate in the downtown.

1.4.2.4 Post-Secondary Institutions

London has two major post-secondary institutions: Western University and Fanshawe College. Combined, these two institutions have more than 40,000 full-time students. These students comprise a substantial portion of the existing LTC ridership, due in large part to the Tuition-Pass program which incorporates the cost of transit passes into every student's tuition fees. The recent growth of Western and Fanshawe has driven much of the recent ridership growth on LTC. Outside of downtown, these two schools are the largest generators of transit demand in London. As these two schools continue to grow, transportation demand generated by them will also grow, stressing the existing transit system further.

A large student population is a valuable asset when improving transit service. Students are more likely to choose transit due to their lower income status. Also, travel demand destinations are concentrated at the post-secondary institutions. Concentrated travel demand is easier and more economical to serve with transit than dispersed travel demand.

Fanshawe College is located on Oxford Street East, east of Highbury Avenue. The east leg of the BRT network is proposed to run along this portion of Oxford Street. The orientation of Fanshawe facilitates the BRT: its buildings are located adjacent to Oxford Street and only extend up to 400 metres away from Oxford Street. This puts all of Fanshawe within a short walking distance of Oxford Street. One of the potential BRT station locations is on Oxford Street adjacent to Fanshawe College (potentially at Fanshawe College Boulevard). This station would be within a short walking distance of the Fanshawe campus, thus serving Fanshawe well. In the fall of 2013, Fanshawe is expected to locate one of its schools (performing arts) to the downtown area, thereby leading to the migration of some student trips to that area.

The Western University campus is located on Western Road southwest of Richmond Street. Unlike Fanshawe College, which is adjacent to the BRT corridor, Western University is between 500 and 1500 metres from Richmond Street, along which the north leg of the BRT is proposed to run. Further, the Thames River runs between the campus and Richmond Street, creating a barrier between the campus and the proposed BRT.

At the Western University campus location, the BRT route along Richmond Street would require students accessing the campus to disembark at the University Drive stop and either walk into the campus (over 1 km distance) or board one of the existing routes that turn onto University Drive to access the main campus buildings on the west side of the river. Yet, current LTC bus routes 13 (Wellington) and 6 (Richmond) both offer direct access to the campus building on the west side of the river. Hence, the proposed BRT service may not attract much additional ridership unless the BRT service is re-routed through the campus.

1.4.2.5 London Health Sciences Centre (Victoria Campus)

The Victoria Campus of the London Health Sciences Centre is a large hospital complex in the southern part of London. It is on the east side of Wellington Road, which is where the proposed south leg of the BRT will run. A BRT station has been proposed for the intersection of Wellington Road and Commissioners Road, which is at the southwestern corner of the hospital site. From the intersection to the closest building within the hospital complex the walk distance is approximately 250 m or a three minute walk, but this increases to almost 10 minutes to access the main hospital buildings further to the east.

There are two existing transit routes that enter the hospital site; LTC bus route 6 (Richmond) enters the site via Baseline Road, and Route 24 (Baseline) enters via Baseline Road and Commissioners Road. Opportunities to route the BRT through this complex may increase the attractiveness to serve this key transit generator and may allow for transfers between the three routes as well. This diversion can be investigated further as part of an environmental assessment.

2. Evaluation Approach

2.1 The Multiple Account Evaluation Approach

The methodology used in this business case for the London Bus Rapid Transit (BRT) strategy is based on a Multiple Account Evaluation (MAE) approach. The MAE approach examines costs and benefits of the BRT strategy relative to a base case scenario in both quantitative and qualitative terms.

The MAE approach represents the tool of choice for building business cases for rapid transit investments. This is because it provides considerable flexibility in building a comprehensive business case, while maintaining the rigorous standards recognized in the transportation economics community. This flexibility is exhibited in two important ways. First, the MAE approach provides the analytical tools to test whether there is a clear basis to proceed with the funding and implementation of the BRT strategy from a public sector perspective, which in this case means the London Transit Commission, the City of London and senior-level government funders. These analytical tools consist of comparing the additional financial costs (i.e. capital and operating costs) arising from the BRT Strategy against the incremental transportation user benefits and environmental benefits associated with the BRT Strategy. The results are summarized in the form of a net present value figure, an economic rate of return or a benefit-cost ratio. For example, a project with a benefit-cost ratio greater than one can claim to create economic value for the users and the community, while a project that does not achieve that threshold destroys economic value. However, this litmus test is based only on the costs and benefits that can be quantified and monetized, such as capital and operating costs and those transportation user benefits and environmental benefits which can be monetized (i.e. quantified benefits converted to monetary values). In this respect, it can be considered a conservative or narrow economic test of the viability of a project.

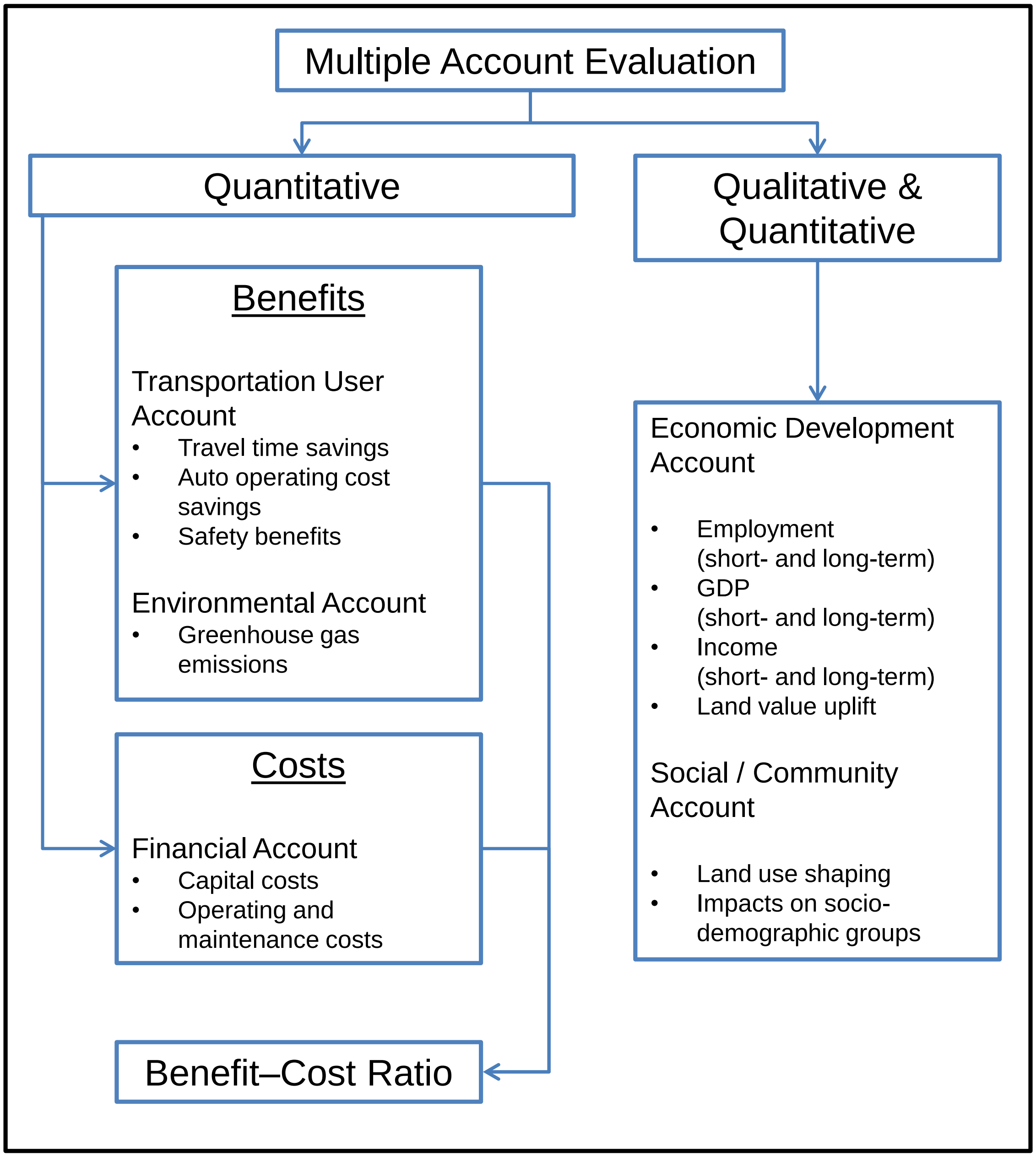
Second, the MAE approach provides a way of considering other economic costs and benefits which are not included in the narrow economic test. This refers to economic costs and benefits that cannot be quantified and monetized (e.g. improved reliability, or social and community impacts); or to economic impacts which are not strictly incremental relative to the base case (i.e. incremental impacts are lost if the project does not proceed) and hence cannot be added to the other monetized costs and benefits. This is achieved by categorizing the costs and benefits into five separate accounts, thereby providing the basis for a comprehensive review of the costs and benefits. However, it does not necessarily provide a decisive pass/fail test for projects, because the results from some of the accounts are not directly comparable to others (e.g. dollar impacts of the economic development account cannot be added to the transportation and environmental accounts due to potential double-counting of benefits).

The MAE approach is used extensively across public transit agencies in Canada, albeit with some variations. It is used for project justification by Metrolinx, the Agence métropolitaine de Transport (the regional transit agency for Montreal) and many municipalities, including Ottawa and Waterloo in their respective Light Rail Transit (LRT) projects.

The MAE approach in this business case considers five separate accounts. Each type of benefit and cost has been allocated into one of the five accounts. This allocation is used because the different types of benefits and costs are not necessarily additive or directly comparable. Grouping additive or comparable benefits and costs into accounts results in a clearer, more rigorous business case. The five accounts and their relationship to each other in this business case are shown in **Figure 3**.

As shown in **Figure 3**, the benefit-cost ratio (or alternatively, the net present value or economic return from a project) is based only on the costs and benefits included in the financial account, the transportation user account and the environmental account. The benefits include travel time savings for both existing transit riders, new riders and motorists who switch to transit (using a dollar value of time factor), auto operating cost savings for motorists who switch to transit, safety benefits from fewer road collisions as a result of fewer vehicle kilometres driven, and environmental benefits as a result of fewer vehicle kilometres driven. The costs include capital expenditures for the BRT infrastructure and additional buses plus operating costs for both BRT services and enhanced local feeder services. Benefits and costs are calculated over a 30 year horizon from the potential start date for the BRT service (2020) through to 2049. Since of the capital spending must take place before the 2020 start date, but this is included in the analysis.

Figure 3: Components of the Multiple Account Evaluation Approach



The Economic Development and Social and Community accounts are assessed separately from cost-benefit analysis. These accounts include qualitative factors such as ability to shape land use and impacts on socio-demographic groups. They also include quantitative factors, such as land value uplift, change in short-term and long-term employment, and change in short-term and long-term GDP. The latter factors are not included in the benefit-cost assessment because they are not necessarily incremental and because they likely overlap with the transportation user benefits.

2.2 The Base Case Scenario

The Base Case Scenario represents a continuation of the transportation strategy that has led to the current configuration of the public transit and roads network in London. Population and employment continue to grow through to 2030, the year for which the transportation modelling results are derived for both the transit and the road networks in London. The population and employment growth estimates used in the Base Case are the same as those used for the BRT Strategy and for Scenario 2 of the TMP. The estimates assume a population growth rate of 1% per year, with 40% of all growth occurring as intensification. These estimates are summarized in **Table 2**.

Table 2: Population and Employment Figures in the Base Case

City Population	2009	2030	Change from 2009 to 2030	CAGR
0-19	88,826	87,318	(1,508)	-0.1%
20-44	133,171	144,248	11,077	0.4%
45-64	93,556	100,667	7,111	0.3%
65+	46,578	97,320	50,742	3.6%
Total	**362,131**	**429,553**	**67,422**	**0.8%**

City Employment	2009	2030	Change from 2009 to 2030	CAGR
Industrial	32,943	45,515	12,572	1.6%
Institutional	32,386	41,078	8,692	1.1%
Commercial	123,588	141,671	18,083	0.7%
Total	**188,917**	**228,264**	**39,347**	**0.9%**

PM Peak Period Travel Demand	2009	2030	Change from 2009 to 2030	CAGR
Work Trips	131,715	154,432	22,717	0.8%
Discretionary Trips	36,838	47,529	10,691	1.2%
School Trips	27,446	31,014	3,568	0.6%
Total	**195,999**	**232,975**	**36,976**	**0.8%**

Note: CAGR = Compound Annual Growth Rate

The Base Case assumes the continuation of a road-oriented transportation strategy combined with a transit network at capacity. Auto travel would continue to be the dominant mode of travel within London. Therefore, a program of road widenings would be required to support the additional travel demand. As for the transit network, it would continue to operate at capacity as it does today, but it would have to cope with higher ridership due to population and employment growth. This would result in a continued deterioration of service quality.

It is important to note that the results of the transit modelling for the Base Case do not show the deterioration in service quality. These results also overestimate actual ridership results in the Base Case because the transit component of the transportation model is not capacity-constrained.[5] Given that transit ridership is already at

5. *This reflects the typical structure of transportation network models, including the Greater Golden Horseshoe GGH model.*

capacity in London, this suggests that the transit ridership results for the Base Case are optimistic.[6] The road network is capacity-constrained in the transportation model, which means that delays tend to increase as traffic volumes increase (if road capacity remains unchanged). However, the transit network in the transportation model is **un**constrained, which means that the model does not take into account actual transit network capacity. Nor does it take into account the feedback effect of in-vehicle crowding and other transit service degradation in discouraging transit use. As passenger loads rise in excess of seated capacity on a vehicle, crowded conditions will tend to prevail, with an adverse effect on customer experience. When buses are sufficiently crowded, they are unable to board new passengers, leaving passengers on the curb to wait for the next bus. These conditions tend to suppress transit demand and create what is known as a latent demand for transit.

2.2.1 Key Features and Costs of the Base Case Scenario

In practice, the Base Case Scenario will be characterized by the two following key features:

- All road widenings recommended in the TMP will be implemented, but not the road widenings required for the BRT Strategy
- The London transit network will continue to operate as a local bus network much as it does today, but with a continued “business-as-usual” increase in bus fleet size in order to address continued ridership and network growth

These features suggest that the base case will not be a zero-cost option relative to today. This is not only due to the road widenings that will continue under the Base Case, but also to the continued bus fleet expansion of approximately 3 additional regular buses per year for the first decade of the evaluation horizon (2020-29). The capital costs incurred for bus fleet expansion under the Base Case would be approximately $35 million in 2012 dollars. It is important to note that under the BRT Strategy Scenario these capital costs and the associated operating costs would go toward the BRT program (e.g., the capital spending could go instead toward articulated buses instead).

Other costs are not captured formally in the Base Case Scenario include the costs associated with the deterioration in service quality. Despite the continued increase in fleet size under the Base Case, this would not be sufficient to fully address the additional ridership for a transit network that this already operating at capacity at peak times. Buses on many routes today are already crush-loaded through at peak times and are unable to accommodate any more passengers. At some stops, users are left at the curb and forced to wait longer for another bus. It is not possible for the existing level of service to accommodate employment and population growth in London, let alone any additional mode shift to transit as a result of increased auto operating costs and road congestion. Incremental additions to transit service under the Base Case may partially alleviate crowding along certain routes during certain time periods, but these will be insufficient to address the capacity constraints in the network. As a result, the quality of the transit service would continue to deteriorate under the Base Case Scenario. This would have the effect of suppressing some of the transit ridership demand under the Base Case or shifting some of that demand back to auto travel.

2.3 The BRT Scenario

The BRT Scenario (or BRT Strategy) represents a transformation of the London transit network. It would include the introduction of bus rapid transit (BRT) along two corridors as well as enhanced local feeder services to support BRT ridership, as recommended in the TMP. The two corridors are:

6. *It follows that the model may underestimate the additional transit ridership due to the BRT Strategy, because it does not recognize the latent demand for transit when the transit network is operating at or in excess of available seat capacity.*

Dundas–Oxford: This east-west corridor begins in the west at Hyde Park Road and continues east along Oxford Street and Richmond Street into downtown; then continues along Dundas Street, Highbury Avenue, and Oxford Street, ending at Clarke Road in the east.

Wellington–Richmond: This north-south corridor begins in the south at Bradley Avenue and continues north along Wellington Road into downtown, then continues along Richmond Street, ending at Fanshawe Park Road in the north.

BRT stations were assumed at the following locations (exact station locations to be confirmed in an environmental assessment):

Dundas–Oxford (East–West) Corridor	Wellington–Richmond (North–South) Corridor
▸ Hyde Park Road	▸ Fanshawe Park Road
▸ Wonderland Road	▸ Windermere Road
▸ Wharncliffe Road / Western Road	▸ University Drive
▸ Richmond Street (at Oxford Street)	▸ Cheapside Street
▸ Dufferin Avenue	▸ Oxford Street
▸ Downtown / Train Station	▸ Dufferin Avenue
▸ Waterloo Street	▸ Downtown / Train Station
▸ Adelaide Street	▸ Alexandra Street
▸ Quebec Street	▸ Commissioners Road
▸ Highbury Avenue (at Dundas Street)	▸ Southdale Road
▸ Highbury Avenue (at Oxford Street)	▸ Bradley Avenue
▸ Fanshawe College	
▸ Clarke Road	

The population and employment estimates and distribution assumed in the BRT Scenario are identical to those in the Base Case.

The road network in the BRT Scenario is similar to the road network in the Base Case; all of the road widenings recommended in the TMP are included in the BRT Scenario. The only difference in the road network between the Base Case and the BRT Scenario are the road widenings along the proposed BRT corridors. The additional lanes along these segments were designated as reserved bus lanes for transit use only instead of general-purpose lanes. Through the downtown area, as noted above, existing curb lanes in constrained areas were restricted to Bus Only lanes (for modeling purposes), thereby resulting in less capacity for auto traffic.

The transit network in the BRT Scenario entails many changes relative to the transit network in the Base Case. The two BRT corridors defined above were modelled as new bus routes overlaid onto the existing transit network. The peak period frequencies for these routes were modelled at five minutes. Supporting the BRT routes are the existing local bus routes, which can serve as a feeder network for the BRT service. No changes were made to the routing of the existing local bus routes. However, the headways on all of the local routes were improved to either 15 minutes or 20 minutes – relative to existing headways which are mainly 30 minutes. This “enhanced feeder service” improves transit connectivity between the BRT corridors and neighbourhoods further away from the BRT, improving the level of mobility provided by the transit network and increasing ridership along the BRT corridors. The enhanced service is provided during weekday peak periods (2 hours in the AM, 4 hours in the PM) only. To provide the additional feeder service, 40 conventional buses are required or 48 buses including spares. In total, it is estimated that the enhanced service requires approximately 60,000 additional service hours per year (see Table A1-2 in Appendix 1).

A high-level operating plan for the BRT routes was also developed to determine the number of service hours and fleet requirements for the BRT network (see Appendix 1). The BRT routes will be operated with articulated buses with an assumed maximum capacity of 110 persons per vehicle. At five-minute headways, there would be a frequency of 12 buses per hour on both of the BRT routes. This frequency results in a capacity of 1,320 persons per hour per direction (pphpd). Modelling of the BRT Scenario indicates that the westbound peak-point ridership during the PM peak hour on the Dundas–Oxford BRT corridor will exceed 1,320 pphpd. As a result, an additional two buses per hour are required to accommodate the extra demand. Therefore, the Dundas–Oxford BRT would operate at a headway of a little more than four minutes with a capacity of 1,540 pphpd.

The BRT network will operate seven days per week. Weekday peak service will be either every four minutes (Dundas–Oxford) or every five minutes (Wellington–Richmond). Midday weekday service will be every ten minutes. The minimum level of service that will be provided is a bus every 20 minutes. To provide the peak service, 31 articulated buses will be required, or 37 buses including spares. In total, it is estimated that the BRT service will require approximately 92,000 additional service hours per year. Details of the high-level operating plan are provided in Appendix 1.

Table 3 summarizes the headway, capacity, bus requirements, travel time characteristics and additional hours of service for the two BRT routes and the enhanced feeder service. The capacity, bus requirements and hours of service are all additional (or incremental) to the Base Case scenario.

Table 3: Summary of BRT Scenario

Criteria	Wellington – Richmond BRT (North–South)	Dundas – Oxford BRT (East–West)	Enhanced Feeder Service
Headway	5 min	4 min	15 to 20 min
Capacity (pphpd)	1,320	1,540	165 to 220
Buses (including spares)	14	23	48
Travel Time (roundtrip)	53 min (including 5 min layover)	66 min (including 6 min layover)	Varies
Additional Hours of Service (per year)	92,000 (combined)		60,000

Note: pphpd = Persons per hour per direction.

3. Assessment and Key Findings

3.1 Transportation User Benefits Account

The Transportation User Benefits Account compiles the benefits that the BRT strategy provides to transportation users. These benefits include travel time savings for both transit users and road users, auto operating cost savings, and safety benefits. These quantitative benefits are incorporated into the benefit-cost assessment portion of the overall evaluation. In addition, there are qualitative benefits that are included in this account but are not included in the quantitative benefit-cost assessment, such as the quality of service experienced by users.

3.1.1 Travel Time Savings

Travel time savings under the BRT Strategy are due to the improved transit services and the associated new transit infrastructure. These savings accrue to two user groups: users who would use transit, even without the BRT Strategy, and new transit riders who are attracted to the service as a result of the improved travel time.

Users who would use transit, even without the BRT strategy, achieve travel time savings through the higher travel speeds provided by the signal priority and reserved lanes provided along the BRT corridors, as well as the higher bus frequencies on both BRT and feeder services. These travel time savings were calculated based on network model outputs for all transit users for the year 2030. The average travel time savings for each existing transit rider amounts to more than seven minutes per peak hour trip, as shown in Table 4 below. Monetized for all transit trips over a year, the travel time savings for transit riders are in excess of $50 million per year, based on a value of time of $13.60 in 2012 currency and growing at 0.5% per year in real terms. (See Appendix 4 for an elaboration of assumptions and data sources.)

It should be noted that in the Base Case, the transit network would be unable to accommodate fully the projected demand, since the transit network has already reached capacity at peak periods. Passengers would increasingly have to wait for multiple buses before being able to embark on a bus. Also, bus travel speeds would likely to decrease due to the increased dwell times at stops caused by passengers trying to get on and off the bus. Therefore, the Base Case would actually sustain a further degradation of service which is not reflected in the modelling results. For this reason, the introduction of the BRT Strategy would bring a large improvement in the quality of service, especially for peak period users. This qualitative user benefit is discussed further below and recognized in Table 5 below as having very positive impacts.

Table 4: Selected Travel Time Savings Impacts

Criteria	Base Case Scenario (2030)	BRT Strategy (2030)
Average Transit Travel Time (min./trip)	63.1	55.6
Total Auto Travel Time, incl. passengers (hours per day)	76,900	75,300

As a result of the BRT implementation, approximately 1,600 new transit users are generated in the peak hour, which in turn reduces auto demand, expressed as auto travel time. Table 4 shows that total auto travel time would drop by about 1600 hours per day under the BRT Strategy. While this is a substantial reduction in driving, it represents only 2% of the demand for auto travel in the Base Case. As a result, the reduction in driving has only modest effects on road congestion. The travel time savings for auto users – calculated using the network model outputs –would be approximately $7.5 million per year in 2030.

3.1.2 Auto Operating Cost Savings

The reduction in vehicle-kilometres travelled due to the mode shift to transit created by the BRT Strategy results in auto operating cost savings. This reduction in auto travel amounts to 19.7 million vehicle kilometers in 2030 and is measured using the transportation network model outputs. An operating cost per kilometre of $0.17 was used to estimate the cost savings, based only on auto operating costs, such as fuel, maintenance and tire use for a mid-size vehicle. It does not take into account any reduction in vehicle ownership costs. The savings in auto operating costs are approximately $4.7 million for the year 2030.

3.1.3 Safety Benefits

The reduction in vehicle-kilometres travelled in the BRT Strategy, compared to the Base Case, also results in safety benefits. These safety benefits are a result of fewer collisions, injuries and deaths. A factor for safety benefits per kilometre was applied ($0.08 per vehicle kilometre saved) to the 19.7 million fewer vehicle kilometres travelled, resulting in safety benefits of approximately $1.5 million in 2030.

3.1.4 Qualitative Impacts

Implementation of the BRT Strategy will provide qualitative benefits to transit users that are not included in the quantitative benefit-cost assessment. The most important benefit is that the transit network would have much more capacity and greater reliability than under the Base Case, particularly on the key high-demand corridors emanating from downtown. Existing services have reached capacity on many routes in many time periods, creating crush-loaded conditions on buses during peak periods which often results in the need to leave users waiting on the curb. Providing increased capacity on the network will reduce crowding on buses and improve the quality of service and passenger comfort substantially.

Another qualitative benefit provided by the BRT strategy is the introduction of all-day frequent service on the BRT corridors. Though many of the benefits (i.e. ridership gains) of high-frequency peak service are captured in the modelling, some are not. All-day frequent service, when provided and communicated to passengers, provides reassurance to riders. Riders know that, regardless of the time of day, they can go to the bus stop and not have to wait more than a certain amount of time before their bus arrives. Riders know that if they have to leave work early, stay at school late, or run an unplanned errand, the transit service will be available for them. When frequent service is provided, riders no longer need to consult a schedule, which increases customer convenience. The perception that one has to schedule their life around transit is reduced or eliminated once high-quality, frequent service is introduced.

There are also social equity benefits that can be derived through more efficient transit service that reduces travel times on a city-wide basis. Lower income residents, who rely on the transit system as their primary mode of travel, can be challenged in terms of seeking and finding housing or employment opportunities in areas that require long transit trips across the City to reach their destinations. A fast and convenient rapid transit spine that runs north-south and east-west across the City can open up a number of new opportunities for captive riders to access housing, services, and employment opportunities in areas of the city that were difficult or time consuming to access without the BRT service in place.

3.1.5 Summary

The majority of transportation user benefits are accrued as travel time benefits. **Table** 5 shows a summary of the accumulated transportation user benefits.

Table 5: Transportation User Benefits Account Summary

Criteria	Value of Benefits (2012 $ M) – BRT Strategy (2030)
Travel Time Savings	60.9
Auto Operating Cost Savings	4.7
Safety Benefits	1.5
Total Quantitative Benefits	67.2
Qualitative Impacts	✔✔✔

Note: ✔= slightly positive impacts; ✔✔= positive impacts; ✔✔✔= very positive impacts.

3.2 Environmental Account

The Environmental Account is an account that incorporates the environmental benefits and costs due to the BRT Strategy. These benefits and costs can be quantified, monetized, and included in the benefit-cost assessment. In this project, the BRT strategy is expected to have environmental benefits due to a reduction in greenhouse gas emissions.

3.2.1 Greenhouse Gas Emissions

Greenhouse gases, primarily carbon dioxide, are emitted during vehicle travel. Reducing vehicle travel can reduce vehicle emissions, including greenhouse gas emissions. Modelling of the BRT strategy indicates a reduction of auto kilometres travelled of 19.7 million in 2030 compared to the Base Case. Though the number of kilometres travelled by buses would increase, the distance is considered to be negligible and hence is not quantified for the purpose of the GHG emission impacts. Based on this reduction in kilometres travelled and a per-kilometre monetary value for greenhouse gas emissions of $0.01 per vehicle kilometer in 2012 currency, the benefits from reduced greenhouse gases would be approximately $0.2 million in 2030 (or $2 million over the 2020-49 period, expressed in net present value terms).

3.3 Financial Account

The Financial Account captures the direct financial impacts of the BRT Strategy. In particular, it includes capital, operating, and maintenance expenses for BRT rolling stock, including articulated buses and regular-sized buses for the enhanced feeder services. The items that have been included in the Financial Account on this project are all quantifiable costs included in the benefit-cost assessment.

3.3.1 Transit Ridership

There is a direct financial benefit that the London Transit Commission will receive as part of the BRT Strategy. Increased transit ridership of approximately 3.5 million trips in 2030, which was projected using the network model, will result in increased fare revenue of approximately $4.6 million in 2012 currency (based on a fare of $1.30/trip). On average, this additional fare revenue would cover 42% of the operating and maintenance costs of the BRT and enhanced feeder services over the 30-year evaluation period. This cost-recovery ratio is likely conservative, given that the incremental ridership forecasts for the BRT Strategy are conservative due to the latent demand that is likely to appear with the addition of new capacity.

However, for the purposes of the benefit-cost assessment, transit fares are not considered separately as a benefit. Fare revenue is not considered to be a benefit because this would amount to double-counting of the BRT Strategy's travel time savings benefits.

3.3.2 Capital Costs

The capital costs for the BRT Strategy include costs for both infrastructure and vehicles. Infrastructure includes road widening, installation of signal priority and queue jump lanes, upgrades to the downtown transit terminal, and a new maintenance facility to accommodate the larger fleet. Two types of vehicles are planned to be purchased: new articulated buses for the BRT service and additional conventional buses for the enhanced feeder service. The road infrastructure for the BRT Strategy was costed in Appendix I of the TMP on a $10/km-basis using a range of North American BRT experiences. These road capital cost estimates likely lie within a -20/+30% range, given the conceptual stage of the BRT Strategy.

For each element of the capital costs, such as segment of road widening, the cost was allocated to one or more years. Some costs have been spread out over multiple years to reflect that some components of the project will take multiple years to complete. For example, the costs for most segments of road widening have been spread over at least two years because the design and construction for each segment will take more than one year to complete. The indicative capital cost schedule is shown in Appendix 2.

The present value of the total capital expenditure under the BRT Strategy is estimated to be $300 million over the 30-year evaluation period discounted at a rate of 5% in real terms (or $423 million undiscounted in 2012 currency).

In the Base Case scenario, the London Transit Commission would continue to add a few conventional buses to its fleet on an annual basis in order to address the rising transit ridership and the congested conditions of the transit network. However, the capital costs associated with these additional buses would be wrapped into the BRT Strategy capital costs under the BRT Scenario.

3.3.3 Operating and Maintenance Costs

The operating and maintenance costs for the BRT strategy cover the ongoing costs for providing the BRT strategy, including items such as labour costs, fuel, and vehicle maintenance. These costs cover both the new BRT service plus the incremental increase in local services representing the "enhanced" service. The operating and maintenance costs have been allocated for each year, beginning once construction of BRT infrastructure has been completed.

The present value of all operating and maintenance costs over the business case analysis period is estimated to be $114 million (or $293 million undiscounted in 2012 currency) for the whole period through to 2049, discounted at a rate of 5% in real terms.

In the Base Case scenario, the London Transit Commission would continue to add some additional revenue service hours on its busiest routes in order to address the rising transit ridership and the congested conditions of the transit network. However, the operating and maintenance costs associated with these additional revenue service hours would be wrapped into the BRT Strategy operating costs under the BRT Scenario. The schedule of operating costs for the Base Case and the BRT Strategy scenarios is shown in Appendix 3.

3.3.4 Summary

The costs during the first few years of the BRT strategy represent capital costs. With the exception of vehicle purchases, these are one-time costs. After capital implementation, operating and maintenance costs begin. Though these costs are incurred on an annual basis, they are incurred later in the program. As a result, the capital costs comprise of the majority of the total program costs. **Table 6** summarizes the Financial Account.

The incremental cost recovery ratio is estimated to be 42%. As noted, this is a conservative estimate because the incremental ridership and fare revenue will be higher than modelled, due to overestimation of ridership in the Base Case.

Table 6: Financial Account Summary

Criteria	Estimated Costs – BRT Strategy, NPV $ Millions
Incremental Capital Costs (NPV, $M)	300
Incremental Operating and Maintenance Costs (NPV, $M)	114
Total Incremental Costs (NPV, $M)	414
Incremental Fare Revenue 2012$ M (undiscounted)	123
Incremental Cost Recovery Ratio – Average, 2020-2049	42%

3.4 Economic Development Account

The Economic Development Account captures the impacts of the BRT strategy on the overall economy, in London, Southwestern Ontario and across the whole province. This account captures both temporary and long-term economic impacts of the BRT Strategy as well as the impacts on land values along the BRT corridors. The temporary economic impacts capture the effects of the capital spending for road widenings, new transit facilities and new vehicles required for the BRT Strategy. Hence, these impacts are limited to the period prior to the BRT service launch, which is when most of the capital spending will take place (although transit vehicles are replaced twice during the whole 30 year period). The long-term economic impacts capture the effects of operating the new BRT services. These impacts occur on an annual basis throughout the entire evaluation period and are driven by the operating and maintenance expenditures for the BRT Strategy. The long-term economic impacts of the BRT Strategy also include the impacts resulting from the the travel time savings and the savings in auto operating costs. In economic terms, these impacts represent productivity improvements which will make the City of London and the wider region a more attractive location for individuals and a more competitive location for businesses.

The temporary and long-term economic impacts resulting from the BRT Strategy capital and operating expenditures are expressed in terms of employment, income and GDP. The direct impacts measure the value added in terms of jobs, income and GDP which results from the first round of capital and operating spending by those firms which would undertake the road building, facilities construction and equipment construction. The indirect impacts measure the value added which results from all the additional rounds of spending undertaken to source all the intermediate inputs for the delivery of the final goods and services. These spending impacts present a valuable picture of how economic activity will be affected in London and across the entire province as a result of the BRT Strategy. However these impacts cannot be combined with the benefits reported under the Transportation User Account due to possible double-counting. The reported spending impacts cover the whole province of Ontario.

3.4.1 Temporary Economic Impacts

The temporary economic impacts of undertaking the BRT Strategy cover the impacts for the whole evaluation period and are reported in the table below. The direct impacts generated during the process of implementing the BRT infrastructure and facilities would be substantial, representing approximately 2,300 person-years of employment, $86 million in incomes and $ 192 million in GDP terms. The direct economic impacts of the road building and facilities construction would be felt primarily in London and surrounding areas, because these activities are labour-intensive and these types of jobs tend to be sourced locally. For example, construction of the BRT infrastructure would require construction workers, supervisors, engineers, managers, and other workers. The direct impacts from the spending on articulated and regular buses would tend to be felt at the location of the manufacturing plants for these vehicles.

SHORT-TERM ECONOMIC IMPACTS						
	DIRECT IMPACTS			REGIONAL (DIRECT & INDIRECT) IMPACTS		
Total investment (undiscounted values)	Person-years of employment	Income	GDP	Person-years of employment	Income	GDP
423,194,208 $	2,300	86,000,000 $	192,000,000 $	3500	129,000,000 $	288,000,000 $

The indirect impacts capture the effects of the additional rounds of spending for all inputs (both goods and services) required to deliver the new BRT infrastructure. When these indirect impacts are included, the overall direct and indirect impacts amount to 3,500 jobs, $129 million in incomes and $288 million in GDP terms. These impacts capture the effects of the BRT Strategy across the province of Ontario, but most of these impacts will be felt in the City of London and the surrounding region.

The incomes earned by the workers and firms engaged in the delivery of the BRT Strategy will tend to be spent on other goods and services. These consumption effects, also called induced effects, are not included in the above figures.

The multipliers used to derive the direct and indirect impacts of the BRT Strategy capital spending were inferred from the capital spending and economic impact results of the VIVA benefits case,[7] which examined the impact of the VIVANext BRT project for York Region.

3.4.2 Long-Term Economic Impacts

The long-term economic impacts refer to the effects of the ongoing operation and maintenance of the BRT service. These economic impacts capture the jobs, income and GDP effects of one year of operating and maintenance expenditures associated with the new BRT service (2030), as reported in the table below. The direct impacts amount to approximately 70 new person-years of employment, $5.7 million in incomes and $12.5 million in GDP per year. These impacts are more modest in scale than the construction impacts reported above, but they are repeated yearly so long as the BRT Strategy remains in place. All the direct impacts would be expected to accrue to locally to the City of London and the surrounding areas.

LONG-TERM ECONOMIC IMPACTS, 2030						
	Person-years of employment	Income (Gross)	GDP	Person-years of employment	Income	GDP
	70	5,700,000 $	12,540,000 $	110	9,000,000 $	19,000,000 $

The indirect impacts capture the effects of the additional rounds of spending for all inputs (both goods and services) required to deliver the new BRT services. When these indirect impacts are included, the overall direct and indirect impacts amount to 110 person-years of employment, $9 million in incomes and $20 million in GDP terms for each year of operation. In principle, these impacts capture the effects of the BRT Strategy across the whole province of Ontario, but most of these impacts would be felt in the City of London and the surrounding region.

The incomes earned by the workers and firms engaged in the delivery of the BRT services would be spent on other goods and services. These consumption effects, also called induced effects, are not included in the above figures.

7. Metrolinx *VIVA Benefits Case,* November 2008.

The direct impact figures above were derived based on estimates of the operations (e.g. drivers) and maintenance employees required to deliver the additional hours of transit service under the BRT Strategy; and the total labour costs associated with these employees. The indirect impacts were derived based on equivalent multipliers used for VIVANext BRT project for York Region.

It is important to note that the long-term economic impacts of the BRT Strategy are not limited to the effects of the operations and maintenance spending. The BRT Strategy results in significant travel time savings for both transit users and road users, with the latter also driving less, as measured in vehicle kilometres travelled. These results – reported under the Transportation User Account above – have important economic ramifications for London, because they represent improvements in the standard of living of those who live and work in London and productivity gains for local businesses. The productivity gains for businesses come from having better access to the regional labour of qualified labour and from more efficient urban goods movement, since some of the travel time savings for road users will be experienced by truck drivers and local drivers engaged in goods or service deliveries. These improvements would make London a more attractive destination for both individuals looking to relocate and for firms looking to invest. This improved competitive position for London would be expected to translate into more people moving to or staying in London and more firms locating their investments in the City and surrounding areas.

3.4.3 Land Value Uplift

Land value uplift is another impact from the implementation of the BRT strategy. It is well-established that higher-order transit projects can lead to substantial increases in the value of land and property where inhabitants benefit from increased accessibility to other destinations.[8] However, these higher values are thought to result from the propagation of the time and cost savings which accrue to the affected transportation users. These users essentially “spend” the accrued time and cost savings on higher property values in the areas that benefit from the increased accessibility. Since transportation users who accrue these time and cost savings are monetizing and “spending” them, these property value uplifts cannot be considered as additional incremental benefits, though they can be considered outside of the project’s benefit-cost ratio.

In London, a 2% uplift has been assumed for all property within a 400-metre radius of each BRT station. This value is approximately the same value assumed for BRT business cases in the Greater Toronto Area, which also has a minimum intensification target of 40%. The total property value within the 400-metre station radii is approximately $4.56 billion, according to the March 2011 City of London Tax Assessment. Thus, an uplift of 2% results in an uplift of approximately $91 million, resulting in a new total property value of $4.65 billion.

3.5 Social and Community Account

The Social and Community Account is an account that incorporates some of the more qualitative influences that the BRT strategy has on the built form of the community, as well as the social and physical impacts on the population. These impacts are not quantified and included in the benefit-cost ratio but are still useful in the overall consideration of the BRT strategy.

3.5.1 Land Use Shaping / Intensification

As explained in Section 1.4.2.1, the proposed BRT strategy is directly tied to a growth management strategy that increases the level of intensification in London. Though the BRT strategy is not fully dependent on increased

8. *For example, it has been estimated that a new commuter rail tunnel to Midtown Manhattan could add US $16 billion to home values within two miles of NJ Transit train stations. See Regional Plan Association The ARC Effect: How better transit boosts home values and local economies, August 2010.*

intensification (since transit improvements are needed to relieve current capacity constraints, in addition to future growth), the BRT strategy will result in higher ridership and greater benefits if greater intensification occurs.

However, greater intensification is highly dependent on improved transit within the existing urban boundary. In auto-dependent areas, land development requires the construction of large amounts of parking to accommodate all of the cars that are used to access these developments. In suburban areas, parking is usually provided in surface lots that consume large amounts of land and force buildings to be spread apart. Often, this parking is set between the street and the building, degrading the quality of the pedestrian experience along these streets and along building accesses. Even if the building is placed near the street, the increased spacing between buildings result in lower densities, creating less walkable neighbourhoods. Lower densities are also difficult to serve with transit because lower densities result in dispersed travel demands, which diminish the potential ridership along a route.

For intensification to be successful and result in higher densities, buildings need to be placed closer together and increased in height (compared to typical suburban development in London). Placing buildings closer together requires devoting less land area for parking, while increasing building heights increases parking requirements if traditional amounts of parking are provided. To provide sufficient parking, buildings would need to provide structured parking, which can cost up to 10 times as much per parking space than surface parking. This additional expense gets passed on in the form of increased housing prices or commercial rents.

In areas where convenient, high-frequency, higher-order transit is provided, parking requirements are able to be relaxed. Travel demand that would otherwise be served by autos can instead be served by transit. Relaxed parking requirements can result in a reduction in the amount of structured parking provided, making intensification more cost-effective and attractive to the market.

Increased intensification will have impacts in the intensification nodes and corridors as well as the periphery. The nodes and corridors that will be intensified will become much more walkable than they are presently. The type of development in these areas will also vary from much of the existing development in London, providing housing and commercial diversity which can support households and businesses that may be poorly accommodated by suburban types of development. Increased intensification also will reduce growth pressures at the periphery, preserving agricultural land and woodlots from development until further in the future.

3.5.2 Impacts on Socio-Demographic Groups

There are several socio-demographic groups that have greater social need than the general population. These groups include:

- The elderly
- School-aged children / youth
- Post-secondary students
- Lower-income households
- Employees who work in the periphery of the city, particularly at manufacturing firms

In addition, public health is an impact that affects the entire population. The following sections discuss how the BRT strategy affects all of these groups.

3.5.2.1 The Elderly

Throughout Canada, as with most developed countries, the elderly population (people of at least 65 years of age) is the most rapidly growing portion of the population. London is not exempt from this trend. As shown in Section 2.2, the elderly population in London is expected to more than double from 2009 to 2030. The elderly population is expected to grow at an average rate of 3.6% per year, more than four times the average growth rate for the overall population, which is 0.8% per year.

As people age, skills required for safe driving often deteriorate, such as vision, hearing, and cognitive skills. For some elderly people, their skills deteriorate to the point that they are no longer able to drive and their license must be revoked. Revocation of one's driver's license is a difficult process for the person, as well as their family and their doctor. In an auto-dependent area with poor alternatives, revocation of one's license can be equivalent to revocation of one's independence.

Improving transit is critical to ensure that elderly people continue to have mobility and independence, even if they are no longer able to drive. Providing BRT services with enhanced feeder services allows seniors to travel around London faster than on the existing transit services. Increasing transit capacity will provide more seats available for seniors to use and will provide more room for individuals with mobility devices. These BRT Strategy benefits for the elderly are also reinforce London's Age Friendly City Strategy.

Improved transit also supports intensification, much of which will be achieved in the form of residential apartments and condominiums near transit and within walking distance of services, such as banks and pharmacies. Intensification can improve the diversity of housing stock in London and can provide options for seniors who want to continue living independently, but do not want or are not able to continue living in suburban, detached housing.

3.5.2.2 School-Aged Children / Youth

Though the population of school-aged children in London will likely be steady (or potentially contract slightly) through 2030, this population group is still a major beneficiary of improved transit. School-aged children are not permitted to drive or, if they are at least 16, face significant legal restrictions on driving. In an auto-dependent community, children and youth are reliant on adults to drive them. However, the improvement of transit provides an opportunity for older children to transport themselves without relying on their parents or other adults to drive them.

Compared to youth who are transported by car, youth who use transit to get themselves around the community will get more exercise because they will walk or bike to and from bus stops. Also, improved transit can help with auto congestion near schools because youth would be able to get to school by transit instead of being dropped off by car.

3.5.2.3 Post-Secondary Students

Post-secondary students are a major demographic group in London due to the presence of Western University and Fanshawe College. As discussed in Section 1.4.2.4, post-secondary students are a significant portion of the existing LTC ridership. According to a recent LTC fare media survey, riders using the Tuition-Pass program account for 46% of all transit trips. Post-secondary students often have little or no disposable income available for transportation. Many students are not able to afford a car. Therefore, post-secondary students are heavily reliant on transit for all varieties of trips, including commuting to school, commuting to jobs, and accessing social events.

Western and Fanshawe have both implemented Tuition-Pass programs. These programs wrap the cost of a transit pass into school fees. Therefore, all full-time students at both Western and Fanshawe have already paid for transit passes. This program has helped drive a significant increase in transit ridership over the last several years.

However, the existing transit system has reached capacity along many routes. Implementation of the BRT strategy will expand capacity throughout the transit network, particularly along the most heavily traveled routes. Increased transit capacity is essential for the continued success of the Tuition-Pass program and to ensure that there is the ability for the transit capacity to accommodate increased travel by post-secondary students as Western and Fanshawe grow.

3.5.2.4 Lower-Income Households

Lower-income households are another demographic group that comprise a significant portion of the existing LTC ridership. As with post-secondary students, lower-income households have limited disposable income and many are unable to afford a car. Therefore, these individuals are dependent on transit for access to jobs and services.

The existing capacity constraints within the transit network heavily impact on the mobility of lower-income individuals. The crowded conditions that are becoming more common reduce the quality of service provided to these users. Implementation of the BRT strategy will expand transit capacity and decrease travel times due to the shorter wait times and limited-stop BRT services, resulting in improved mobility and job access for these individuals.

3.5.2.5 Employees Who Work in the Periphery

Many of London's larger employers, such as manufacturers and shopping malls are located in employment areas around the periphery of the city. The existing transit network, which is focused on the downtown, provides more limited service within London's periphery. Though some shopping centres are smaller transit hubs where several bus routes converge, other areas of the periphery are served by individual routes at lower frequencies. For employees of businesses located in these areas, transit is not an attractive option. Those employees who can afford cars and are able to drive are likely to choose driving. Other employees who are not able to drive have limited ability to access these areas. This lack of mobility hurts both potential employees looking for jobs and employers whose talent pool may be restricted due to the limited transit service in their area.

The BRT strategy will increase transit service in the peripheral areas of London. The BRT services will provide frequent service into the north, west, south, and east portions of London, connecting with several shopping centres and other places of employment around the periphery. The BRT services will provide faster travel times and increased capacity, which will improve the ability of residents to get to these areas. The BRT strategy will also provide enhanced feeder services, which will be more frequent and structured to connect with the BRT. These enhanced services will be able to connect other employers in the periphery to the BRT corridors with routes that are more frequent and direct than today. Though transfers will be required by many users accessing these employers, the more frequent and direct service will result in an improved transit experience for users. Employers will benefit by being better connected to all of London, allowing them to tap into a larger pool of potential employees.

3.5.2.6 The Millennials (18-34 Age Group)

The 18-34 age group – known as the Millennials – is at the forefront of changes in mobility trends across North America and in London, Ontario. This group is relying significantly less on automobile travel than previous generations. According to a recent U.S. report

> *"Young people aged 16 to 34 drove 23 per cent fewer miles on average in 2009 than they did in 2001 – a greater decline in driving than any other age group. The severe economic recession was likely responsible for some of the decline, but not all."*
>
> - U.S. PIRG Education Fund, *A New Direction: Our Changing Relationship with Driving and the Implications for America's Future*, p. 3.

The ReThink London process has also highlighted the importance of this age group in shaping mobility trends and particularly in explaining “a shift towards less reliance on the automobile and an increased likelihood that people will choose other forms of transportation to move from place to place in the future”.[9]

The BRT Strategy supports the desire of Millennials – as they enter the peak driving age 35-54 year-old demographic group – to live in urban and walkable neighborhoods and to opt for non-auto forms of transportation such as public transit and active transportation. The BRT Strategy achieves this not only by improving the capacity and attractiveness of the transit network in London, but also by supporting the growth management strategy in the TMP and specifically by supporting intensification – i.e. increased residential and employment densities within the built-up area of London. This intensification is a necessary condition for moving towards complete streets and more walkable neighborhoods.

3.5.2.7 Public Health for All

The availability of transit and other non-auto modes has a direct impact on public health. One recognized benefit on public health that transit provides to its users is increased exercise. Unlike auto travel, which is often “door-to-door” with very little exercise, transit trips generally are preceded and followed with walking or cycling, even if only for a few hundred metres. This extra exercise completed while accessing and egressing transit can reduce the risk of various diseases, such as cardiovascular disease, diabetes, and certain types of cancer. This exercise can also burn calories, reducing obesity levels.

Another benefit from improved transit and reduced auto use is improved air quality. Reducing auto use will reduce the number of pollutants emitted into the atmosphere. These pollutants, known as Criteria Air Contaminants, include carbon monoxide, sulphur dioxide, nitrogen oxides, sulphur oxides, fine particulates, and volatile organic compounds. These contaminants are found at higher levels in areas with more traffic, particularly urban areas, and contribute to various lung diseases, such as asthma and lung cancer.

3.6 Comparing Benefits and Costs

3.6.1 Benefit-Cost Ratio

The benefits and costs captured in the benefit-cost ratio – or in the economic rate of return on investment; or the net economic benefits – are the incremental benefits and costs associated with the BRT Strategy as compared to the Base Case. The incremental benefits estimated for the BRT Strategy are conservative (i.e. potentially underestimated) for three reasons:

- The additional ridership resulting from the introduction of the BRT services, including the new feeder services for the BRT corridors, are likely underestimated because the ridership forecast for the Base Case is too optimistic. The Base Case ridership forecast of 27.3 million trips for 2030 is probably not feasible in practice, because the current transit network was already approaching full capacity with 23.5 million riders in 2012, with peak period frequencies at 5 minutes or less when multiple bus routes are considered together on major corridors. Therefore, some of the Base Case ridership demand is likely to be suppressed due to the poor quality of the service when operating in excess of full capacity. This latent demand will reappear when the capacity issues are addressed under the BRT Strategy, thereby suggesting that the incremental ridership from the BRT Strategy is significantly greater than the forecast 3.5 million additional trips (for 2030). The true incremental benefit of the BRT strategy is driven by the

9. ReThink London discussion paper 4, *Providing Transportation Choices*, p. 57.

sum of the latent demand that is unmet in the Base Case plus the incremental demand for BRT service as calculated without transit capacity constraints.

- The capital and operating costs of the BRT Strategy do not take account of any savings which are likely to result from the restructuring and optimization of the transit route network (e.g. removal of overlapping services) that must necessarily accompany the introduction of the BRT service. The operating plan developed for the BRT Strategy in this report is a high-level plan design only as an overlay on top of the existing transit network. The necessary optimization of services could yield operating and capital cost (i.e. fewer vehicles) savings.
- Conservative assumptions have been used to convert travel time benefits into monetary values (e.g. the growth in the value of time is limited to 0.5% per year in real terms, which is well below the assumptions in other benefit case assessments in Ontario)

Based on combined transportation user benefits and environmental benefits of $737 million in present value terms over the full 30-year evaluation period (or $2.1 billion undiscounted) and capital and operating costs of $414 million over the same period ($717 million undiscounted), the net benefits amount to $323 million. This represents the net economic value created by the BRT investment. In benefit-cost terms, it represents a ratio of $1.8 of benefits for every $1 of capital and operating costs invested in the BRT Strategy. (A benefit-cost ratio of 1 is the breakeven point where the project's benefits equal its costs. At ratios greater than 1, the project's benefits outweigh its costs.) Yet another way of representing the same benefit and cost figures is through the rate of return of 11.3% for the BRT Strategy investment.

However, it is important to note that the benefit-cost ratio of 1.8 represents only the strict economic test of whether the BRT Strategy creates value for London. It does not include other potential benefits, such as those described in the Economic Development Account and the Social and Community Account. To the extent that the benefits described in these accounts are also considered (although some of these may be double-counted), this further improves the business case for the BRT Strategy from a wider public perspective.

3.6.2 Sensitivity Analyses

Four sensitivity analyses have been completed to test how the benefit-cost ratio is affected by variations in the assumptions. These analyses were completed for the discount rate, the value of time, potential capital expenditure overruns, and potential operating expenditure overruns. The results of the sensitivity analyses below show that the BRT Strategy remains a positive economic value creation opportunity and an attractive rapid transit investment even if it is subject to a higher discount rate, a lower value of travel time, significant capital cost overruns or significant operating and maintenance cost overruns.

3.6.2.1 Discount Rate

The discount rate used to bring the future stream of costs and benefits back to a single present value for comparative purposes is 5% in real terms, as used public sector investments for the province of Ontario. **Table 7** shows how the results vary if the discount rate is decreased to 3% or increased to 7%.

As shown in the table, the benefit-cost ratio and the net present value of the project improve considerably with a lower discount rate and deteriorate by a similar magnitude with a higher discount rate. However, even with a discount rate of 7%, the BRT Strategy creates substantial economic value ($162 million) and retains a benefit-cost ratio well above break-even.

Table 7: Sensitivity Analysis – Discount Rate

Discount Rate	BRT Strategy		
	Project Benefits Less Costs (NPV $M)	*Benefit-Cost Ratio*	*Economic Rate of Return*
3%	598	2.2	11.3%
5%	323	1.8	11.3%
7%	162	1.5	11.3%

3.6.2.2 Value of Time

The value of time used to estimate the value of travel time savings as a result of the BRT Strategy is $13.60 per hour for 2012. **Table 8** shows how the results vary if the value of time is decreased by 25% to $10.20 or increased by 25% to $17.

As shown in the table, the benefit-cost ratio and the net present value of the project improve substantially with a higher value of time and deteriorate by a similar magnitude with a lower value of time. These results are consistent with the fact that the majority of project benefits are derived from travel time savings for either existing transit users or new transit users. Therefore, a higher value of time increases the size of the benefits without affecting costs. Even with a lower value of time of $10.20 per hour, the BRT Strategy creates substantial economic value ($157 million) and retains a benefit-cost ratio well above break-even.

Table 8: Sensitivity Analysis – Value of Time

Value of Time ($/hour)	BRT Strategy		
	Project Benefits Less Costs (NPV $M)	*Benefit-Cost Ratio*	*Economic Rate of Return*
$10.20	157	1.4	8.4%
$13.60	323	1.8	10.3%
$17.00	493	2.2	14.0%

3.6.2.3 Potential Capital Cost Overruns

The section examines the impact of potential capital cost overruns for the BRT Strategy. **Table 9** below shows how the results vary based on potential capital cost overruns of 20% and 50% relative to the estimates presented in section 3.3.2 above.

As shown in the table, the benefit-cost ratio and the net present value of the project deteriorate significantly depending on the magnitude of the capital cost overruns, but the results remain positive even under a 50% capital cost overrun scenario. This is an important result, because capital costs represent the bulk of the project costs over the evaluation period (over 70% on present value basis).

Table 9: Sensitivity Analysis – Capital Cost Overruns

Capital Cost Overrun (%)	BRT Strategy		
	Project Benefits Less Costs (NPV $M)	*Benefit-Cost Ratio*	*Economic Rate of Return*
50%	167	1.3	7.5%
20%	261	1.5	9.5%
0%	323	1.8	11.3%

3.6.2.4 Potential Operating Expenditure Overruns

The section examines the impact of potential overruns in the operations and maintenance costs associated with the BRT Strategy. **Table 10** below shows how the results vary based on potential operating cost overruns of 10% and 20% and 50% relative to the estimates presented in section 3.3.3 above.

As shown in the table, there is relatively limited deterioration in the benefit-cost ratio and the net present value of the project even under a 20% operating cost overrun – which is a large overrun, considering that the LTC already has extensive experience in this area. This is consistent with the fact that the operating and maintenance costs represent a relatively small share of the overall project costs during the evaluation period (less than 30% on a PV basis).

Table 10: Sensitivity Analysis – Operating and Maintenance Expenditure Overruns

Operating and Maintenance Cost Overruns	**BRT Strategy**		
	Project Benefits Less Costs (NPV $M)	***Benefit-Cost Ratio***	***Economic Rate of Return***
20%	291	1.7	10.7%
10%	307	1.7	11.0%
0%	323	1.8	11.3%

4. Summary

The London Bus Rapid Transit Strategy represents a unique, once-in-a-generation opportunity to transform the scale and quality of London's transit network in order meet the population growth and ridership demands for the City and the wider region. There is a strong business case for the BRT Strategy proposed as part of the Transportation Master Plan. This is based on comparing the transportation user benefits and the environmental benefits to the additional capital and operating costs required for the Strategy. In addition, the BRT Strategy generates broader economic development impacts and social and community impacts.

The BRT strategy would fundamentally restructure the transit network by providing two high-frequency, high-capacity trunk routes with faster travel speeds and larger buses, resulting in corridors with a much higher transit capacity than can be provided with conventional bus service in mixed traffic. The remaining local services can then have frequencies increased and be restructured to serve the BRT corridors, feeding demand onto the BRT while providing improved service to neighbourhoods away from the BRT corridors.

In strict benefit-cost terms, the BRT Strategy would be expected to generate $1.8 of benefits for every $1 investment in the capital and operations required to deliver the transformation of London's transit service. The benefits are primarily travel time savings for transit and road users, but also include safety benefits from fewer road collisions and reduced greenhouse gas emissions – both of which are the result of fewer vehicle kilometres driven on London's roads. All these benefits and the accompanying economic and social impacts would be lost to London if the BRT Strategy did not proceed.

Expressed in terms of an economic return on investment, the BRT Strategy would generate an economic rate of return of 11.3% over the 30-year horizon from the service start date in 2020 through to 2049. This represents an attractive return from a public sector perspective and one which would contribute significantly to making the City of London and the wider region a more attractive destination for both skilled workers and for firms considering where to locate their facilities and investments.

A summary of the Multiple Account Evaluation is shown in **Table 11** below. This evaluation is conservative in several respects. First, it underestimates the increase in transit ridership which is likely to result from the BRT Strategy, because there is likely to be an additional latent demand for transit services once the capacity constraints are relieved and the quality of service improves relative to the Base Case. Second, we have used relatively conservative assumptions for the monetization of benefits and time values. For example, the growth in value of time is set to 0.5% per year in real terms, which is well below the assumptions used for many other benefit case assessments in Ontario.

Consideration of the other two accounts, Economic Development and Social Community, further strengthens the case for the BRT strategy, since the BRT strategy provides substantial economic development opportunities and service improvements to the entire population, particularly to groups such as the elderly and students.

Table 11: Multiple Account Evaluation Summary (2020-49)

	Criteria	BRT Strategy
Transportation User Account	Transportation User Benefits (NPV $M)	735
	Qualitative User Benefits	✔✔✔
Environmental Account	GHG Emissions (NPV $M)	2
Financial Account	Net Incremental Capital Costs (NPV $M)	(300)
	Net Incremental Operating Costs (NPV $M)	(114)
	Benefits Less Costs (NPV $M)	323
	Benefit-Cost Ratio	1.8
	Economic Rate of Return	11.3%
Economic Development Account	ECONOMIC IMPACTS DURING CONSTRUCTION	
	Employment (person-years)	3,500
	Income (2012$ M)	129
	GDP (2012$ M)	288
	LONG-TERM ECONOMIC IMPACTS, 2030	
	Employment (person-years)	110
	Income (2012$ M)	9
	GDP (2012$ M)	20
	Land Value Uplift ($M)	90
Social Community Account	Land Use Shaping	✔✔
	Impacts on Socio-Demographic Groups	✔✔

Note: ✔= slightly positive impacts
✔✔= positive impacts
✔✔✔= very positive impacts

If there is remaining doubt as to the value that this BRT strategy brings to London, consider London's transit network without any improvements. The existing network has been successful in generating substantial increases in ridership over the last several years, but is now at the breaking point. Buses on many routes are crush-loaded through most of the day and are unable to accommodate any more passengers. At some stops, users are left at the curb and forced to wait longer for another bus. It is not possible for the existing level of service to accommodate growth in London's population, growth in the student population, or a further mode shift to transit. Incremental additions to transit service may partially alleviate crowding along certain routes during certain time periods, but these are insufficient to fully solve future capacity constraints. Though there may not be large fiscal outlays toward infrastructure or services in the Base Case, there would be negative impacts on the population, particularly groups that are dependent on transit, such as the elderly, youth, and lower-income individuals. These groups will bear the brunt of the degraded service quality and reduced mobility that will result from the Base Case. Further, London is not likely to achieve its 40% intensification target with the Base Case transit network, resulting in more sprawl at the periphery and less investment within the downtown and other built neighbourhoods.

Appendix 1 – Service Operating Plan

Table A1-1. High-Level BRT Operating Plan

BRT Route	Monday to Friday						Saturday					Sunday
	Early AM (6 AM to 7 AM)	Peak AM (7 AM to 9 AM)	Base (9 AM to 2 PM)	Peak PM (2 PM to 6 PM)	Early Evening (6 PM to 9 PM)	Late Evening (9 PM to 12 AM)	Early AM (6 AM to 8 AM)	Base (8 AM to 10 AM)	Peak (10 AM to 5 PM)	Early Evening (5 PM to 9 PM)	Late Evening (9 PM to 12 AM)	All day (8 AM to 11 PM)
Headways (min)												
Northbound	10	5	10	5	15	20	15	10	10	15	20	15
Southbound	10	5	10	5	15	20	15	10	10	15	20	15
Eastbound	10	4	10	4	15	20	15	10	10	15	20	15
Westbound	10	4	10	4	15	20	15	10	10	15	20	15
Number of buses per route												
Northbound/ Southbound	6.0	11.0	6.0	11.0	4.0	3.0	4.0	6.0	6.0	4.0	3.0	4.0
Eastbound/ Westbound	7.0	17.0	7.0	17.0	5.0	4.0	5.0	7.0	7.0	5.0	4.0	5.0
Hours of service per period												
Northbound/ Southbound	6	22	30	44	12	9	8	12	42	16	9	60
Eastbound/ Westbound	7	34	35	68	15	12	10	14	49	20	12	75
TOTAL ANNUAL SERVICE HOURS (BRT ROUTES ONLY): 92,148												
BRT Fleet Requirements: 37 articulated buses (31 + 6 spares)												

Notes: Assumed distance: northbound/southbound 12.2 km, eastbound/westbound 15.62 km
Assumed travel time: northbound/southbound 24 min, eastbound/westbound 30 min
Assumed layover time: northbound/southbound 5 min, eastbound/westbound 6 min

The BRT fleet requirements are based on the number of buses per route during the AM peak period (i.e. 11 for the North/South route and 17 for the East/West route), with an additional three articulated buses to cover the transit time between the bus depot and the routes and 6 spares.

Table A1-2. Enhanced Feeder Service Operating Plan

Headway	Most routes running at 20-minute headways; certain high-demand routes running at 15-minute headway
Span of Enhanced Service	Monday to Friday: 7 AM to 9 AM and 2 PM to 6 PM (6 hours per day)
Daily Increase in Service Hours	240 hours
Total Annual Service Hours (Enhanced Service)	60,240 hours (251 weekdays per year)
Fleet Requirements	48 conventional buses (40 + 8 spares)

Appendix 2 - Indicative Capital Costs for BRT Scenario and Base Case

Table A2. Indicative Capital Costs for BRT Scenario and Base Case

All Figures in 2012 $000s unless otherwise noted	Description	TOTAL	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049
CAPITAL COSTS: ROADS																																							
South Leg																																							
Wellington Street	4 to 6 through lanes	**89,000**			13,500	25,650	13,000	13,500	13,500	10,000																													
North Leg																																							
Richmond Street	4 to 6 through lanes	**35,700**		5,500	15,890	14,310																																	
East Leg																																							
Highbury Avenue	4 to 6 through lanes	**18,600**		3,500	13,590	1,510																																	
Dundas Street	4 to 6 through lanes	**24,300**					6,500	15,750	2,050																														
Oxford Street	4 to 6 through lanes	**26,500**							6,500	15,320	4,680																												
West Leg																																							
Oxford Street West	4 to 6 through lanes	**83,000**					13,500	23,800	23,000	13,000	9,700																												
Downtown																																							
Richmond Street	Optimization	**14,600**				1,500	13,100																																
York Street	Optimization	**3,400**					3,400																																
Colborne Street	Optimization	**1,100**							1,100																														
Dundas Street	Optimization	**2,700**						2,700																															
Wellington Street	Optimization	**1,100**								1,100																													
Total Roads:		**300,000**		**9,000**	**42,980**	**42,970**	**49,500**	**55,600**	**46,150**	**39,420**	**14,380**																												
CAPITAL COSTS: ROLLING STOCK AND FACILITIES																																							
New maintenance facility		**25,000**								25,000																													
BRT Required Fleet	37 articulated buses, 750k/unit	**71,006**							27,510												27,510												27,510						(11,462)
Enhanced Service Required Fleet	48 regular buses, 500k/unit	**57,164**							22,128												22,128												22,128						(9,220)
Downtown Exchange Terminal		**5,000**						5,000																															
TOTAL ROLLING STOCK AND FACILITIES		**158,230**						**5,000**	**49,638**	**25,000**											**49,638**												**49,638**						**(20,682)**
TOTAL CAPITAL COST		**458,230**		**9,000**	**42,980**	**42,970**	**49,500**	**60,600**	**95,788**	**64,420**	**14,380**										**49,638**												**49,638**						**(20,682)**
BASE CASE CAPITAL COSTS																																							
New regular buses (# of buses)		95		2	3	4	4	3	3	3	3	3	3	3	3	3	3	3	2	0	0	3	3	3	3	3	3	3	3	3	2	0	0	3	3	3	3	3	3
Capital Costs $461k/unit		**35,036**								(1,383)	(1,383)	(1,383)	(1,383)	(1,383)	(1,383)	(1,383)	(1,383)	(1,383)	(922)			(1,383)	(1,383)	(1,383)	(1,383)	(1,383)	(1,383)	(1,383)	(1,383)	(1,383)	(922)			(1,383)	(1,383)	(1,383)	(1,383)	(1,383)	(1,383)
Net New Capital Costs Under BRT Strategy		**423,194**		9,000	42,980	42,970	49,500	60,600	95,787	63,037	12,997	(1,383)	(1,383)	(1,383)	(1,383)	(1,383)	(1,383)	(1,383)	(922)		49,638	(1,383)	(1,383)	(1,383)	(1,383)	(1,383)	(1,383)	(1,383)	(1,383)	(1,383)	(922)		49,638	(1,383)	(1,383)	(1,383)	(1,383)	(1,383)	(22,065)

Appendix 3 - BRT Operating Costs and Cost Recovery

Table A3: BRT Operating Costs and Cost Recovery

Figures in 2012 $000s or as otherwise stated	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15
BRT SCENARIO OPERATING COSTS															
BRT Service (hours/year)	92,148	92,148	92,148	92,148	92,148	92,148	92,148	92,148	92,148	92,148	92,148	92,148	92,148	92,148	92,148
Enhanced Feeder Bus Service (hours/year)	60,240	60,240	60,240	60,240	60,240	60,240	60,240	60,240	60,240	60,240	60,240	60,240	60,240	60,240	60,240
Total Additional Service Hours (per year)	152,388	152,388	152,388	152,388	152,388	152,388	152,388	152,388	152,388	152,388	152,388	152,388	152,388	152,388	152,388
Direct operating cost per revenue service hour (2012 $)	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Direct Operating Costs (2012 $)	$15,239,211	$15,239,211	$15,239,211	$15,239,211	$15,239,211	$15,239,211	$15,239,211	$15,239,211	$15,239,211	$15,239,211	$15,239,211	$15,239,211	$15,239,211	$15,239,211	$15,239,211
BASE CASE OPERATING COSTS															
New regular buses for 2020-49 horizon (# of buses, cumulative)	3	6	9	12	15	18	21	24	27	29	29	29	29	29	29
Additional revenue service hours	6,582	13,164	19,746	26,328	32,910	39,492	46,074	52,656	59,238	63,626	63,626	63,626	63,626	63,626	63,626
Additional operating costs (post-2020)	$ 658,200	$ 1,316,400	$ 1,974,600	$ 2,632,800	$ 3,291,000	$ 3,949,200	$ 4,607,400	$ 5,265,600	$ 5,923,800	$ 6,362,600	$ 6,362,600	$ 6,362,600	$ 6,362,600	$ 6,362,600	$ 6,362,600
Net BRT Incremental Operating Costs	$14,581,011	$13,922,811	$13,264,611	$12,606,411	$11,948,211	$11,290,011	$10,631,811	$ 9,973,611	$ 9,315,411	$ 8,876,611	$ 8,876,611	$ 8,876,611	$ 8,876,611	$ 8,876,611	$ 8,876,611
BASE CASE COST RECOVERY															
Base Case ridership	24,616,564	24,868,617	25,123,250	25,380,490	25,640,364	25,902,899	26,168,122	26,436,061	26,706,744	26,980,198	27,256,451	27,535,534	27,817,474	28,102,301	28,390,044
Per annum growth rate															
Incremental ridership (optimistic, unconstrained)	249,498	501,550	756,183	1,013,423	1,273,297	1,535,833	1,801,056	2,068,995	2,339,677	2,613,131	2,889,385	3,168,467	3,450,407	3,735,234	4,022,977
Incremental fare revenue (optimistic)	$324,347	$652,015	$983,038	$1,317,450	$1,655,287	$1,996,582	$2,341,373	$2,689,693	$3,041,580	$3,397,070	$3,756,200	$4,119,007	$4,485,529	$4,855,804	$5,229,870
Cost recovery ratio	49%	50%	50%	50%	50%	51%	51%	51%	51%	53%	59%	65%	70%	76%	82%
BRT SCENARIO COST RECOVERY															
BRT Scenario ridership (# of trips)	24,891,622	25,427,470	25,974,854	26,534,021	27,105,225	27,688,726	28,284,787	28,893,681	29,515,682	30,151,073	30,800,143	31,115,509	31,434,105	31,755,963	32,081,117
Incremental ridership (# of trips)	275,058	558,854	851,604	1,153,531	1,464,861	1,785,826	2,116,665	2,457,619	2,808,938	3,170,876	3,543,691	3,579,976	3,616,631	3,653,663	3,691,073
Incremental fare revenue (fare = $1.30)	$ 357,576	$ 726,510	$ 1,107,085	$ 1,499,590	$ 1,904,319	$ 2,321,574	$ 2,751,664	$ 3,194,905	$ 3,651,620	$ 4,122,138	$ 4,606,799	$ 4,653,968	$ 4,701,621	$ 4,749,761	$ 4,798,395
Cost recovery ratio (2020-49, average)	42%														

Figures in 2012 $000s or as otherwise stated	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049
	Year 16	Year 17	Year 18	Year 19	Year 20	Year 21	Year 22	Year 23	Year 24	Year 25	Year 26	Year 27	Year 28	Year 29	Year 30
BRT SCENARIO OPERATING COSTS															
BRT Service (hours/year)	92,148	92,148	92,148	92,148	92,148	92,148	92,148	92,148	92,148	92,148	92,148	92,148	92,148	92,148	92,148
Enhanced Feeder Bus Service (hours/year)	60,240	60,240	60,240	60,240	60,240	60,240	60,240	60,240	60,240	60,240	60,240	60,240	60,240	60,240	60,240
Total Additional Service Hours (per year)	152,388	152,388	152,388	152,388	152,388	152,388	152,388	152,388	152,388	152,388	152,388	152,388	152,388	152,388	152,388
Direct operating cost per revenue service hour (2012 $)	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Direct Operating Costs (2012 $)	$15,239,211	$15,239,211	$15,239,211	$15,239,211	$15,239,211	$15,239,211	$15,239,211	$15,239,211	$15,239,211	$15,239,211	$15,239,211	$15,239,211	$15,239,211	$15,239,211	$15,239,211
BASE CASE OPERATING COSTS															
New regular buses for 2020-49 horizon (# of buses, cumulative)	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29
Additional revenue service hours	63,626	63,626	63,626	63,626	63,626	63,626	63,626	63,626	63,626	63,626	63,626	63,626	63,626	63,626	63,626
Additional operating costs (post-2020)	$ 6,362,600	$ 6,362,600	$ 6,362,600	$ 6,362,600	$ 6,362,600	$ 6,362,600	$ 6,362,600	$ 6,362,600	$ 6,362,600	$ 6,362,600	$ 6,362,600	$ 6,362,600	$ 6,362,600	$ 6,362,600	$ 6,362,600
Net BRT Incremental Operating Costs	$ 8,876,611	$ 8,876,611	$ 8,876,611	$ 8,876,611	$ 8,876,611	$ 8,876,611	$ 8,876,611	$ 8,876,611	$ 8,876,611	$ 8,876,611	$ 8,876,611	$ 8,876,611	$ 8,876,611	$ 8,876,611	$ 8,876,611
BASE CASE COST RECOVERY															
Base Case ridership	28,680,733	28,974,399	29,271,072	29,570,782	29,873,561	30,179,441	30,488,452	30,800,627	31,115,999	31,434,600	31,756,463	32,081,622	32,410,110	32,741,961	33,077,210
Per annum growth rate															
Incremental ridership (optimistic, unconstrained)	4,313,667	4,607,332	4,904,005	5,203,716	5,506,495	5,812,374	6,121,385	6,433,561	6,748,932	7,067,533	7,389,396	7,714,555	8,043,043	8,374,894	8,710,144
Incremental fare revenue (optimistic)	$5,607,767	$5,989,532	$6,375,207	$6,764,830	$7,158,443	$7,556,086	$7,957,801	$8,363,629	$8,773,612	$9,187,793	$9,606,215	$10,028,921	$10,455,956	$10,887,363	$11,323,187
Cost recovery ratio	88%	94%	100%	106%	113%	119%	125%	131%	138%	144%	151%	158%	164%	171%	178%
BRT SCENARIO COST RECOVERY															
BRT Scenario ridership (# of trips)	32,409,600	32,741,446	33,076,690	33,415,366	33,757,511	34,103,158	34,452,345	34,805,107	35,161,481	35,521,505	35,885,214	36,252,647	36,623,843	36,998,839	37,377,675
Incremental ridership (# of trips)	3,728,866	3,767,047	3,805,618	3,844,584	3,883,949	3,923,718	3,963,893	4,004,480	4,045,482	4,086,905	4,128,751	4,171,026	4,213,734	4,256,878	4,300,465
Incremental fare revenue (fare = $1.30)	$ 4,847,526	$ 4,897,161	$ 4,947,303	$ 4,997,959	$ 5,049,134	$ 5,100,833	$ 5,153,061	$ 5,205,824	$ 5,259,127	$ 5,312,976	$ 5,367,376	$ 5,422,334	$ 5,477,854	$ 5,533,942	$ 5,590,605
Cost recovery ratio (2020-49, average)															

Notes: BRT Scenario ridership growth is 2.15% p.a. for 2020-30 and 1% p.a. thereafter.

Appendix 4 – Input Values and Assumptions Used in MAE Analysis

Factor	Value	Source
Discount Rate (%, real terms)	5%	Province of Ontario
Value of Time (2012 $/hr)	$13.58	Based on $13.02/hr (2008$) weighted value from Metrolinx, Transport Canada and Greater Golden Horseshoe (GGH) Model; adjusted to 2012$ and for London CMA average earnings (90.8% of Toronto/Hamilton CMA earnings)
Value of Time Growth (% p.a.)	0.50%	Based on Province of Ontario labour productivity growth between 2000 and 2010
Consumer Price Index (% p.a.)	3%	AECOM team estimate
Peak hour factor (transit)	0.39	Household survey (London TMP, 2012)
PM peak to daily conversion (transit)	3.125	Household survey (London TMP, 2012)
Daily - Annual Factor (Transit)	275	Based on ratio of average weekday to annual ridership for LTC (2011)
PM peak to daily conversion (auto traffic)	10%	AECOM team estimate
Daily - Annual Auto Factor	312.5	260 weekdays + 50% weekend days
Auto operating costs (cents/km, 2012)	16.68	CAA auto operating costs for mid-size car, excluding ownership costs
Annual change in auto operating costs (% p.a.)	2%	Historical change in auto ownership costs in Ontario
Average Accident Cost (cents/km, 2012)	0.08	Based on Metrolinx estimate of $0.07/km (2008$), adjusted to 2012$
Average cost of CO2 (cents/km, 2012)	0.01	Based on Metrolinx estimate of $0.01/km (2008$), adjusted to 2012$